



Bidding Requirements & Specifications, Divisions 1-33



WRA Architects, Inc.

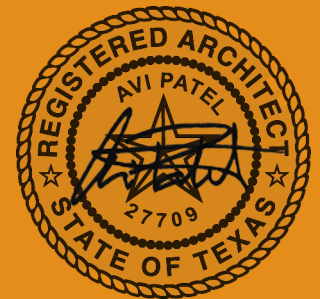
12377 Merit Drive
Suite 1800

Dallas, Texas 75251
214.750.0077 voice

214.750.5931 fax

www.wraarchitects.com

Castleberry ISD High School Addition



9.4.24



Castleberry Independent School District
215 Churchill Road
Fort Worth, Texas 76114
817-252-2000
www.castleberryisd.net

JOB NO. 2359

DATE: September 4, 2024

Volume

1 of 1

Division 01-33

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PROJECT MANUAL

Castleberry ISD High School Addition Fort Worth, Texas

September 04, 2024

Construction Documents

Owner

Castleberry Independent School District

Architect

WRA Architects, Inc.
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Electronic Mail: apatel@wraarchitects.com

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Electronic Mail: x.zhang@aplhaengtx.com

Mechanical, Electrical and Plumbing Engineers

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Brian Little
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Roofing Consultant

Apex Roofing Technology
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Kennedale, Texas 76060

Civil Engineer

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Allen, Texas 75013
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Electronic Mail: seth@rlkengineering.com

Landscape Architect

Ramsey Landscape Architects, LLC
11914 Wishing Well Court
Frisco, Texas 75035

Contact: Mike Ramsey
Telephone: 972-335-0889
Electronic Mail: mike.rla@att.net

WRA Architects, Inc. Project Number: 2359

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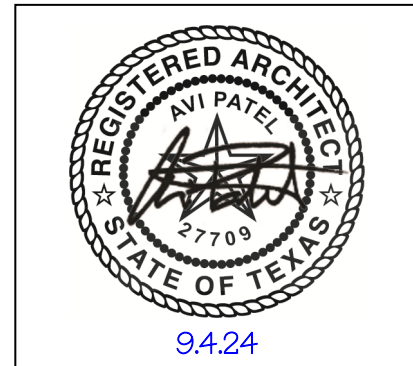
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PROFESSIONAL SEALS PAGE

The specification sections listed below were prepared by or under the direct supervision of the Architect:

WRA Architects, Inc.
12377 Merit Drive, Suite 1800
Dallas, Texas 75251

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- 01 21 00 Allowances
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- 01 78 39 Project Record Documents
- 01 79 00 Demonstration and Training

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- 03 33 00 Architectural Concrete
- 03 49 00 Glass-Fiber-Reinforced Concrete (GFRC)
- 03 54 16 Hydraulic Cement Underlayment

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- 04 20 00 Unit Masonry

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- 05 12 13 Architecturally Exposed Structural Steel Framing
- 05 40 00 Cold-Formed Metal Framing
- 05 50 00 Metal Fabrications
- 05 51 13 Metal Pan Stairs
- 05 52 13 Pipe and Tube Railings
- 05 70 00 Decorative Metal

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- 06 10 53 Miscellaneous Rough Carpentry
- 06 16 00 Sheathing
- 06 41 16 Plastic-Laminate-Clad Architectural Cabinets

06 61 16 Solid Surfacing Fabrications
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07 14 00 Elevator Pit Waterproofing
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07 19 01 Graffiti Repellents
07 21 00 Thermal Insulation
07 21 19 Foamed-In-Place Insulation
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07 91 00 Preformed Joint Seals
07 92 00 Joint Sealants
07 92 19 Acoustical Joint Sealants
07 95 13.13 Interior Expansion Joint Cover Assemblies
07 95 13.16 Exterior Expansion Joint Cover Assemblies

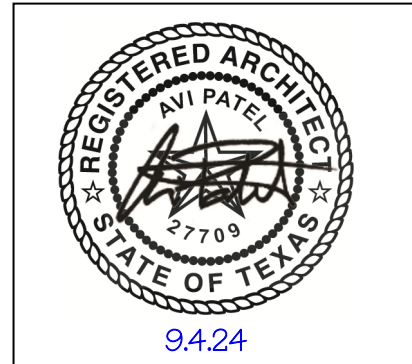
DIVISION 08 – OPENINGS

08 11 13 Hollow Metal Doors and Frames
08 11 69 Metal Storm Doors and Frames
08 14 16 Flush Wood Doors
08 31 13 Access Doors and Frames
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08 33 23 Overhead Coiling Doors
08 33 26 Overhead Coiling Grilles
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08 36 13.05 Sectional Glass Doors
08 41 13 Aluminum-Framed Entrances and Storefronts
08 43 29 Sliding Aluminum-Framed Storefronts
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08 56 19 Metal Storm Windows
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08 71 00 Door Hardware
 Door Hardware Schedule
08 80 00 Glazing
08 83 00 Mirrors
08 87 00 Glazing Surface Films

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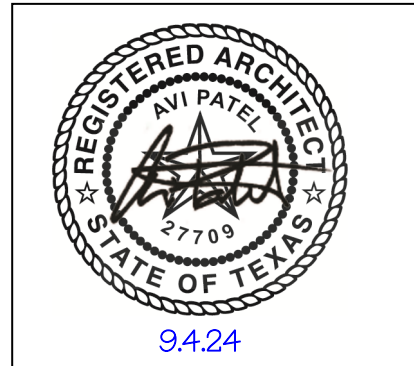
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09 21 16.23 Gypsum Board Shaft Wall Assemblies
09 22 16 Non-Structural Metal Framing
09 27 13 Glass-Fiber-Reinforced Gypsum Fabrications
09 29 00 Gypsum Board
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09 54 29 Linear PVC Ceilings
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09 64 34	Hardboard Flooring
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09 65 19	Resilient Tile Flooring
09 65 66	Resilient Athletic Flooring
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09 72 00	Wall Coverings
09 78 36	Interior Modular Wall Paneling
09 81 16	Acoustical Blanket Insulation
09 84 00	Acoustic Room Components
09 84 53	Sound Barrier Mullion Trim Cap
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09 93 00	Staining and Transparent Finishing
09 96 00	High-Performance Coatings
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10 21 13.19	Plastic Toilet Compartments
10 21 23	Cubicle Curtains and Tracks
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10 41 00	Fire Department Access Lock and Vault
10 43 13	Emergency Aid Cabinets
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10 44 16	Fire Extinguishers
10 51 00	Lockers
10 71 14	Fixed Aluminum Sunshades
10 75 16	Ground-Set Flagpoles

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11 60 01	Specialty Music Instrument Storage
11 66 23	Gymnasium Equipment
11 66 43	Interior Scoreboards
11 73 00	Patient Care Equipment

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12 35 53.19	Wood Laboratory Casework
12 36 23.13	Plastic-Laminate-Clad Countertops
12 36 61.16	Solid Surfacing Countertops
12 61 00	Fixed Audience Seating
12 66 00	Telescoping Stands

DIVISION 14 – CONVEYING EQUIPMENT

14 24 00	Hydraulic Elevators
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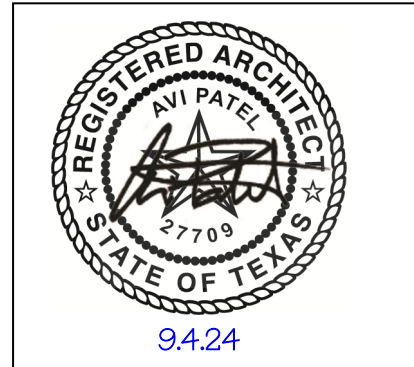
DIVISION 31 – EARTHWORK

31 31 16	Termite Control
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DIVISION 32 – EXTERIOR IMPROVEMENTS

- 32 17 13 Parking Bumpers
- 32 18 13 Synthetic Grass Surfacing
- 32 31 19 Decorative Metal Fences and Gates
- 32 33 00 Site Furnishings

SEAL



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PROFESSIONAL SEALS PAGE

The specification sections listed below were prepared by or under the direct supervision of the Structural Engineer:

ALPHA CONSULTING ENGINEERS
4975 Preston Park Blvd Suite 640W
Plano, TX 75093

DIVISION 03 – CONCRETE

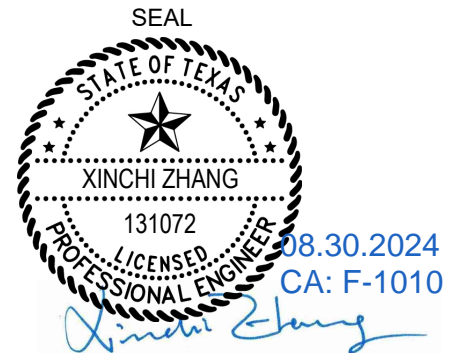
03 10 00 CONCRETE FORMING
03 15 00 EMBEDDED METAL ASSEMBLIES
03 20 00 CONCRETE REINFORCING
03 31 00 STRUCTURAL CONCRETE

DIVISION 05 – Metals

05 12 00 STRUCTURAL STEEL
05 21 00 STEEL JOISTS
05 31 00 METAL ROOF DECK
05 31 13 COMPOSITE METAL FLOOR DECK AND FIELD WELDED SHEAR STUDS

DIVISION 31 – Earthwork

31 63 29 DRILLED CONCRETE PIERS



END OF DOCUMENT

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PROFESSIONAL SEALS PAGE

The specification sections listed below were prepared by or under the direct supervision of the Mechanical Engineer:

EMA Engineering & Consulting
328 South Broadway
Tyler, TX 75702

DIVISION 01 - GENERAL REQUIREMENTS

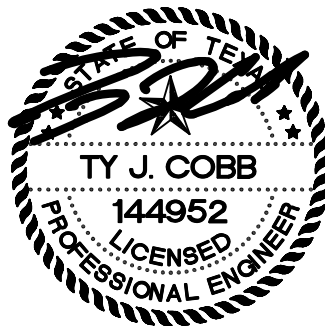
01 91 00 Building Systems Commissioning

DIVISION 21 - FIRE SUPPRESSION

21 00 10 Basic Fire Protection System Requirements
21 00 90 Fire Protection System Submittal Procedures
21 13 14 Fire Protection System

DIVISION 22 - PLUMBING

22 00 10 Basic Plumbing Requirements
22 00 90 Plumbing Submittal Procedures
22 05 20 Gauges, Meters, and Thermometers
22 05 24 Valves - General
22 05 30 Pipe and Pipe Fittings - General
22 05 54 Plumbing Identification
22 07 20 Piping Insulation
22 08 00 Commissioning of Plumbing
22 11 17 Domestic Water Piping and Appurtenances Copper
22 13 17 Soil, Waste and Sanitary Drain Piping, Vent Piping, and Appurtenances
22 13 18 Condensate Piping
22 13 19 Interceptors
22 14 01 Roof Drainage and Appurtenances
22 14 29 Sump Pumps
22 15 14 Compressed Air Piping and Appurtenances (Shops)
22 16 01 Natural Gas Piping and Appurtenances
22 33 34 Access Doors
22 40 01 Plumbing Fixtures and Fixture Carriers
22 66 54 Chemical Waste and Vent Piping System



08-30-2024

The specification sections listed below were prepared by or under the direct supervision of the Mechanical Engineer:

EMA Engineering & Consulting
328 South Broadway
Tyler, TX 75702

DIVISION 23 - HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

23 00 00 Basic Mechanical Requirements
23 00 90 HVAC Submittal Procedures
23 05 29 Hangers and Supports for HVAC Piping and Equipment
23 05 32 Roof Curbs
23 05 33 Roof Curb Adapters
23 05 53 Identification for HVAC Piping and Equipment
23 05 93 Testing, Adjusting, and Balancing for HVAC
23 07 13 Duct and Grille Insulation
23 07 21 Refrigerant Piping Insulation
23 08 00 Commissioning of Heating, Ventilating and Air Conditioning (HVAC)
23 09 23 Energy Management Control System (Bacnet)
23 09 23A Sequence of Operations General
23 09 23B Sequence of Operations for Air Handling
23 09 23G Sequence of Operations Rooftop Unit Sequences
23 09 23H Sequence of Operations Split System Sequences
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23 09 25 Variable Frequency Drives
23 09 63 Safe Shelter Emergency Systems Controls
23 23 00 Refrigerant Piping
23 31 13 Metal Ductwork
23 31 16 Fabric Ductwork
23 33 33 Access Doors
23 34 16 HVAC Fans
23 36 16 Variable Air Volume Terminal Units
23 37 13 Diffusers, Registers, and Grilles
23 43 23 Bipolar Ionization Air Purification System
23 63 13 Air Cooled Condensing Units
23 73 13 Modular Indoor Central Station Air Handling Units
23 81 19 Packaged HVAC Units
23 81 27 Small Capacity Split System Units
23 82 16 Duct Mounted Air Coils
23 82 39 Electric Unit Heaters



08-30-2024

The specification sections listed below were prepared by or under the direct supervision of the Electrical Engineer:

EMA Engineering & Consulting
328 South Broadway
Tyler, TX 75702

DIVISION 26 - ELECTRICAL

26 00 00 Electrical
26 05 05 Selective Demolition for Electrical
26 05 19 Low Voltage Electrical Power Conductors and Cables
26 05 26 Grounding and Bonding for Electrical Systems
26 05 33 Raceways and Boxes for Electrical Systems
26 05 53 Identification for Electrical Systems
26 05 73 Power System Studies
26 08 00 Commissioning of Electrical Systems
26 09 13 Electrical Power Monitoring
26 09 16 Electrical Control Components
26 09 18 Laboratory Utility Shut-Off System
26 09 23 Lighting Control Devices
26 20 00 Low Voltage Electrical Distribution
26 27 26 Wiring Devices
26 33 53 Static Uninterruptible Power Supply
26 43 00 Surge Protective Devices
26 50 00 Lighting
26 55 61 Theatrical Lighting
26 82 13 Electrical Hand / Hair Dryers

DIVISION 27 - COMMUNICATIONS

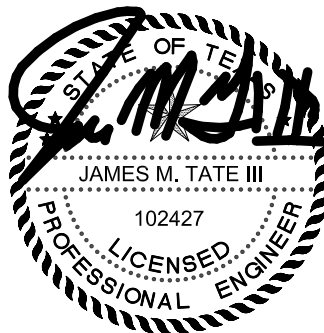
27 10 30 Data Cable Plant
27 41 31 Integrated Audio-Visual Systems
27 51 41 Intercom Communication System

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

28 05 44 Emergency Responder Radio Coverage System
28 13 27 Building Access Control System
28 21 23 Video Surveillance System
28 31 24 Premises Intruder Alarm System
28 46 21 Fire Detection and Alarm System

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PROFESSIONAL SEALS PAGE - MEP.DOCX
EMA REGISTRATION NO. F-893



08-30-2024

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The specification sections listed below were prepared by or under the direct supervision of the Civil Engineer:

RLK Engineering, Inc
111 W Main
Allen, TX, 75013

DIVISION 31 – EARTHWORK

311000 Site Clearing
312200 Grading
312219 Finish Grading

DIVISION 32 – EXTERIOR IMPROVEMENTS

321300 Rigid Paving
321723 Pavement Markings

DIVISION 33 – UTILITIES

330000 Utilities
334000 Storm Drainage Utilities



9-4-2024

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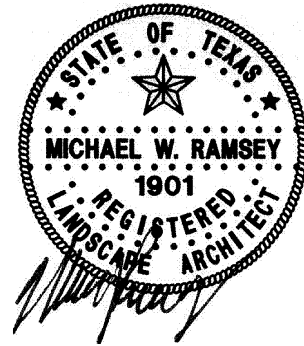
The specification sections listed below were prepared by or under the direct supervision of the Landscape Architect:

RAMSEY LANDSCAPE ARCHITECTS, LLC
11914 Wishing Well Ct.
Frisco, TX 75035

DIVISION 32 – EXTERIOR IMPROVEMENTS

32 01 90 Landscape Grounds Maintenance
32 80 00 Irrigation
32 90 00 Planting
32 92 00 Lawns & Grasses

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03 54 16	Hydraulic Cement Underlayment.....	04 Sep 24	

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GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.
- B. Because subsurface conditions indicated by the soil borings are a sampling in relation to the entire construction area, and for other reasons, the Owner, the Architect, the Architect's consultants, and the firm reporting the subsurface conditions do not warranty the conditions below the depths of the borings or that the strata logged from the borings are necessarily typical of the entire site. Any party using the information described in the soil borings and geotechnical report shall accept full responsibility for its use.
- C. A geotechnical investigation report for Project, prepared by CMJ Engineering, Inc., Project No. 1029-24-03 dated April 29, 2024, is available for viewing as appended to this Document.
 - 1. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
 - 2. Any party using information described in the geotechnical report shall make additional test borings and conduct other exploratory operations that may be required to determine the character of subsurface materials that may be encountered.

END OF DOCUMENT

**GEOTECHNICAL ENGINEERING STUDY
CASTLEBERRY HIGH SCHOOL ADDITIONS
215 CHURCHILL ROAD
CASTLEBERRY ISD
FORT WORTH, TEXAS**

Presented To:

Castleberry Independent School District

April 2024

PROJECT NO. 1029-24-03



April 29, 2024
Report No. 1029-24-03

Castleberry Independent School District
5228 Ohio Garden Road
Fort Worth, Texas 76114

Attn: Mr. Lenny Lasher, Assistant Superintendent

**GEOTECHNICAL ENGINEERING STUDY
CASTLEBERRY HIGH SCHOOL ADDITIONS
215 CHURCHILL ROAD
CASTLEBERRY ISD
FORT WORTH, TEXAS**

Dear Mr. Lasher:

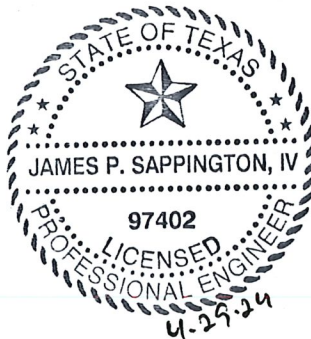
Submitted here are the results of a geotechnical engineering study for the referenced project. This investigation was performed in general accordance with CMJ Estimate No. 23-9226 (Revised) dated December 27, 2023. The geotechnical services were authorized via P.O. Number 2752400236, executed by Ms. DeAnne M. Page, Executive Director of Financial Services on February 2, 2024.

Engineering analyses and recommendations are contained in the text section of the report. Results of our field and laboratory services are included in the appendix of the report. We would appreciate the opportunity to be considered for providing the construction material testing services during the construction phase of this project.

We appreciate the opportunity to be of service to Castleberry Independent School District and its consultants. Please contact us if you have any questions or if we may be of further service at this time.

Respectfully submitted,
CMJ ENGINEERING, INC.
TEXAS FIRM REGISTRATION NO. F-9177


Daniel R. Green, Ph.D., E.I.T.
Graduate Engineer
Texas No. 54428




James P. Sappington, IV, P.E.
President
Texas No. 97402

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(1) Mr. Avi Patel, AIA, NCARB; WRA Architects (email)
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1.0 INTRODUCTION

1.1 General

The project site is located at the existing Castleberry High School campus in Fort Worth, Texas. The project as currently planned, will consist of the planned Phases 1A and 1B, consisting of new administration/CTE wing, new gymnasium (storm shelter), new core, connector to the existing school, band hall addition, plaza, service yard, and new student parking. The total new building footprint area is on the order of 65,500 square feet comprised of one, two, and three-story components, and split-level construction. Anticipated dead loads range from 20 to 150 kips and anticipated live loads range from 10 to 125 kips. New access drives and fire lanes are also planned. Site retaining walls are also anticipated with heights up to 10 feet, particularly in the new plaza area. New shotput and discus pads are also planned. Plate A.1, Plan of Borings, presents the approximate locations of the exploration borings.

1.2 Purpose and Scope

The purpose of this geotechnical engineering study has been to determine the general subsurface conditions, evaluate the engineering characteristics of the subsurface materials encountered, and develop recommendations for the type or types of foundations suitable for the project.

To accomplish its intended purposes, the study has been conducted in the following phases: (1) drilling sample borings to determine the general subsurface conditions and to obtain samples for testing; (2) performing laboratory tests on appropriate samples to determine pertinent engineering properties of the subsurface materials; and (3) performing engineering analyses, using the field and laboratory data to develop geotechnical recommendations for the proposed construction.

The design is currently in progress and the locations and/or elevations of the structures could change. Once the final design is near completion (80-percent to 90-percent stage), it is recommended that CMJ Engineering, Inc. be retained to review those portions of the construction documents pertaining to the geotechnical recommendations, as a means to determine that our recommendations have been interpreted as intended.

1.3 Report Format

The text of the report is contained in Sections 1 through 12. All plates and large tables are contained in Appendix A. The alpha-numeric plate and table numbers identify the appendix in which they appear. Small tables of less than one page in length may appear in the body of the text and are numbered according to the section in which they occur.

Units used in the report are based on the English system and may include tons per square foot (tsf), kips (1 kip = 1,000 pounds), kips per square foot (ksf), pounds per square foot (psf), pounds per cubic foot (pcf), and pounds per square inch (psi).

2.0 FIELD EXPLORATION AND LABORATORY TESTING

2.1 Field Exploration

Subsurface materials at the project site were explored with eighteen (18) vertical soil borings. Borings B-1 through B-11 were drilled to depths of 40 to 55 feet below existing grades in the area of the proposed buildings, plazas, and retaining walls. Borings B-12 through B-16 were drilled to a depth of 8 feet for proposed drives, fire lanes, parking, and service yard, and Borings B-17 and B-18 were drilled to a depth of 15 feet for proposed shotput and discuss pads. The borings were drilled using continuous flight augers with a truck-mounted drilling rig. Borings were drilled at the approximate locations shown on the Plan of Borings, Plate A.1. The boring logs are included on Plates A.4 through A.21 and keys to classifications and symbols used on the logs are provided on Plates A.2 and A.3. Ground surface elevations shown on the boring logs are approximate as interpreted from the grading plan, Sheet CG2, design development document dated April 18, 2024 as prepared by RLK Engineering.

Undisturbed samples of cohesive soils were obtained with nominal 3-inch diameter thin-walled (Shelby) tube samplers at the locations shown on the logs of borings. The Shelby tube sampler consists of a thin-walled steel tube with a sharp cutting edge connected to a head equipped with a ball valve threaded for rod connection. The tube is pushed into the soil by the hydraulic pulldown of the drilling rig. The soil specimens were extruded from the tube in the field, logged, tested for consistency with a hand penetrometer, sealed, and packaged to limit loss of moisture.

The consistency of cohesive soil samples was evaluated in the field using a calibrated hand penetrometer. In this test a 0.25-inch diameter piston is pushed into the relatively undisturbed

sample at a constant rate to a depth of 0.25 inch. The results of these tests, in tsf, are tabulated at respective sample depths on the logs. When the capacity of the penetrometer is exceeded, the value is tabulated as 4.5+.

Disturbed samples of the noncohesive granular or stiff to hard cohesive materials were obtained utilizing a nominal 2-inch O.D. split-barrel (split-spoon) sampler in conjunction with the Standard Penetration Test (ASTM D1586). This test employs a 140-pound hammer that drops a free fall vertical distance of 30 inches, driving the split-spoon sampler into the material. The number of blows required for 18 inches of penetration is recorded and the value for the last 12 inches, or the penetration obtained from 50 blows, is reported as the Standard Penetration Value (N) at the appropriate depth on the logs of borings.

To evaluate the relative density and consistency of the harder formations, a modified version of the Texas Cone Penetration test was performed at selected locations. Texas Department of Transportation (TxDOT) Test Method Tex-132-E specifies driving a 3-inch diameter cone with a 170-pound hammer freely falling 24 inches. This results in 340 foot-pounds of energy for each blow. This method was modified by utilizing a 140-pound hammer freely falling 30 inches. This results in 350 foot-pounds of energy for each hammer blow. In relatively soft materials, the penetrometer cone is driven 1 foot and the number of blows required for each 6-inch penetration is tabulated at respective test depths, as blows per 6 inches on the log. In hard materials (rock or rock-like), the penetrometer cone is driven with the resulting penetrations, in inches, recorded for the first and second 50 blows, a total of 100 blows. The penetration for the total 100 blows is recorded at the respective testing depths on the boring logs.

Groundwater observations during and after completion of the borings are shown on the upper right of the boring log. Upon completion of the borings, the bore holes were backfilled with soil cuttings and plugged at the surface by hand tamping.

2.2 Laboratory Testing

Laboratory soil tests were performed on selected representative samples recovered from the borings. In addition to the classification tests (liquid limits, plastic limits, and particle size analyses), moisture content, unit weight, and unconfined compressive strength tests were performed. Results of the laboratory classification tests, moisture content, unit weight, and

unconfined compressive strength tests conducted for this project are included on the boring logs. Particle size analysis results are presented on Plates A.22 through A.24.

Free swell tests were performed on specimens from selected samples of the soils. These tests were performed to help in evaluating the swell potential of near-surface soils in the area of the proposed structures. The results of the swell tests are presented on Plate A.25

Analytical tests to aid in evaluation of corrosive potential of the on-site soils were performed on selected samples recovered from the borings. The results of the analytical testing are tabulated on Plate A.26.

The above laboratory tests were performed in general accordance with applicable ASTM procedures, or generally accepted practice.

3.0 SUBSURFACE CONDITIONS

3.1 Soil Conditions

Specific types and depths of subsurface strata encountered at the boring locations are shown on the boring logs in Appendix A. Note that depths on the borings refer to the depth from the existing grade or ground surface present at the time of the investigation, and the boundaries between the various soil types are approximate.

Fill soils are present at the surface in Boring B-3 extending to a depth of 9 feet below existing grade. The fills consist of dark brown, brown, and light reddish brown silty clayey sands, clayey sands, and sandy clays containing ironstone nodules, calcareous nodules, gravel, and asphalt fragments.

Natural soils encountered consist of dark brown, brown, light brown, reddish brown, light reddish brown, tan, and gray silty clays, sandy clays, sands, silty sands, clayey sands, and silty clayey sands. The various soils contain iron stains, ironstone nodules, iron seams, calcareous nodules, and gravel. Sand layers are noted within the clayey sands in Boring B-1 below a depth of 10 feet. A 6-inch thick sandstone seam was noted within the silty clayey sands in Boring B-17 at a depth of 1½ feet, and a 1-foot thick fractured sandstone layer was encountered in Boring B-17 at a depth of 2 feet below existing grade.

The various soils encountered in the borings had tested Liquid Limits (LL) ranging from 17 to 47 with Plasticity Indices (PI) ranging from 6 to 31 and are classified as SC, SM, SC-SM, and CL by the USCS. The various clayey soils were generally firm to hard in consistency with pocket penetrometer readings of 1.5 to over 4.5 tsf. Tested unit weight values varied from 105 to 122 pcf and tested unconfined compressive strength values were from 1,560 to 8,220 psf. Select strength tests and pocket penetrometer readings reflect more granular materials, indicating higher in-situ strengths than the tested values.

Brown, light brown, reddish brown, light reddish brown, and tan sands and silty sands were next encountered in the borings at depths of 1 to 14 feet extending to depths of 4 to 32 feet below existing grade. Sand was present at the surface in Borings B-8 through B-11 and B-15. The sands contain iron stains, iron seams, ironstone nodules, calcareous nodules, and gravel. Clay seams are noted within the sands in Boring B-5 below a depth of 8½ feet. Sandy clay layers are noted within the silty sands in Boring B-10 below a depth of 8 feet, and sandy clay seams are noted within the sands in Boring B-15 below a depth of 5 feet. These sands and silty sands were loose to dense in consistency with Standard Penetration (N) values of 6 to 33 hammer blows for 1 foot of penetration.

Tan or tan and gray limestone was next encountered in Borings B-4, B-6, B-7, B-8, B-10, and B-11 at depths of 18 to 32 feet below existing grade. These limestones are considered moderately hard to hard (rock basis) with Texas Cone Penetrometer (THD) values of 1¼ to 2½ inches of penetration for 100 hammer blows.

Gray limestone was next encountered in Borings B-1 through B-11 at depths of 19 to 35 feet extending through termination at depths of 40 to 55 feet below existing grade. The gray limestone often contains shale seams and layers and occasionally contains shaly limestone seams. The gray limestone is considered moderately hard to very hard (rock basis) with Texas Cone Penetrometer (THD) values of ¾ to 3½ inches of penetration for 100 hammer blows.

The Atterberg Limits tests indicate the various soils encountered at this site vary from generally stable to moderately active with respect to moisture induced volume changes. Active clays can experience volume changes (expansion or contraction) with fluctuations in their moisture content.

3.2 Groundwater Observations

The borings were drilled using continuous flight augers in order to observe groundwater seepage during drilling. Groundwater seepage was encountered during drilling in Borings B-1 through B-3, B-5, B-6, B-8 through B-12, B-14, B-17, and B-18 at depths of 2 to 25 feet with water levels of 4 to 41 feet measured at drilling completion in these borings. Boring B-6 was dry at completion. In addition, borehole cave-in was observed during drilling in Borings B-1 through B-3 and B-8 through B-11 at depths of 10 to 27 feet. No seepage was encountered during drilling or at completion in Borings B-4, B-7, B-13, B-15, and B-16. Table 3.2-1 summarizes the water level data as encountered in the borings.

TABLE 3.2-1		
Groundwater Observations		
Boring No.	Seepage During Drilling (ft.)	Water at Completion (ft.)
B – 1	15 w/ cave-in at 21	21
B – 2	19 w/ cave-in at 21	22
B – 3	25 w/ cave-in at 22, 27	41
B – 4	Dry	Dry
B – 5	14	25
B – 6	13	Dry
B – 7	Dry	Dry
B – 8	5 w/ cave-in at 25	18
B – 9	10 w/ cave-in at 14, 17, 27	31
B – 10	3 w/ cave-in at 10, 12, 21, 25	4
B – 11	10 w/ cave-in at 20	17
B – 12	4	7
B – 13	Dry	Dry
B – 14	2	7
B – 15	Dry	Dry
B – 16	Dry	Dry
B – 17	7	4
B – 18	4	13

While it is not possible to accurately predict the magnitude of subsurface water fluctuation that might occur based upon these short-term observations, it should be recognized that groundwater conditions will vary with fluctuations in rainfall. Seepage near the observed levels should be anticipated throughout the year.

Fluctuations of the groundwater level can occur due to seasonal variations in the amount of rainfall; site topography and runoff; hydraulic conductivity of soil strata; and other factors not evident at the time the borings were performed. During wet periods of the year seepage can occur in the more granular soils, joints in the clays, or atop/within the tan limestones. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

4.0 EXISTING FILLS

Existing fills were present at the surface in Boring B-3 extending to a depth of 9 feet below existing grade. Samples of the fills were reasonably dense and free of significant voids. However, in the absence of documented density control, the possibility of undercompacted zones or voids exists. Removal and replacement of all the fill following the recommendations in subsequent sections of this report is the only method eliminating the risk of unusual settlement.

Methods less extreme than complete removal are discussed in the Foundation Recommendations and Pavements sections of this report. These methods are intended to represent a reasonable approach for construction of on-grade elements and paving; however, they will not eliminate the risk of unexpected movements in some areas.

5.0 FOUNDATION RECOMMENDATIONS

5.1 General Foundation Considerations

Two independent design criteria must be satisfied in the selection of the type of foundation to support the proposed structures. First, the ultimate bearing capacity, reduced by a sufficient factor of safety, must not be exceeded by the bearing pressure transferred to the foundation soils. Second, due to consolidation or expansion of the underlying soils during the operating life of the structures, total and differential vertical movements must be within tolerable limits.

Shallow or near surface footings could be subject to differential movements due to possible indeterminate settlement of the existing fills. The most positive foundation system for the proposed structures would be situated below the fills and below the zone of seasonal moisture variations. In addition, the anticipated column loads indicate a deep foundation system transferring column loads to a suitable bearing stratum is considered the most positive foundation system. Due to the

anticipated column loads and possible indeterminate settlement of the existing fills, straight drilled reinforced concrete shafts penetrating the gray limestone with shale seams and layers and shaly limestone seams offer a positive foundation system and are recommended.

Care must be taken not to disturb the foundation system of the existing structures. Differential movements between the additions and the existing structures should be anticipated independent of the type of foundation system used for the addition, unless both are structurally suspended atop similar deep foundation systems.

5.2 Straight Shaft Design Parameters

5.2.1 Design Criteria

Recommendations and parameters for the design of cast-in-place straight-shaft drilled piers are outlined below. Specific recommendations for the construction and installation of the straight drilled piers are included in the following section, and shall be followed during construction.

Bearing Stratum	Gray LIMESTONE, w/ shale seams and layers, and shaly limestone seams
Depth of Bearing Stratum:	Approximately 19 to 35 feet below <u>existing</u> grades (El. 545 to 567)
Required Penetration/Depth:	All piers should penetrate into the bearing stratum a minimum of 2 feet. Deeper penetrations may be required to develop additional skin friction and/or uplift resistance.
Allowable End Bearing Capacity:	30,000 psf
Allowable Skin Friction:	Applicable below a minimum penetration of 2 feet into the gray limestone and below any temporary casing; 4,800 psf for compressive loads and 3,600 psf for tensile loads.

The above values contain a safety factor of three (3). Drilled shafts should extend through any clay or weathered seams and bear only in unweathered gray limestone. Penetrations greater than the minimum penetration may be required to develop additional skin friction and/or uplift resistance.

It should be anticipated that groundwater seepage and caving soils will be encountered above the bearing stratum during installation of all straight shafts. Temporary casing will likely be required for

proper installation of all shafts; however, in the event the casing cannot seal off the groundwater, underwater/slurry concrete placement techniques would be necessary to properly install the shafts. *In underwater/slurry concrete placement techniques, end bearing is neglected and the shaft design is based entirely on skin friction. This will require deeper penetrations.* **Test shafts are recommended to determine the need for underwater/slurry concrete placement, or if a temporary casing is capable of adequately sealing off groundwater.**

In order to develop full load carrying capacity in skin friction, adjacent shafts should have a minimum center-to-center spacing of 2.5 times the diameter of the larger shaft. Closer spacing may require some reductions in skin friction and/or changes in installation sequences. Closely spaced shafts should be examined on a case-by-case basis. As a general guide, the design skin friction will vary linearly from the full value at a spacing of 2.5 diameters to 50 percent of the design value at 1.0 diameter.

During construction one of the more important responsibilities of the pier excavation contractor and the construction materials inspection laboratory will be to verify the presence of the bearing materials encountered during construction.

Settlements for properly installed and constructed straight shafts in the gray limestone with shale seams and layers and shaly limestone seams will be primarily elastic and are estimated to be $\frac{3}{4}$ inch or less.

5.2.2 Soil Induced Uplift Loads

The drilled shafts could experience tensile loads as a result of post construction heave in the site soils. The magnitude of these loads varies with the shaft diameter, soil parameters, and particularly the in-situ moisture levels at the time of construction. In order to aid in the structural design of the reinforcement, the reinforcement quantity should be adequate to resist tensile forces based on soil adhesion equal to 750 psf acting over the upper 10 feet of the pier shaft. This load must be resisted by the dead load on the shaft, continuous vertical reinforcing steel in the shaft, and a shaft adhesion developed within the bearing strata as previously discussed for straight shafts.

5.2.3 Lateral Load Design Values

Drilled shaft design parameters for use with LPile based on our laboratory test results are presented in the table below together with our recommended design stratigraphy. The design depth interval is referenced from present existing grades. For the limestone, the “Weak Rock” (Reese) model is suitable for use with LPile. Where the ground surface is exposed surrounding a drilled shaft a p-modification factor of 0.1 is appropriate at the surface increasing linearly to the full value at a depth of 10 feet. This reduction is because of the potential for shrinkage cracks forming along the sides of the drilled shafts.

TABLE 5.2.3-1 – RECOMMENDED LATERAL LOAD DESIGN VALUES

Soil Type	Design Depth Interval (ft)	Design Total Unit Weight (pcf)	Design Strength		Design ϵ_{50} or k_{rm}	k-value (pci)
			Cohesion (psi)	Friction Angle (degrees)		
Sands, Silty Sands, Clayey Sands, Silty Clayey Sands (Sand, Reese)	10-35	120	0	30	-	60
Gray Limestone w/ Shale Seams and Layers (Estimated RQD = 75%)	35+	140	Uniaxial Compressive Strength (psi)		0.0001	$E=1 \times 10^5$ psi
			500			

5.2.4 Drilled Shaft Construction Considerations

Drilled pier construction should be monitored by a representative of the geotechnical engineer to observe, among other things, the following items:

- Identification of bearing material
- Adequate penetration of the shaft excavation into the bearing layer
- The base and sides of the shaft excavation are clean of loose cuttings
- If seepage is encountered, whether it is of sufficient amount to require the use of temporary steel casing. If casing is needed it is important that the field representative observe that a high head of plastic concrete is maintained within the casing at all times during their extraction to prevent the inflow of water

Precautions should be taken during the placement of reinforcing steel and concrete to prevent loose, excavated soil from falling into the excavation. Concrete should be placed as soon as practical after completion of the drilling, cleaning, and observation. Excavation for a drilled pier

should be filled with concrete before the end of the workday, or sooner if required to prevent deterioration of the bearing material. Prolonged exposure or inundation of the bearing surface with water will result in changes in strength and compressibility characteristics. If delays occur, the drilled pier excavation should be deepened as necessary and cleaned, in order to provide a fresh bearing surface.

Shaft excavations should be maintained in the dry. It should be anticipated that groundwater seepage and caving soils will be encountered during installation of all straight shafts and that seepage rates will likely be sufficient to require the use of temporary casing for installation of all straight shafts. The casing should be seated in the bearing stratum with all water and most loose material removed prior to beginning the design penetration. Care must then be taken that a sufficient head of plastic concrete is maintained within the casing during extraction. If the water cannot be controlled, we recommend the concrete be placed by a tremie or by using a concrete pump. If this method is utilized, end bearing should be neglected and the shaft design based entirely on skin friction. *In this case deeper penetrations will be required.* **Test shafts are recommended to determine the need for underwater/slurry concrete placement, or if a temporary casing is capable of adequately sealing off groundwater.**

Tremied or pumped-in concrete for straight shafts should take place as continuously as possible until the concrete placement is complete. The bottom of the discharge pipe should always be kept below the surface of the concrete.

Before tremied or pumped-in concrete is used, care should be taken to ensure that the water is at a stabilized level and muck is removed to as low a level as possible, which will provide for a thin water solution to be displaced during concrete placement. The pipe or tremie is to be plugged when inserted into the pier and lowered until it is resting on the bottom of the hole. It should be filled with concrete and then lifted off the bottom about 1 foot. The concrete should then be placed in a continuous operation until all water is forced out of the hole. The tremie or pipe must always have about 5 feet of pipe into the concrete. Once the water is forced from the pier, the remaining concreting operation will be the same as for a cased hole.

The concrete should have a slump of 6 inches plus or minus 1 inch. Concrete for use in underwater/slurry placements may have a slump of 8 inches plus or minus 1 inch. Where underwater concrete placement techniques are not utilized, the concrete should be placed in a

manner to prevent the concrete from striking the reinforcing cage or the sides of the excavation. Concrete should be tremied to the bottom of the excavation to control the maximum free fall of the plastic concrete to less than 10 feet.

In addition to the above guidelines, the specifications from the Association of Drilled Shaft Contractors Inc. "Standards and Specifications for the Foundation Drilling Industry" as Revised 1999 or other recognized specifications for proper installation of drilled shaft foundation systems should be followed.

5.3 Grade Beams and Floor Slabs

5.3.1 General

The design of ground-supported grade beams and floor slab support depends on the magnitude of movement that these structural components can tolerate. The potential magnitude of these movements varies with the subsurface conditions over the site. Potential vertical movements were evaluated using the TxDOT Potential Vertical Rise (PVR) Method, and the results of our laboratory-testing program. Based on subsurface conditions encountered and planned Finished Floor Elevations as depicted on the referenced grading plan Sheet CG2 (Level 0 FF = 568.3, Level 0.5 FF = 576.35, Level 1 FF = 588.7) it is estimated that post-construction movements are on the order of 1 inch or less. If grade beams and floor slabs can tolerate movements on the order of 1 inch, grade beams and floor slabs may be placed atop the prepared grade without special soil conditioning.

If such movements are not tolerable, the most positive method of preventing slab distress due to swelling soils and differential soil movement is to structurally suspend the interior slab. Support of the structural floor is provided by the drilled piers. Due to the expansion potential of the site clays, it is recommended that the suspended floor slab and associated grade beams be constructed on carton forms with a minimum 6-inch void space or crawl space. Consult this office for additional recommendations if a suspended floor system is selected.

All fill required to establish finished grade must consist of non-expansive select fill with a Liquid Limit less than 35 and a Plasticity Index (PI) between 4 and 16. The select fill should be compacted in maximum 9-inch loose lifts at minus 2 to plus 3 percentage points of the soil's optimum moisture content at a minimum of 95 percent of Standard Proctor density (ASTM D698).

Select fills placed at or below 10 feet below finished grade should be compacted to 100 percent of Standard Proctor density.

5.3.2 Connector Building – Existing Fill Considerations

Floor slabs placed on-grade will be subject to movement as a result of possible indeterminate settlement of the existing fills present at this location (Boring B-3). Reductions in anticipated movements can be achieved by using methods developed in this area to reduce the potential for on-grade slab movements. A more commonly used method consists of re-working the existing fill soils. The materials encountered at this location appear to consist of select fill soils as specified in the previous report section. Therefore, it is recommended that the connector building subgrade be prepared in accordance with report Section 5.3.2.1 prior to foundation installation.

5.3.2.1 Reworking of Near-Surface Soils with Select Fill – Connector Building

In general, the procedure is performed as follows:

1. Remove all existing pavements, surface vegetation, trees and associated root mats, organic topsoil and any other deleterious material.
2. Excavate to a minimum of 2 feet below existing grade. The exposed subgrade should be proof rolled using a heavy (25-ton minimum) pneumatic tired roller making several passes over the subgrade. Any soft or spongy areas should be overexcavated to firm materials and backfilled following the recommendations provided in report Section 9.0. The proof rolling operations should be observed by the project geotechnical engineer or his/her representative. Scarify the exposed clay subgrade at the base of the excavation to a depth of 8 inches, adjust the moisture, and compact between minus 2 to plus 3 percentage points above optimum moisture to a minimum of 95 percent Standard Proctor density (ASTM D698). More granular materials may need to be compacted closer to optimum moisture at the discretion of the geotechnical engineer.
3. Complete pad fill using on-site or imported sandy clay/clayey sand non-expansive select fill with a Liquid Limit less than 35 and a Plasticity Index (PI) between 5 and 16. Site excavated soils meeting select fill material specifications may also be used to complete pad fill. The select fill should be compacted in maximum 9-inch loose lifts at minus 2 to plus 3 percentage points of the soil's optimum moisture content at a minimum of 95 percent of Standard Proctor density (ASTM D698). Field density tests should be taken as each lift of select fill material is placed. Each lift should be compacted, tested, and approved before another lift is added. Over-compaction should not be allowed. The select fill should be placed within 48 hours of completing the installation of the moisture conditioned soils.

6.0 EXPANSIVE SOIL CONSIDERATIONS

6.1 Site Drainage

An important feature of the project is to provide positive drainage away from the proposed buildings. If water is permitted to stand next to or below the structures, excessive soil movements (heave) can occur. This could result in differential floor slab or foundation movement.

A well-designed site drainage plan is of utmost importance and surface drainage should be provided during construction and maintained throughout the life of the structures. Consideration should be given to the design and location of gutter downspouts, planting areas, or other features which would produce moisture concentration adjacent to or beneath the structures or paving. Consideration should be given to the use of self-contained, watertight planters. Joints next to the structures should be sealed with a flexible joint sealer to prevent infiltration of surface water. Proper maintenance should include periodic inspection for open joints and cracks and resealing as necessary.

Rainwater collected by the gutter system should be transported by pipe to a storm drain or to a paved area. If downspouts discharge next to the structures onto flatwork or paved areas, the area should be watertight in order to eliminate infiltration next to the building.

6.2 Additional Design Considerations

The following information has been assimilated after examination of numerous projects constructed in active soils throughout the area. It is presented here for your convenience. If these features are incorporated in the overall design of the project, the performance of the structures should be improved.

- Special consideration should be given to completion items outside the building area, such as stairs, sidewalks, signs, etc. They should be adequately designed to sustain the potential vertical movements mentioned in the report.
- Roof drainage should be collected by a system of gutters and downspouts and transmitted away from the structures where the water can drain away without entering the building subgrade.
- Sidewalks should not be structurally connected to the building. They should be sloped away from the building so that water will drain away from the structures.

- The paving and the general ground surface should be sloped away from the buildings on all sides so that water will always drain away from the structures. Water should not be allowed to pond near the building after the slab has been placed.
- Trees and deep rooted shrubs should not be used as landscaping around the structure perimeter as the root systems can lead to desiccation of the subgrade soils. Any trees should be planted at a distance from the building such that the building will not fall within the drip line of the mature plants (usually one to one-and-one-half times the mature height of the tree). If existing tree removal is not an acceptable option, a vertical root barrier, extending to a minimum depth of 4 feet, should be constructed around the perimeter of the foundation in proximity to the area described above.
- Every attempt should be made to limit the extreme wetting or drying of the subsurface soils since swelling and shrinkage will result. Standard construction practices of providing good surface water drainage should be used. A positive slope of the ground away from the foundation should be provided to carry off the run-off water both during and after construction.
- Backfill for utility lines or along the perimeter beams should consist of on-site material so that they will be stable. If the backfill is too dense or too dry, swelling may form a mound along the ditch line. If the backfill is too loose or too wet, settlement may form a sink along the ditch line. Either case is undesirable since several inches of movement is possible and floor cracks are likely to result. The soils should be processed using the previously discussed compaction criteria.

7.0 BELOW GRADE AREAS & RETAINING WALLS

7.1 Permanent Basement Walls

7.1.1 General

Below grade walls will either be single formed, double formed or a combination of the two. The type of construction affects the lateral earth pressures acting on the basement walls. Design parameters are provided below for both single and double formed walls.

7.1.2 Single Formed Wall

A lateral earth pressure, expressed as an equivalent fluid pressure, of 100 psf/ft is recommended for a rigid single formed wall with a drained condition and a level backfill. Surcharge loads should be included in the wall design where appropriate, as previously discussed.

7.1.3 Double Formed Wall

Recommended lateral earth pressures, expressed as equivalent fluid pressures, are presented below for a rigid double formed wall with a drained condition and a level backfill behind the top of the wall. The equivalent fluid pressure for an undrained condition should be used if a drainage system is not present to remove water trapped in the backfill and behind the wall. Pressures are provided for an at-rest and active earth pressure conditions. In order to allow for an active condition the top of the wall(s) must deflect on the order of 0.4 percent.

TABLE 7.1.3-1 – EQUIVALENT FLUID PRESSURES				
Backfill Material	At-Rest Equivalent Fluid Pressure (pcf)		Active Equivalent Fluid Pressure (pcf)	
	Drained	Undrained	Drained	Undrained
Excavated on-site soil fill materials	75	100	60	90
Select fill or on-site soils meeting material specifications	65	90	50	85
Free draining granular backfill material	50	90	35	80

For the select fill or free draining granular backfill, these values assume that a “full” wedge of the material is present behind the wall. The wedge is defined where the wall backfill limits extend outward at least 2 feet from the base of the wall and then upward on a 1H:2V slope. For narrower backfill widths of granular or select fill soils, the equivalent fluid pressures for the on-site soils should be used.

Surcharge loads must be included in the wall design where appropriate, as previously discussed. Piping and electrical conduits through the fill should be designed for potential soil loading due to fill settlement.

Excavated On-Site Soil: For wall backfill areas with site-excavated materials, or similar imported materials all oversized fragments larger than four inches in maximum dimension should be removed from the backfill materials prior to placement. The backfill should be free of all organic and deleterious materials, and should be placed in maximum 8-inch compacted lifts at a minimum of 95 percent of Standard Proctor density (ASTM D698) within a moisture range of plus to minus three (3) percentage points of optimum moisture content. Compaction within five feet of the walls

should be accomplished using hand compaction equipment, and should be between 90 and 95 percent of the Standard Proctor Density.

Select Fill (on-site or imported): All wall select backfill should consist of clayey sand and/or sandy clay material with a Plasticity Index of 16 or less, with a Liquid Limit not exceeding 35. The select fill should be placed in maximum 8-inch lifts and compacted to between 95 and 100 percent of Standard Proctor density (ASTM D698) within a moisture range of plus to minus 3 percentage points of the optimum moisture content. Compaction within five feet of the walls should be accomplished using hand compaction equipment and should be compacted between 90 and 95 percent of the Standard Proctor Density.

Free Draining Granular Backfill: All free draining granular wall backfill material should be a crushed stone, sand/gravel mixture, or sand/crushed stone mixture. The material should have less than 3 percent passing the No. 200 sieve and less than 30 percent passing the No. 40 sieve. The minus No. 40 sieve material should be non-plastic. Granular wall backfill should not be water jetted during installation.

7.1.4 Additional Lateral Pressures

The location and magnitude of permanent surcharge loads (if present) should be determined, and the additional pressure generated by these loads such as the weight of construction equipment and vehicular loads that are used at the time the structures are being built must also be considered in the design. The effect of this or any other surcharge loading may be accounted for by adding an additional uniform load to the full depth of the side walls equivalent to one-half of the expected vertical surcharge intensity for select backfill materials, or equal to the full vertical surcharge intensity for clay backfill. The equivalent fluid pressures, given here, do not include a safety factor. Analysis of surcharge loads (if any) should be performed on a case-by-case basis. This is not included in the scope of this study. These services can be provided as additional services upon request.

7.2 Retaining Walls

If the retaining walls are sensitive to movements, we recommend they be supported on a deep foundation system as previously discussed. If differential movements as are acceptable, the retaining wall foundations can be supported on footings founded in the natural soils at least 2 feet below existing grade.

The retaining wall foundations may be designed for an allowable bearing pressure of 2.0 ksf. Soils existing in a soft to firm state should be evaluated on a case-by-case basis. Close inspection of soil strength should be conducted by a geotechnical engineer to allow designation and removal of soft soils not meeting the bearing capacity stated above. The base of all excavated footings should be inspected by a geotechnical engineer or geotechnician under his or her supervision to assure that the bottom is firm, level and free of loose soil material and/or debris.

It should be noted that retaining wall foundations are typically subjected to non-uniform pressure across the foundation, and possibly negative pressure (separation of foundation from soil) under a portion of the foundation, due to the overturning moment induced by the lateral earth pressures. The allowable foundation pressures given above are for the maximum pressure induced by the foundation loads, and not the average pressure under the foundation base.

The horizontal bases of the footings will develop resistance to sliding by means of a combination of friction and adhesion (for cohesive foundation materials). Given the primarily sandy nature of the foundation materials, adhesion should be neglected and an ultimate friction factor of 0.45 may be used to calculate sliding resistance of the footings bearing on site soils.

Sliding resistance may be increased in areas where keyways are present beneath the wall footings. The vertical earth-formed sides of keyways will resist lateral forces by developing passive earth pressures. A passive lateral earth pressure coefficient of 2.0 should be used for passive resistance calculations where passive resistance is developed against a vertical earth-formed side of a keyway, based on a soil unit weight of 125 pcf, per foot of footing height.

Foundations for the retaining walls designed in accordance with these recommendations will have a minimum factor of safety of 3 with respect to a bearing capacity failure, and should experience a total settlement of 1 inch or less and a differential settlement of ½ inch or less, after construction.

Lateral earth pressures on retaining walls will depend on a variety of factors, including the type of soils behind the wall, the condition of the soils, and the drainage conditions behind the wall. Recommended lateral earth pressures expressed as equivalent fluid pressures, per foot of wall height, presented in Table 7.1.3-1 for a double formed wall with a level backfill behind the top of the wall are appropriate for retaining walls. The equivalent fluid pressure for an undrained condition should be used if a drainage system is not present to remove water trapped in the backfill

and behind the wall. Pressures are provided for at-rest and active earth pressure conditions. Rigid walls are not anticipated to develop enough movement to mobilize active earth pressures. In order to allow for an active condition, the top of the wall(s) must deflect on the order of 0.4 percent. Surcharge loads must be included in the wall design where appropriate, as previously discussed.

7.3 Wall Backfill Settlement

Settlement of the wall backfill should be anticipated. Piping and conduits through the fill should be designed for potential soil loading due to fill settlement. Floor slabs, sidewalls, and pavements over fills may also settle. Backfill compacted to the density recommended above is anticipated to settle on the order of 0.2 to 0.5 percent of the fill thickness.

7.4 Wall Drainage

The equivalent fluid pressures for a single formed wall assume a drained condition. Equivalent fluid pressures for a drained condition were also provided for a double formed wall. Drained conditions must incorporate drainage behind the below grade wall to prevent the development of hydrostatic pressures.

A vertical drain is necessary for single formed walls. This drain may consist of manufactured products such as “Enka-Drain”, “Miradrain”, or other similar systems. The vertical drain should be connected to a permanent perimeter drainage system that is located 12 or more inches lower than the adjacent below grade slab.

For double-formed walls a perimeter drain should be provided. The bottom of the drain should be situated a minimum of 12 inches lower than the adjacent below grade floor slab. The perimeter drain should be a perforated or slotted drain with a minimum pipe diameter of 4 inches and be wrapped in filter fabric for protection against infiltration. Accessible clean-outs should be provided.

For retaining walls drainage could be provided using a collector pipe or weep holes near the base of the retaining wall, with a maximum spacing of 15 feet. Drains should be properly filtered to minimize the potential for erosion through these drains, and /or the plugging of drain lines.

8.0 SEISMIC CONSIDERATIONS

Based on the conditions encountered in the borings for the above referenced project the IBC-2021 site classification is TYPE D for seismic evaluation.

9.0 EARTHWORK

9.1 Site Preparation and Material Requirements

The project site should be stripped of vegetation, roots, old construction debris, and other organic material. It is estimated that the depth of stripping will be on the order of 4 to 6 inches. The actual stripping depth should be based on field observations with particular attention given to old drainage areas, uneven topography, and excessively wet soils. The stripped areas should be observed to determine if additional excavation is required to remove weak or otherwise objectionable materials that would adversely affect the fill placement or other construction activities.

The subgrade should be firm and able to support the construction equipment without displacement. Soft or yielding subgrade should be corrected and made stable before construction proceeds. The subgrade should be proof rolled to detect soft spots, which if exist, should be excavated to provide a firm and otherwise suitable subgrade. Proof rolling should be performed using a heavy pneumatic tired roller, loaded dump truck, or similar piece of equipment weighing a minimum of 25 tons. The proof rolling operations should be observed by the project geotechnical engineer or his/her representative.

The on-site soils are suitable for use in site grading. Imported general fill (not to be used below building structures) material should be clean soil with a Liquid Limit less than 50 and no rock greater than 4 inches in maximum dimension. The fill materials should be free of vegetation and debris. Spoils from excavations may be used for site grading and general fill, provided 50 percent of the crushed material passes the No. 4 sieve and no particles are greater than 4 inches in maximum dimension.

It is noted that the surficial soils consisted of more granular clayey sands, silty clayey sands, silty sands, and sands. This type of material is difficult to compact, and can be difficult from a trafficability standpoint, particularly when wet. Also, during periods of inclement weather these surface soils can become saturated and subject to pumping. This may require undercutting to a

firm subgrade and blending them with more clayey soils or low quantities of cement or removing them entirely.

9.2 Placement and Compaction

Fill material should be placed in loose lifts not exceeding 8 inches in uncompacted thickness. The uncompacted lift thickness should be reduced to 4 inches for structure backfill zones requiring hand-operated power compactors or small self-propelled compactors. The fill material should be uniform with respect to material type and moisture content. Clods and chunks of material should be broken down and the fill material mixed by disking, blading, or plowing, as necessary, so that a material of uniform moisture and density is obtained for each lift. Water required for sprinkling to bring the fill material to the proper moisture content should be applied evenly through each layer.

The fill material should be compacted to a density ranging from 95 to 100 percent of maximum dry density as determined by ASTM D698, Standard Proctor. In conjunction with the compacting operation, the fill material should be brought to the proper moisture content. The moisture content for general earth fill should range from 2 percentage points below optimum to 5 percentage points above optimum (-2 to +5). These ranges of moisture contents are given as maximum recommended ranges. For some soils and under some conditions, the contractor may have to maintain a more narrow range of moisture content (within the recommended range) in order to consistently achieve the recommended density.

Field density tests should be taken as each lift of fill material is placed. As a guide, one field density test per lift for each 5,000 square feet of compacted area is recommended. For small areas or critical areas the frequency of testing may need to be increased to one test per 2,500 square feet. A minimum of 2 tests per lift should be required. The earthwork operations should be observed and tested on a continuing basis by an experienced geotechnician working in conjunction with the project geotechnical engineer.

Each lift should be compacted, tested, and approved before another lift is added. The purpose of the field density tests is to provide some indication that uniform and adequate compaction is being obtained. The actual quality of the fill, as compacted, should be the responsibility of the contractor and satisfactory results from the tests should not be considered as a guarantee of the quality of the contractor's filling operations.

If fill is to be placed on existing slopes that are steeper than five horizontal to one vertical, then the fill materials should be benched into the existing slopes in such a manner as to provide a good contact between the two materials and allow relatively horizontal lift placement.

Permanent slopes at the site should be as flat as practical to reduce creep and occurrence of shallow slides. The following slope angles are recommended as maximums.

Height (ft.)	Horizontal to Vertical
0 – 3	1:1
3 – 6	2:1
6 – 9	3:1
> 9	4:1

The above angles refer to the total height of a slope. Site improvement should be maintained away from the top of the slope to reduce the possibility of damage due to creep or shallow slides.

9.3 Trench Backfill

Trench backfill for pipelines or other utilities should be properly placed and compacted. Overly dense or dry backfill can swell and create a mound along the completed trench line. Loose or wet backfill can settle and form a depression along the completed trench line. Distress to overlying structures, pavements, etc. is likely if heaving or settlement occurs. On-site soil fill material is recommended for trench backfill. Care should be taken not to use free draining granular material, to prevent the backfilled trench from becoming a french drain and piping surface or subsurface water beneath structures, pipelines, or pavements. If a higher class bedding material is required for the pipelines, a lean concrete bedding will limit water intrusion into the trench and will not require compaction after placement. The soil backfill should be placed in approximately 4- to 6-inch loose lifts. The density and moisture content should be as recommended for fill in Section 9.2, Placement and Compaction, of this report. A minimum of one field density test should be taken per lift for each 150 linear feet of trench, with a minimum of 2 tests per lift.

9.4 Excavation

The side slopes of excavations through the overburden soils should be made in such a manner to provide for their stability during construction. Existing structures, pipelines or other facilities, which

are constructed prior to or during the currently proposed construction and which require excavation, should be protected from loss of end bearing or lateral support.

Temporary construction slopes and/or permanent embankment slopes should be protected from surface runoff water. Site grading should be designed to allow drainage at planned areas where erosion protection is provided, instead of allowing surface water to flow down unprotected slopes.

Trench safety recommendations are beyond the scope of this report. The contractor must comply with all applicable safety regulations concerning trench safety and excavations including, but not limited to, OSHA regulations.

9.5 Acceptance of Imported Fill

Any soil imported from off-site sources should be tested for compliance with the recommendations for the particular application and approved by the project geotechnical engineer prior to the materials being used. The owner should also require the contractor to obtain a written, notarized certification from the landowner of each proposed off-site soil borrow source stating that to the best of the landowner's knowledge and belief there has never been contamination of the borrow source site with hazardous or toxic materials. The certification should be furnished to the owner prior to proceeding to furnish soils to the site. Soil materials derived from the excavation of underground petroleum storage tanks should not be used as fill on this project.

9.6 Soil Corrosion Potential

Various analytical laboratory tests were performed on selected soil samples. These tests include soluble sulfate, pH, and electrical resistivity. The tests indicate that the subsurface soils are generally nearly non-corrosive to buried ductile iron, cast iron, steel and galvanized pipe and mildly corrosive to corrosive to buried concrete.

The results of these tests are attached on Plate A.26. Standard construction practice for protecting buried pipes and similar facilities in contact with these soils should be used.

9.7 Erosion and Sediment Control

All disturbed areas should be protected from erosion and sedimentation during construction, and all permanent slopes and other areas subject to erosion or sedimentation should be provided with

permanent erosion and sediment control facilities. All applicable ordinances and codes regarding erosion and sediment control should be followed.

9.8 Utilities

Care should be taken that utility cuts are not left open for extended periods, and that the cuts are properly backfilled. Backfilling should be accomplished with properly compacted on-site soils, rather than granular materials.

Trench excavations should be sloped or braced in the interest of safety. Attention is drawn to OSHA Safety and Health Standards (29 CFR 1926/1910), Subpart P, regarding trench excavations greater than 5 feet in depth.

10.0 PAVEMENTS

10.1 Pavement Subgrade Preparation

10.1.1 General

Subgrade soils are expected to consist of more granular clayey sands, silty sands, silty clayey sands, and sands. Cuts may expose moderately plastic sandy clays in isolated areas. The success of the pavement subgrade is subgrade soil strength and control of water. Adequate subgrade performance can be achieved by modifying or stabilizing existing soils used to construct the pavement subgrade.

The performance of the pavement for this project depends upon several factors including: the characteristics of the supporting soil; the magnitude and frequency of wheel load applications; the quality of construction materials; the contractor's placement and workmanship abilities; and the desired period of design life.

Pavement sections are susceptible to edge distress as edge support deteriorates over time. Therefore, care must be taken to provide and maintain proper edge support. In conjunction with a stabilized subgrade underlying the pavement, it is recommended that the stabilized subgrade extend a minimum of 12 inches beyond each side of the proposed pavement. Maintenance should be provided when edge support deteriorates.

10.1.2 Pavement Subgrade Treatment

Pavement performance is impacted by many factors far beyond what is normally included in engineering design. Wherein pavement analyses should include establishing an appropriate thickness of asphalt concrete or Portland Cement concrete and appropriate subgrade remediation/stabilization, other factors such as location of trees adjacent to the existing paving and water conditions in grassed areas adjacent to curbing impact the performance of the pavement.

Lime stabilization is not recommended because the predominate surface soils are granular and lime will not react with most of them. The most conventional option is cement modification, which serves to improve and maintain their support value. Treatment of these soils with cement will improve their subgrade characteristics to support area paving.

In lieu of a cement stabilized subgrade for pavement consisting of Portland cement concrete, the recommended PCC pavement thicknesses presented in Section 10.2 may be increased by 1 inch, and placed atop a properly compacted subgrade.

Alternatively, in lieu of a cement stabilized subgrade, a flexible base meeting TxDOT Item 247, Type A, Grade 1/2 may be utilized on an equal basis and placed atop a properly compacted subgrade. The option of using a flexible base in lieu of cement stabilizing the subgrade presents a relatively quick, straight forward solution to preparing the subgrade prior to pavement placement.

Prior to cement stabilization or compaction, the subgrade should be proofrolled with heavy pneumatic equipment, with particular attention given to areas of existing fill. Any soft or pumping areas should be undercut to a firm subgrade and properly backfilled as described in the Earthwork section. The subgrade should be scarified to a minimum depth of 6 inches and uniformly compacted to a minimum of 95 percent of ASTM D698, to -2 to +4 percentage points of the optimum moisture content determined by that test. It should then be protected and maintained in a moist condition until the pavement is placed. The presence of iron seams, ironstone nodules, calcareous nodules, and gravel in the surficial soils can complicate mixing of the soil and cement.

We recommend a minimum of 5 percent Portland cement be used to modify the subgrade soils. The amount of cement required to stabilize the subgrade should be on the order of 23 pounds per square yard for a 6-inch depth based on a soil dry unit weight of 100 pcf. The cement should be thoroughly mixed and blended with the upper 6 inches of the subgrade (TxDOT Item 275 or similar standard).

The Portland cement should meet the requirements of Item 275 in the Texas Department of Transportation (TxDOT) Standard Specifications for Construction of Highways, Streets and Bridges, 2014 Edition.

The stabilized subgrade should be scarified to a minimum depth of 6 inches and uniformly compacted to a minimum of 98 percent of ASTM Standard Test Method for Moisture-Density Relations of Soil-Cement Mixtures (ASTM D558), to minus 3 to plus 1 percentage points of the optimum moisture content determined by that test. Cement treatment should extend beyond exposed pavement edges to reduce the effects of shrinkage and associated loss of subgrade support. It should then be protected and maintained in a moist condition until the pavement is placed via curing compound or sprinkling. Providing proper curing of the cement treated subgrade cannot be understated. Failure to properly cure the cement treated subgrade can result in undue shrinkage cracking.

We recommend that subgrade stabilization extend to at least one foot beyond pavement edges to aid in reducing pavement movements and cracking along the curb line due to seasonal moisture variations after construction. Each construction area should be shaped to allow drainage of surface water during earthwork operations, and surface water should be pumped immediately from each construction area after each rain and a firm subgrade condition maintained. Water should not be allowed to pond in order to prevent percolation and subgrade softening, and cement should be added to the subgrade after removal of all surface vegetation and debris.

The Texas Transportation Institute has performed studies to reduce “block cracks” common to cement-treated base materials. Microcracking is the application of several vibratory roller passes to a cement-treated base after a short curing stage, typically after one to three days, to create a fine network of cracks. Microcracking is one technique to help reduce the risk of shrinkage cracks in the cement-treated base. The goal of microcracking is to form a network of fine cracks and prevent the wider, more severe cracks from forming. Proper moisture control during cement placement/mixing and curing are also key factors to reducing shrinkage cracking.

After placement and satisfactory compaction of the cement treated subgrade, the base should be moist cured by sprinkling for 48 to 72 hours before microcracking. If performing construction during winter months when average daily temperatures are 60° F or below, moist cure the base at least 96 hours before microcracking. Microcracking should be performed with the same (or equivalent tonnage) steel wheel vibratory roller used for compaction. A minimum 12-ton roller should be used.

Typically three full passes (one pass is down and back) with the roller operating at maximum amplitude and traveling approximately 2 to 3 mph will satisfactorily microcrack the section. After satisfactory completion of microcracking, the subgrade should be moist cured by sprinkling to a total cure time of at least 72 hours from the day of placement.

Surface drainage is critical to the performance of this pavement. Water should be allowed to exit the pavement surface quickly. All pavement construction should be performed in accordance with the following procedures.

10.2 Pavement Sections

The project may include the construction of parking lots and/or drives. At the time of this investigation, site paving plans or vehicle traffic studies were not available. Therefore, several rigid and flexible pavement sections are presented for a 20-year design life based on our experience with similar facilities for Light-Duty Parking Areas, Medium-Duty Parking Areas and Drives, and Medium- to Heavy-Duty Drives. In general, these areas are defined as follows:

Light-Duty Parking Areas are those lots and drives subjected almost exclusively to passenger cars, with an occasional light- to medium-duty truck (2 to 3 per week)

Medium-Duty Parking Areas and Drives are those lots subjected to a variety of light-duty vehicles to medium-duty vehicles and an occasional heavy-duty truck or 85-kip fire truck (1 to 2 per week).

Medium- to Heavy-Duty Drives are those drives subjected to a variety of light to heavy-duty vehicles. These pavements include areas subject to significant truck and 85-kip fire apparatus traffic or trash vehicles.

We recommend that rigid pavements be utilized at this project whenever possible, since they tend to provide better long-term performance when subjected to significant slow moving and turning traffic.

If asphaltic concrete pavement is used, we recommend a full depth asphaltic concrete section having a minimum total thickness of 5 inches for light-duty parking areas, 6 inches for medium-duty parking areas and drives, and 8 inches for medium- to heavy-duty drives. A minimum surface course thickness of 2 inches is recommended for asphaltic concrete pavements.

If Portland cement concrete pavement is used, a minimum thickness of 5 inches of concrete is recommended for light-duty parking areas, 6 inches for medium-duty parking areas and drives, and 7 inches for medium- to heavy-duty areas.

A California Bearing Ratio or other strength tests were not performed because they were not within the scope of our services on this project. A subgrade modulus of 100 psi was considered appropriate for the near-surface soils. If heavier vehicles are planned, the above cross sections can be confirmed by performing strength tests on the subgrade materials once the traffic characteristics are established. Periodic maintenance of pavement structures normally improves the durability of the overall pavement and enhances its expected life.

The above sections should be considered minimum pavement thicknesses and higher traffic volumes and heavy trucks may require thicker pavement sections. Additional recommendations can be provided after traffic volumes and loads are known. Periodic maintenance should be anticipated for minimum pavement thickness. This maintenance should consist of sealing cracks and timely repair of isolated distressed areas.

10.3 Pavement Material Requirements

Reinforced Portland Cement Concrete: Reinforced Portland cement concrete pavement should consist of Portland cement concrete having a 28-day compressive strength of at least 3,500 psi. The mix should be designed in accordance with the ACI Code 318 using 3 to 6 percent air entrainment. The pavement should be adequately reinforced with temperature steel and all construction joints or expansion/contraction joints should be provided with load transfer dowels. The spacing of the joints will depend primarily on the type of steel used in the pavement. We recommend using No. 3 steel rebar spaced at 18 inches on center in both the longitudinal and transverse direction. Control joints formed by sawing are recommended every 12 to 15 feet in both the longitudinal and transverse direction. The cutting of the joints should be performed as soon as the concrete has “set-up” enough to allow for sawing operations.

Hot Mix Asphaltic Concrete Surface Course: Item 340, Type D, Texas Department of Transportation Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, 2014 Edition.

Hot Mix Asphaltic Concrete Base Course: Item 340, Type A or B, Texas Department of Transportation Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, 2014 Edition.

Cement Stabilized Subgrade: Cement treatment for base course (road mix) - Item 275, Texas Department of Transportation Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, 2014 Edition.

Flexible Base: Crushed Stone Flexible Base – Item 247, Type A, Grade 1/2, Texas Department of Transportation Standard Specifications for Construction of Maintenance of Highways, Streets, and Bridges, 2014 Edition.

10.4 General Pavement Considerations

The design of the pavement drainage and grading should consider the potential for differential ground movement due to future soil swelling on the order of 1 inch. In order to minimize rainwater infiltration through the pavement surface, and thereby minimizing future upward movement of the pavement slabs, all cracks and joints in the pavement should be sealed on a routine basis after construction.

11.0 CONSTRUCTION OBSERVATIONS

In any geotechnical investigation, the design recommendations are based on a limited amount of information about the subsurface conditions. In the analysis, the geotechnical engineer must assume the subsurface conditions are similar to the conditions encountered in the borings. However, quite often during construction anomalies in the subsurface conditions are revealed. Therefore, it is recommended that CMJ Engineering, Inc. be retained to observe earthwork and foundation installation and perform materials evaluation during the construction phase of the project. This enables the geotechnical engineer to stay abreast of the project and to be readily available to evaluate unanticipated conditions, to conduct additional tests if required and, when necessary, to recommend alternative solutions to unanticipated conditions. Until these construction phase services are performed by the project geotechnical engineer, the recommendations contained in this report on such items as final foundation bearing elevations, proper soil moisture condition, and other such subsurface related recommendations should be considered as preliminary.

It is proposed that construction phase observation and materials testing commence by the project geotechnical engineer at the outset of the project. Experience has shown that the most suitable method for procuring these services is for the owner or the owner's design engineers to contract directly with the project geotechnical engineer. This results in a clear, direct line of communication between the owner and the owner's design engineers and the geotechnical engineer.

12.0 REPORT CLOSURE

The boring logs shown in this report contain information related to the types of soil encountered at specific locations and times and show lines delineating the interface between these materials. The logs also contain our field representative's interpretation of conditions that are believed to exist in those depth intervals between the actual samples taken. Therefore, these boring logs contain both factual and interpretive information. Laboratory soil classification tests were also performed on samples from selected depths in the borings. The results of these tests, along with visual-manual procedures were used to generally classify each stratum. Therefore, it should be understood that the classification data on the logs of borings represent visual estimates of classifications for those portions of each stratum on which the full range of laboratory soil classification tests were not performed. It is not implied that these logs are representative of subsurface conditions at other locations and times.

With regard to groundwater conditions, this report presents data on groundwater levels as they were observed during the course of the field work. In particular, water level readings have been made in the borings at the times and under conditions stated in the text of the report and on the boring logs. It should be noted that fluctuations in the level of the groundwater table can occur with passage of time due to variations in rainfall, temperature and other factors. Also, this report does not include quantitative information on rates of flow of groundwater into excavations, on pumping capacities necessary to dewater the excavations, or on methods of dewatering excavations. Unanticipated soil conditions at a construction site are commonly encountered and cannot be fully predicted by mere soil samples, test borings or test pits. Such unexpected conditions frequently require that additional expenditures be made by the owner to attain a properly designed and constructed project. Therefore, provision for some contingency fund is recommended to accommodate such potential extra cost.

The analyses, conclusions and recommendations contained in this report are based on site conditions as they existed at the time of our field investigation and further on the assumption that the exploratory borings are representative of the subsurface conditions throughout the site; that is, the subsurface conditions everywhere are not significantly different from those disclosed by the borings at the time they were completed. If, during construction, different subsurface conditions from those encountered in our borings are observed, or appear to be present in excavations, we must be advised promptly so that we can review these conditions and reconsider our recommendations where necessary. If there is a substantial lapse of time between submission of this report and the start of the work at the site, if conditions have changed due either to natural causes or to construction operations at or adjacent to the site, or if structure locations, structural loads or finish grades are changed, we urge that we be promptly informed and retained to review our report to determine the applicability of the conclusions and recommendations, considering the changed conditions and/or time lapse.

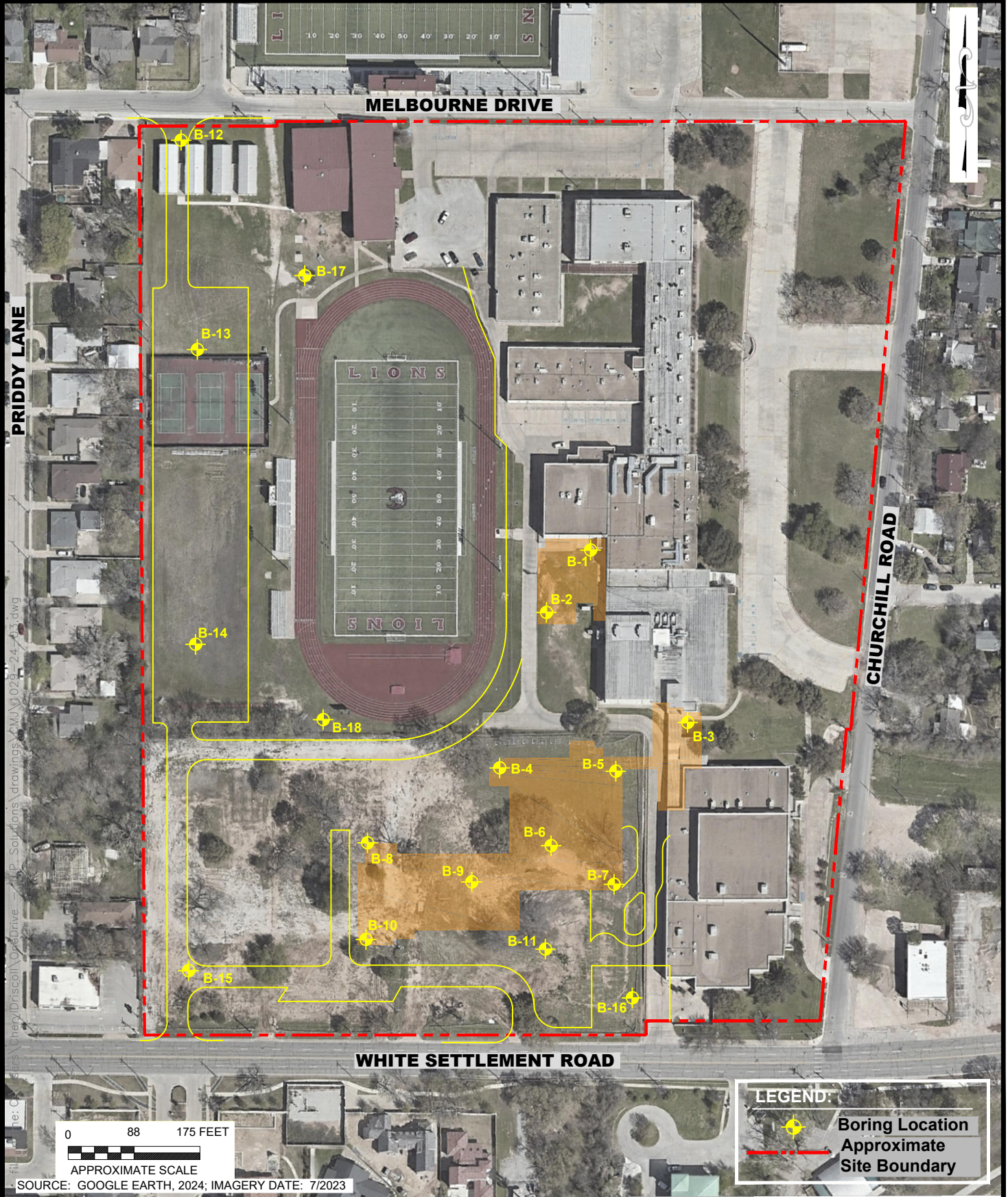
Further, it is urged that CMJ Engineering, Inc. be retained to review those portions of the plans and specifications for this particular project that pertain to earthwork and foundations as a means to determine whether the plans and specifications are consistent with the recommendations contained in this report. In addition, we are available to observe construction, particularly the compaction of structural fill, or backfill and the construction of foundations as recommended in the report, and such other field observations as might be necessary.

The scope of our services did not include any environmental assessment or investigation for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater or air, on or below or around the site.

This report has been prepared for use in developing an overall design concept. Paragraphs, statements, test results, boring logs, diagrams, etc. should not be taken out of context, nor utilized without a knowledge and awareness of their intent within the overall concept of this report. The reproduction of this report, or any part thereof, supplied to persons other than the owner, should indicate that this study was made for design purposes only and that verification of the subsurface conditions for purposes of determining difficulty of excavation, trafficability, etc. are responsibilities of the contractor.

This report has been prepared for the exclusive use of Castleberry Independent School District and their consultants for specific application to design of this project. The only warranty made by us in connection with the services provided is that we have used that degree of care and skill ordinarily exercised under similar conditions by reputable members of our profession practicing in the same or similar locality. No other warranty, expressed or implied, is made or intended. These recommendations should be reviewed once a grading plan is finalized.

* * * *



file:///C:/Users/Cheryl/OneDrive/Desktop/Projects/1029-24-03/dwg/1029-24-03.dwg
 Cheryl Driscoll
 P. Solutions

Major Divisions		Grp. Sym.	Typical Names	Laboratory Classification Criteria		
Coarse-grained soils (more than half of the material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3 Not meeting all gradation requirements for GW Liquid and Plastic limits below "A" line or P.I. greater than 4 Liquid and plastic limits plotting in hatched zone between 4 and 7 are borderline cases requiring use of dual symbols $C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3 Not meeting all gradation requirements for SW Liquid and Plastic limits below "A" line or P.I. less than 4 Liquid and plastic limits plotting between 4 and 7 are borderline cases requiring use of dual symbols Liquid and Plastic limits above "A" line with P.I. greater than 7	
		Gravels with fines (Appreciable amount of fines)	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines		
			GM	Silty gravels, gravel-sand-silt mixtures		
		Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines
			Sands with fines (Appreciable amount of fines)	SP		Poorly graded sands; gravelly sands, little or no fines
		Sands with fines (Appreciable amount of fines)		SM		Silty sands, sand-silt mixtures
	SC		Clayey sands, sand-clay mixtures			
	Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Sils and clays (Liquid limit less than 50)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity	Determine percentages of sand and gravel from grain size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 percent.....GW, GP, SW, SP More than 12 percent.....GM, GC, SM, SC 5 to 12 percent.....Borderline cases requiring dual symbols	
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, and lean clays		
			OL	Organic silts and organic silty clays of low plasticity		
		Sils and clays (Liquid limit greater than 50)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts		
			CH	Inorganic clays of high plasticity, fat clays		
OH			Organic clays of medium to high plasticity, organic silts			
Highly Organic soils		Pt	Peat and other highly organic soils			
<p>The Plasticity Chart plots Plasticity Index (Y-axis, 0 to 60) against Liquid Limit (X-axis, 0 to 100). A diagonal 'A' line is shown. Regions are labeled: CH (top right), OH and MH (middle right), CL (middle left), ML and OL (bottom left), and CL-ML (hatched area at bottom left). The A-line is labeled 'A' Line'.</p>						

SOIL OR ROCK TYPES											
	GRAVEL		LEAN CLAY		LIMESTONE						
	SAND		SANDY		SHALE						
	SILT		SILTY		SANDSTONE						
	HIGHLY PLASTIC CLAY		CLAYEY		CONGLOMERATE	Shelby Tube	Auger	Split Spoon	Rock Core	Cone Pen	No Recovery

TERMS DESCRIBING CONSISTENCY, CONDITION, AND STRUCTURE OF SOIL

Fine Grained Soils (More than 50% Passing No. 200 Sieve)

Descriptive Item	Penetrometer Reading, (tsf)
Soft	0.0 to 1.0
Firm	1.0 to 1.5
Stiff	1.5 to 3.0
Very Stiff	3.0 to 4.5
Hard	4.5+

Coarse Grained Soils (More than 50% Retained on No. 200 Sieve)

Penetration Resistance (blows/foot)	Descriptive Item	Relative Density
0 to 4	Very Loose	0 to 20%
4 to 10	Loose	20 to 40%
10 to 30	Medium Dense	40 to 70%
30 to 50	Dense	70 to 90%
Over 50	Very Dense	90 to 100%

Soil Structure

Calcareous	Contains appreciable deposits of calcium carbonate; generally nodular
Slickensided	Having inclined planes of weakness that are slick and glossy in appearance
Laminated	Composed of thin layers of varying color or texture
Fissured	Containing cracks, sometimes filled with fine sand or silt
Interbedded	Composed of alternate layers of different soil types, usually in approximately equal proportions

TERMS DESCRIBING PHYSICAL PROPERTIES OF ROCK

Hardness and Degree of Cementation

Very Soft or Plastic	Can be remolded in hand; corresponds in consistency up to very stiff in soils
Soft	Can be scratched with fingernail
Moderately Hard	Can be scratched easily with knife; cannot be scratched with fingernail
Hard	Difficult to scratch with knife
Very Hard	Cannot be scratched with knife
Poorly Cemented or Friable	Easily crumbled
Cemented	Bound together by chemically precipitated material; Quartz, calcite, dolomite, siderite, and iron oxide are common cementing materials.

Degree of Weathering

Unweathered	Rock in its natural state before being exposed to atmospheric agents
Slightly Weathered	Noted predominantly by color change with no disintegrated zones
Weathered	Complete color change with zones of slightly decomposed rock
Extremely Weathered	Complete color change with consistency, texture, and general appearance approaching soil

Project No. 1029-24-03	Boring No. B-1	Project Castleberry High School Additions 215 Churchill Road - Fort Worth, Texas
Location See Plate A.1		Water Observations Seepage at 15' with borehole cave-in at 21' during drilling; water at 21' at completion
Completion Depth 45.0'	Completion Date 3-11-24	

Depth, Ft.	Symbol	Samples	Surface Elevation	Type	REC %	RQD %	Blows/Ft. or Pen Reading, T.S.F.	Passing No 200 Sieve, %	Liquid Limit, %	Plastic Limit, %	Plasticity Index	Moisture Content, %	Unit Dry Wt. Lbs./Cu. Ft.	Unconfined Compression Pounds/Sq. Ft.
			589.0	B-53, w/ CFA										
				CLAYEY SAND , reddish brown, w/ iron seams, ironstone nodules, and gravel			4.0					12		
							2.25					12		
							1.5					13		
							1.25	44	26	14	12	17		
5							3.5					14	118	2650
				- w/ sand layers below 10'										
							2.5					13		
10							4.5+					15		
			575.0	SAND , tan, w/ iron seams, ironstone nodules, and gravel, medium dense								12		
				- reddish brown below 18.5'										
15							21	9				5		
			567.0	- cave-in at 21' during drilling										
				LIMESTONE , gray, hard to very hard										
20														
							100/1"							
25														
							100/0.625"							
30														
							100/0.5"							
35				- w/ shale seams below 35'										
							100/0.375"							
40														
			544.0											
45														

LOG OF BORING 1029-24-03.GPJ CMJ.GDT 4/19/24

Project No. 1029-24-03	Boring No. B-2	Project Castleberry High School Additions 215 Churchill Road - Fort Worth, Texas
Location See Plate A.1		Water Observations Seepage at 19' with borehole cave-in at 21' during drilling; water at 22' at completion
Completion Depth 40.0'	Completion Date 3-11-24	

Depth, Ft.	Symbol	Samples	Surface Elevation 588.0	Type B-53, w/ CFA	REC %	RQD %	Blows/Ft. or Pen Reading, T.S.F.	Passing No 200 Sieve, %	Liquid Limit, %	Plastic Limit, %	Plasticity Index	Moisture Content, %	Unit Dry Wt. Lbs./Cu. Ft.	Unconfined Compression Pounds/Sq. Ft.
			Stratum Description											
0 - 5.5	[Diagonal Hatching]		578.0	CLAYEY SAND , reddish brown and light reddish brown, w/ iron seams and ironstone nodules			1.0 0.75 4.0 4.5+ 2.5					10 6 14 8 8		
5.5 - 10	[Diagonal Hatching]		578.0	SAND , light brown, w/ gravel, medium dense									8 105 2330	
10 - 21	[Dotted Pattern]			- cave-in at 21' during drilling			22 29							
21 - 25	[Dotted Pattern]		563.0	LIMESTONE , gray, w/ shale seams and layers, hard to very hard										
25 - 30	[Brick Pattern]						100/1.25"							
30 - 35	[Brick Pattern]						100/1.5"							
35 - 40	[Brick Pattern]		548.0				100/0.75"							

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Project No. 1029-24-03	Boring No. B-3	Project Castleberry High School Additions 215 Churchill Road - Fort Worth, Texas
Location See Plate A.1		Water Observations Seepage at 25' with borehole cave-in at 22' and 27' during drilling; water at 41' at completion
Completion Depth 45.0'	Completion Date 3-11-24	

Depth, Ft.	Symbol	Samples	Surface Elevation	Type	REC %	RQD %	Blows/Ft. or Pen Reading, T.S.F.	Passing No 200 Sieve, %	Liquid Limit, %	Plastic Limit, %	Plasticity Index	Moisture Content, %	Unit Dry Wt. Lbs./Cu. Ft.	Unconfined Compression Pounds/Sq. Ft.
			575.0	B-53, w/ CFA										
0 - 4	[Diagonal Hatching]			SILTY CLAYEY SAND , dark brown, brown, and light reddish brown, w/ ironstone nodules, gravel, and asphalt fragments (FILL)			2.0					13		
4 - 5	[Diagonal Hatching]			- w/ calcareous nodules below 4'			4.5+					9	118	2300
5 - 6	[Diagonal Hatching]						0.75	20	13	7		9		
6 - 7	[Diagonal Hatching]						0.5					10		
7 - 8	[Diagonal Hatching]						0.25					4		
8 - 10	[Diagonal Hatching]		568.0	SANDY CLAY / CLAYEY SAND , light reddish brown, w/ iron seams, ironstone nodules, calcareous nodules, and asphalt fragments, hard (FILL)			4.5+	53	29	12	17	9		
10 - 11	[Diagonal Hatching]		566.0	SAND , tan and light reddish brown, w/ calcareous nodules and gravel, loose to medium dense			0.25					4		
11 - 15	[Dotted Pattern]													
15 - 16	[Dotted Pattern]						9	10				2		
16 - 20	[Dotted Pattern]						14							
20 - 22	[Dotted Pattern]			- cave-in at 22' during drilling										
22 - 25	[Dotted Pattern]						24							
25 - 27	[Dotted Pattern]			- cave-in at 27' during drilling										
27 - 30	[Dotted Pattern]			- dense below 28.5'										
30 - 35	[Dotted Pattern]		545.0	LIMESTONE , gray, w/ shale seams and layers, hard to very hard			33							
35 - 40	[Dotted Pattern]						100/1.25"							
40 - 45	[Dotted Pattern]						100/0.5"							
45 - 45.0	[Dotted Pattern]		530.0				100/0.75"							

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Project No. 1029-24-03	Boring No. B-4	Project Castleberry High School Additions 215 Churchill Road - Fort Worth, Texas
Location See Plate A.1		Water Observations Dry during drilling; dry at completion
Completion Depth 40.0'	Completion Date 3-13-24	

Depth, Ft.	Symbol	Samples	Surface Elevation	Type	REC %	RQD %	Blows/Ft. or Pen Reading, T.S.F.	Passing No 200 Sieve, %	Liquid Limit, %	Plastic Limit, %	Plasticity Index	Moisture Content, %	Unit Dry Wt. Lbs./Cu. Ft.	Unconfined Compression Pounds/Sq. Ft.
			586.0	CME 55, w/ CFA										
Stratum Description														
			583.0	CLAYEY SAND , dark brown, w/ iron seams and ironstone nodules - reddish brown below 1'			2.0					20		
				SANDY CLAY , light reddish brown, w/ iron seams and ironstone nodules, firm to stiff - very stiff to hard below 4'			0.5					10		
5							0.5					15		
							1.5					16	115	1560
							3.75	57	45	14	31	16	113	
							4.5+					16		
10			576.0	- w/ calcareous nodules below 9'			3.25					16		
				SAND , light brown, medium dense										
							16							
							20							
			564.0	- w/ gravel below 18'										
				LIMESTONE , tan and gray, moderately hard										
25			561.0	LIMESTONE , gray, w/ shaly limestone seams, moderately hard to hard			100/2.25"							
							100/1.75"							
30							100/2"							
35														
40			546.0				100/1.25"							

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Project No. 1029-24-03	Boring No. B-5	Project Castleberry High School Additions 215 Churchill Road - Fort Worth, Texas
Location See Plate A.1		Water Observations Seepage at 14' during drilling; water at 25' at completion
Completion Depth 40.0'	Completion Date 3-13-24	

Depth, Ft.	Symbol	Samples	Surface Elevation	Type	REC %	RQD %	Blows/Ft. or Pen Reading, T.S.F.	Passing No 200 Sieve, %	Liquid Limit, %	Plastic Limit, %	Plasticity Index	Moisture Content, %	Unit Dry Wt. Lbs./Cu. Ft.	Unconfined Compression Pounds/Sq. Ft.
			577.0	CME 55, w/ CFA										
			575.0	SILTY CLAYEY SAND , brown and reddish brown, w/ iron stains and ironstone nodules			0.5					13		
				SAND , light brown, loose to medium dense			1.0		22	16	6	5		
5							7							
				- w/ clay seams below 8.5'			8							
10							11							
				- w/ gravel below 13.5'			20							
15														
			558.0	LIMESTONE , gray, moderately hard to hard			100/3.5"							
20														
							100/2"							
25														
							100/1.75"							
30														
				- w/ shale seams and shaly limestone seams below 32'			100/2.5"							
35														
			537.0				100/2"							
40														

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Project No. 1029-24-03		Boring No. B-6		Project Castleberry High School Additions 215 Churchill Road - Fort Worth, Texas											
Location See Plate A.1		Water Observations Seepage at 13' during drilling; dry at completion													
Completion Depth 45.0'		Completion Date 3-13-24													
Surface Elevation 583.0		Type CME 55, w/ CFA													
Depth, Ft.	Symbol	Samples	Stratum Description			REC %	RQD %	Blows/Ft. or Pen Reading, T.S.F.	Passing No 200 Sieve, %	Liquid Limit, %	Plastic Limit, %	Plasticity Index	Moisture Content, %	Unit Dry Wt. Lbs./Cu. Ft.	Unconfined Compression Pounds/Sq. Ft.
5			CLAYEY SAND , light brown, w/ iron stains and ironstone nodules					0.25					4		
5			SAND , light brown, loose to medium dense					6							
10								10							
15			- w/ gravel below 13'					12							
15								18							
20			SILTY CLAY , light brown, w/ ironstone nodules, calcareous nodules, and calcareous deposits, very stiff					4.0	47	16	31	17			
25			LIMESTONE , tan and gray, moderately hard to hard					100/2"							
30			LIMESTONE , gray, moderately hard to hard					100/2"							
35								100/1.25"							
40								100/1.75"							
45			- w/ shale seams and shaly limestone seams below 41'					100/2"							
45			538.0												

LOG OF BORING 1029-24-03.GPJ CMJ.GDT 4/19/24

Project No. 1029-24-03	Boring No. B-7	Project Castleberry High School Additions 215 Churchill Road - Fort Worth, Texas
Location See Plate A.1		Water Observations Dry during drilling; dry at completion
Completion Depth 40.0'	Completion Date 3-14-24	

Depth, Ft.	Symbol	Samples	Surface Elevation	Type	REC %	RQD %	Blows/Ft. or Pen Reading, T.S.F.	Passing No 200 Sieve, %	Liquid Limit, %	Plastic Limit, %	Plasticity Index	Moisture Content, %	Unit Dry Wt. Lbs./Cu. Ft.	Unconfined Compression Pounds/Sq. Ft.
			577.0	CME 55, w/ CFA										
				SILTY SAND , brown, w/ iron stains and ironstone nodules, loose to medium dense - reddish brown below 2'			0.5		NP	NP	NP	6		
5							9							
							9							
10							11	18				8		
15			562.0	- w/ gravel below 14' SILTY CLAY , light brown			12							
			559.0	LIMESTONE , tan, hard			100/1.25"							
20														
			555.0	LIMESTONE , gray, hard to very hard			100/1.25"							
25														
							100/1"							
30														
							100/1.125"							
35														
							100/1"							
40			537.0											

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Project No. 1029-24-03	Boring No. B-8	Project Castleberry High School Additions 215 Churchill Road - Fort Worth, Texas
Location See Plate A.1		Water Observations Seepage at 5' with borehole cave-in at 25' during drilling; water at 18' at completion
Completion Depth 50.0'	Completion Date 3-13-24	

Depth, Ft.	Symbol	Samples	Surface Elevation	Type	REC %	RQD %	Blows/Ft. or Pen Reading, T.S.F.	Passing No 200 Sieve, %	Liquid Limit, %	Plastic Limit, %	Plasticity Index	Moisture Content, %	Unit Dry Wt. Lbs./Cu. Ft.	Unconfined Compression Pounds/Sq. Ft.
			591.0	B-53, w/ CFA										
				SAND , brown, w/ iron stains and ironstone nodules, loose to medium dense			0.25					5		
5				- reddish brown below 3.5'			10	10				8		
			583.0	SILTY CLAYEY SAND , light reddish brown, w/ iron seams, ironstone nodules, and calcareous nodules			1.5					15	117	2800
			576.0	SAND , tan and brown, medium dense			3.0	33	22	15	7	12	115	
20				- w/ gravel below 23.5'			13							
25				- cave-in at 25' during drilling			23							
			559.0	LIMESTONE , tan			100/0.875"							
			557.0	LIMESTONE , gray, w/ shale seams, very hard			100/0.75"							
45							100/0.625"							
50			541.0				100/0.5"							

LOG OF BORING 1029-24-03.GPJ CMJ.GDT 4/19/24

Project No. 1029-24-03	Boring No. B-9	Project Castleberry High School Additions 215 Churchill Road - Fort Worth, Texas
Location See Plate A.1		Water Observations Seepage at 10' with borehole cave-in at 14', 17', and 27' during drilling; water at 31' at completion
Completion Depth 50.0'	Completion Date 3-13-24	

Depth, Ft.	Symbol	Samples	Surface Elevation	Type	REC %	RQD %	Blows/Ft. or Pen Reading, T.S.F.	Passing No 200 Sieve, %	Liquid Limit, %	Plastic Limit, %	Plasticity Index	Moisture Content, %	Unit Dry Wt. Lbs./Cu. Ft.	Unconfined Compression Pounds/Sq. Ft.
			588.0	B-53, w/ CFA										
Stratum Description														
0 - 3.5				SILTY SAND , reddish brown, w/ iron seams and ironstone nodules, loose			0.5					8		
3.5 - 5				- light reddish brown below 3.5'										
5 - 9							9	20				12		
9 - 10			580.0	CLAYEY SAND , light reddish brown, w/ iron seams, ironstone nodules, and calcareous nodules			3.0	46	26	14	12	15	115	
10 - 14			576.0	SAND , tan and brown, medium dense										
14 - 15				- cave-in at 14' during drilling			14							
15 - 17				- cave-in at 17' during drilling										
17 - 20				- w/ gravel below 20'										
20 - 27														
27 - 30			560.0	- cave-in at 27' during drilling										
30 - 31				LIMESTONE , gray, w/ shale seams and layers, hard to very hard			100/1.25'							
31 - 35							100/0.5"							
35 - 40							100/0.375"							
40 - 45							100/0.625"							
45 - 50			538.0				100/0.375"							

LOG OF BORING 1029-24-03.GPJ - CMJ.GDT 4/19/24

Project No. 1029-24-03	Boring No. B-10	Project Castleberry High School Additions 215 Churchill Road - Fort Worth, Texas
Location See Plate A.1		Water Observations Seepage at 3' with borehole cave-in at 10', 12', 21', and 25' during drilling; water at 4' at completion
Completion Depth 55.0'	Completion Date 3-13-24	

Depth, Ft.	Symbol	Samples	Surface Elevation	Type	REC %	RQD %	Blows/Ft. or Pen Reading, T.S.F.	Passing No 200 Sieve, %	Liquid Limit, %	Plastic Limit, %	Plasticity Index	Moisture Content, %	Unit Dry Wt. Lbs./Cu. Ft.	Unconfined Compression Pounds/Sq. Ft.
			590.0	B-53, w/ CFA										
				SILTY SAND , light reddish brown, w/ iron seams and ironstone nodules, loose			0.25		NP	NP	NP	6		
5				- w/ sandy clay layers below 8'			8	16				19		
10				- cave-in at 10' during drilling								15		
15				- cave-in at 12' during drilling										
20				- cave-in at 21' during drilling										
25				- w/ gravel below 22'										
30			560.0	LIMESTONE , tan, moderately hard										
35			555.0	LIMESTONE , gray, w/ shale seams and layers, very hard			100/2.5"							
40							100/0.5"							
45							100/0.75"							
50							100/0.375"							
55			535.0				100/0.375"							

LOG OF BORING 1029-24-03.GPJ CMJ.GDT 4/19/24

Project No. 1029-24-03	Boring No. B-11	Project Castleberry High School Additions 215 Churchill Road - Fort Worth, Texas
Location See Plate A.1		Water Observations Seepage at 10' with borehole cave-in at 20' during drilling; water at 17' at completion
Completion Depth 45.0'	Completion Date 3-14-24	

Depth, Ft.	Symbol	Samples	Surface Elevation	Type	REC %	RQD %	Blows/Ft. or Pen Reading, T.S.F.	Passing No 200 Sieve, %	Liquid Limit, %	Plastic Limit, %	Plasticity Index	Moisture Content, %	Unit Dry Wt. Lbs./Cu. Ft.	Unconfined Compression Pounds/Sq. Ft.
			589.0	B-53, w/ CFA										
				SAND , brown, w/ iron stains and ironstone nodules, loose			0.25					6		
5							7	11				6		
			581.0	SANDY CLAY , light brown and reddish brown, w/ iron seams, ironstone nodules, and calcareous nodules, stiff			2.0		27	12	15	15	119	2200
			577.0	SAND , light reddish brown, w/ iron stains and ironstone nodules, medium dense			15	9				4		
15							18							
				- w/ gravel below 20' - cave-in at 20' during drilling										
			563.0	LIMESTONE , tan										
			560.0	LIMESTONE , gray, w/ shale seams, hard to very hard			100/1"							
							100/0.375"							
							100/0.75"							
							100/0.375"							
45			544.0											

LOG OF BORING 1029-24-03.GPJ CMJ.GDT 4/19/24

Project No. 1029-24-03	Boring No. B-12	Project Castleberry High School Additions 215 Churchill Road - Fort Worth, Texas
Location See Plate A.1		Water Observations Seepage at 4' during drilling; water at 7' at completion
Completion Depth 8.0'	Completion Date 3-12-24	

Depth, Ft.	Symbol	Samples	Surface Elevation	Type	REC %	RQD %	Blows/Ft. or Pen Reading, T.S.F.	Passing No 200 Sieve, %	Liquid Limit, %	Plastic Limit, %	Plasticity Index	Moisture Content, %	Unit Dry Wt. Lbs./Cu. Ft.	Unconfined Compression Pounds/Sq. Ft.
			590.0	B-53, w/ CFA										
Stratum Description														
			589.0	CLAYEY SAND , dark brown, w/ iron stains and ironstone nodules SAND , tan			1.0	17				10		
			586.0	SANDY CLAY / CLAYEY SAND , light brown and reddish brown, w/ iron seams and ironstone nodules, stiff			2.75					15	118	2310
5			582.0				2.75		29	13	16	15		

LOG OF BORING 1029-24-03.GPJ_CMJ.GDT 4/19/24

Project No. 1029-24-03	Boring No. B-13	Project Castleberry High School Additions 215 Churchill Road - Fort Worth, Texas
Location See Plate A.1		Water Observations Dry during drilling; dry at completion
Completion Depth 8.0'	Completion Date 3-12-24	

Depth, Ft.	Symbol	Samples	Surface Elevation	Type	REC %	RQD %	Blows/Ft. or Pen Reading, T.S.F.	Passing No 200 Sieve, %	Liquid Limit, %	Plastic Limit, %	Plasticity Index	Moisture Content, %	Unit Dry Wt. Lbs./Cu. Ft.	Unconfined Compression Pounds/Sq. Ft.
			591.0	B-53, w/ CFA										
Stratum Description														
				SAND , tan, w/ iron stains and ironstone nodules			0.5	9				6		
5			587.0	CLAYEY SAND , reddish brown, w/ iron stains and ironstone nodules			1.25					13		
			583.0				0.75					12		

LOG OF BORING 1029-24-03.GPJ_CMJ.GDT 4/19/24

Project No. 1029-24-03	Boring No. B-14	Project Castleberry High School Additions 215 Churchill Road - Fort Worth, Texas
Location See Plate A.1		Water Observations Seepage at 2' during drilling; water at 7' at completion
Completion Depth 8.0'	Completion Date 3-12-24	

Depth, Ft.	Symbol	Samples	Surface Elevation	Type	REC %	RQD %	Blows/Ft. or Pen Reading, T.S.F.	Passing No 200 Sieve, %	Liquid Limit, %	Plastic Limit, %	Plasticity Index	Moisture Content, %	Unit Dry Wt. Lbs./Cu. Ft.	Unconfined Compression Pounds/Sq. Ft.
			591.0	B-53, w/ CFA										
Stratum Description														
				SAND , brown, w/ iron stains and ironstone nodules - tan below 1'			0.75	8				7		
5			587.0	SANDY CLAY , light brown, reddish brown, and gray, w/ iron seams and ironstone nodules, stiff to very stiff			3.0		32	12	20	16		
			583.0				2.75					15	117	4700

LOG OF BORING 1029-24-03.GPJ_CMJ.GDT 4/19/24

Project No. 1029-24-03	Boring No. B-15	Project Castleberry High School Additions 215 Churchill Road - Fort Worth, Texas
Location See Plate A.1		Water Observations Dry during drilling; dry at completion
Completion Depth 8.0'	Completion Date 3-14-24	

Depth, Ft.	Symbol	Samples	Surface Elevation	Type	REC %	RQD %	Blows/Ft. or Pen Reading, T.S.F.	Passing No 200 Sieve, %	Liquid Limit, %	Plastic Limit, %	Plasticity Index	Moisture Content, %	Unit Dry Wt. Lbs./Cu. Ft.	Unconfined Compression Pounds/Sq. Ft.
			591.0	B-53, w/ CFA										
				Stratum Description										
				SAND , tan, w/ iron stains and ironstone nodules, medium dense			0.25	10				6		
5				- w/ sandy clay seams below 5'			15							
			583.0											

LOG OF BORING 1029-24-03.GPJ_CMJ.GDT 4/19/24

Project No. 1029-24-03	Boring No. B-16	Project Castleberry High School Additions 215 Churchill Road - Fort Worth, Texas
Location See Plate A.1		Water Observations Dry during drilling; dry at completion
Completion Depth 8.0'	Completion Date 3-14-24	

Depth, Ft.	Symbol	Samples	Surface Elevation	Type	REC %	RQD %	Blows/Ft. or Pen Reading, T.S.F.	Passing No 200 Sieve, %	Liquid Limit, %	Plastic Limit, %	Plasticity Index	Moisture Content, %	Unit Dry Wt. Lbs./Cu. Ft.	Unconfined Compression Pounds/Sq. Ft.
			573.0	CME 55, w/ CFA										
				Stratum Description										
			571.0	SILTY CLAYEY SAND , brown, light brown, and light reddish brown, w/ iron stains and ironstone nodules			0.75	15	17	11	6	8		
				SAND , light brown, loose			0.75					5		
5							7							
							8							
			565.0				9							

LOG OF BORING 1029-24-03.GPJ_CMJ.GDT 4/19/24

Project No. 1029-24-03	Boring No. B-17	Project Castleberry High School Additions 215 Churchill Road - Fort Worth, Texas
Location See Plate A.1		Water Observations Seepage at 7' during drilling; water at 4' at completion
Completion Depth 15.0'	Completion Date 3-12-24	

Depth, Ft.	Symbol	Samples	Surface Elevation	Type	REC %	RQD %	Blows/Ft. or Pen Reading, T.S.F.	Passing No 200 Sieve, %	Liquid Limit, %	Plastic Limit, %	Plasticity Index	Moisture Content, %	Unit Dry Wt. Lbs./Cu. Ft.	Unconfined Compression Pounds/Sq. Ft.
			591.0	B-53, w/ CFA										
			589.0	SILTY CLAYEY SAND , dark brown and brown, w/ iron stains, ironstone nodules, and gravel - 6-inch thick sandstone seam at 1.5'			1.25	14	26	20	6	9		
			588.0	SANDSTONE , tan, fractured, w/ gravel layers										
				SAND , tan, medium dense			15							
5			584.0	SANDY CLAY , light reddish brown, w/ iron seams, ironstone nodules, and calcareous nodules, hard - reddish brown below 9'			4.5+	68	32	12	20	15	114	
10							4.5+					14	122	8220
15			576.0											

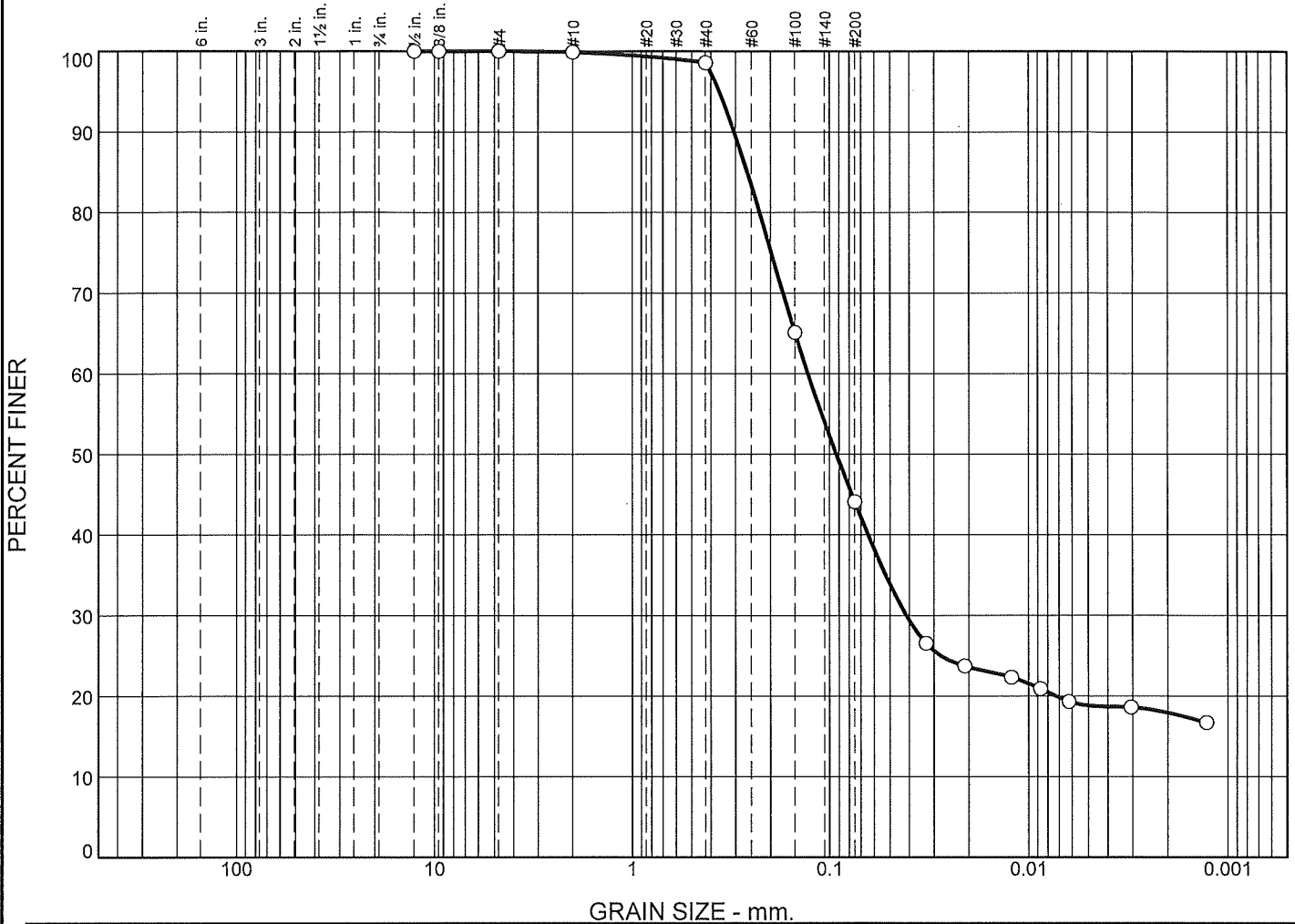
LOG OF BORING 1029-24-03.GPJ_CMJ.GDT 4/19/24

Project No. 1029-24-03	Boring No. B-18	Project Castleberry High School Additions 215 Churchill Road - Fort Worth, Texas
Location See Plate A.1		Water Observations Seepage at 4' during drilling; water at 13' at completion
Completion Depth 15.0'	Completion Date 3-12-24	

Depth, Ft.	Symbol	Samples	Surface Elevation	Type	REC %	RQD %	Blows/Ft. or Pen Reading, T.S.F.	Passing No 200 Sieve, %	Liquid Limit, %	Plastic Limit, %	Plasticity Index	Moisture Content, %	Unit Dry Wt. Lbs./Cu. Ft.	Unconfined Compression Pounds/Sq. Ft.
			591.0	B-53, w/ CFA										
			590.0	CLAYEY SAND , brown, w/ iron stains and ironstone nodules SAND , tan			1.0					12		
5			587.0	SANDY CLAY / CLAYEY SAND , light brown, reddish brown, and gray, w/ iron seams and ironstone nodules, stiff to very stiff			2.25					18		
							2.75					18	114	2090
							3.0		25	12	13	11		
15			576.0	- hard below 14'			4.5+					16		

LOG OF BORING 1029-24-03.GPJ CMJ.GDT 4/19/24

Particle Size Distribution Report



%	+3"	% Gravel		% Sand			% Fines			
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay		
○	0.0	0.0	0.0	0.1	1.3	54.5	25.3	18.8		
×	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
○	26	14	0.2617	0.1287	0.0926	0.0413				

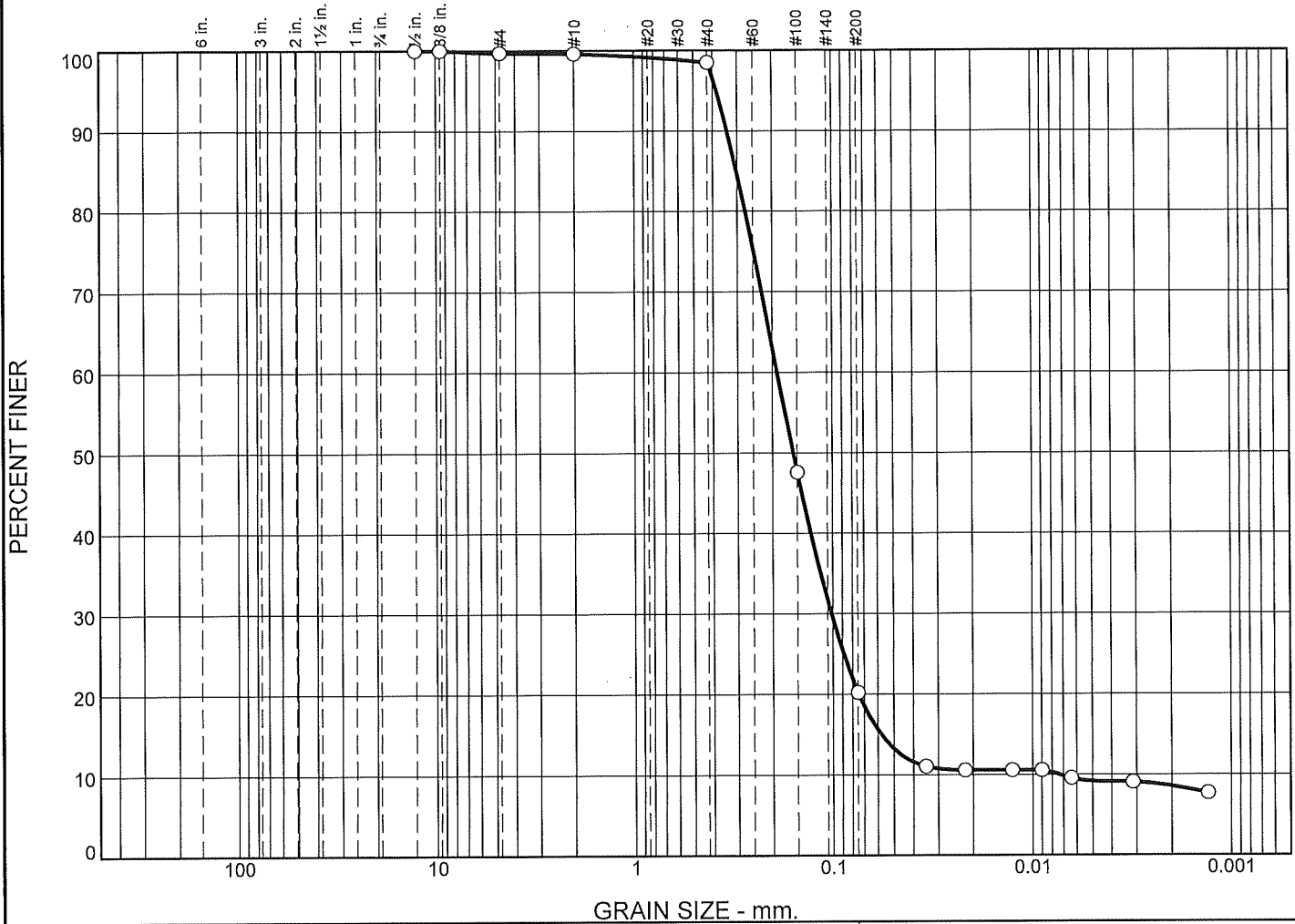
MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○		SC	

Project No. 1029-24-03 **Client:** Castleberry I.S.D.
Project: Castleberry HS Add.-215 Churhill Rd-Fort Worth, TX
 ○ **Depth:** 3-4 **Sample Number:** B-1

CMJ ENGINEERING, INC.
 Fort Worth, Texas

Remarks:

Particle Size Distribution Report



%	+3"	% Gravel		% Sand			% Fines			
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay		
<input type="radio"/>	0.0	0.0	0.3	0.1	1.1	78.3	11.0	9.2		
<input checked="" type="checkbox"/>	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
<input type="radio"/>			0.3027	0.1891	0.1571	0.1017	0.0577	0.0073	7.46	25.80

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
<input type="radio"/>			

Project No. 1029-24-03 Client: Castleberry I.S.D. Project: Castleberry HS Add.-215 Churchill Rd-Fort Worth, TX <input type="radio"/> Depth: 3.5-5 Sample Number: B-9	Remarks:
CMJ ENGINEERING, INC. Fort Worth, Texas	PLATE A.23

Particle Size Distribution Report



%	+3"	% Gravel		% Sand			% Fines			
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay		
○	0.0	0.0	0.0	0.0	0.7	83.2	10.0	6.1		
⊗	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
○			0.2988	0.1901	0.1601	0.1097	0.0715	0.0332	1.91	5.73

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○			

Project No. 1029-24-03 **Client:** Castleberry I.S.D.
Project: Castleberry HS Add.-215 Churchill Rd-Fort Worth, TX
 ○ **Depth:** 3.5-5 **Sample Number:** B-10

CMJ ENGINEERING, INC.
 Fort Worth, Texas

Remarks:

PLATE A.24

FREE SWELL TEST RESULTS

Project: Castleberry High School Additions
215 Churchill Road – Fort Worth, Texas

Project No.: 1029-24-03

Boring No.	Depth Interval (ft.)	Sample Description	Liquid Limit	Plastic Limit	Plasticity Index	Moisture Content %		Percent Swell (%)
			LL	PL	PI	Initial	Final	
B-2	3 – 4	Clayey Sand	29	15	14	8.3	15.9	0.0
B-4	4 – 5	Sandy Clay	45	14	31	16.4	18.1	0.3
B-8	14 – 15	Silty Clayey Sand	22	15	7	11.8	14.1	0.0
B-9	9 – 10	Clayey Sand	26	14	12	15.3	15.9	0.0
B-17	7 – 8	Sandy Clay	32	12	20	14.9	15.8	0.0

Free swell tests performed at approximate overburden pressure

ANALYTICAL TEST RESULTS

Project: Castleberry High School Additions
215 Churchill Road – Fort Worth, Texas

Project No.: 1029-24-03

Boring No.	Depth (ft.)	Soluble Sulfate (ppm)	pH	Resistivity (ohm-cm)
B-1	9 – 10	<100	6.92	5,860
B-4	7 – 8	<100	7.80	2,690
B-12	4 – 5	<100	5.96	14,950

SECTION 01 10 00

SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Project information.
 - 2. Work covered by Contract Documents.
 - 3. Work performed by Owner.
 - 4. Owner-furnished/Contractor-installed (OFICI) products.
 - 5. Owner-furnished/Owner-installed (OFOI) products.
 - 6. Contractor's use of site and premises.
 - 7. Coordination with occupants.
 - 8. Work restrictions.
 - 9. Specification and Drawing conventions.

1.2 PROJECT INFORMATION

- A. Project Identification: Castleberry ISD High School Addition; Project No. 2359.
 - 1. Project Location: 215 Churchill Road, Fort Worth, Texas 76114.
- B. Owner: Castleberry Independent School District.
- C. Architect: WRA Architects, Inc.: 12377 Merit Drive, Suite 1800, Dallas, Texas 75251.
- D. Architect's Consultants: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:
 - 1. Refer to Title Page.
- E. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.
 - 1. See Section 01 31 00 "Project Management and Coordination." for requirements for using web-based Project software.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:
 - 1. Three-story addition to the existing Castleberry High School campus. The new addition will include administration, science labs, CTE classrooms, and multipurpose spaces. There will be a new connector building to link the existing cafeteria/gym building to the older portion of the high school.
- B. Type of Contract:
 - 1. Project will be constructed under a single prime contract.

1.4 WORK PERFORMED BY OWNER

- A. Cooperate fully with Owner, so work may be carried out smoothly, without interfering with or delaying Work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.
- B. Concurrent Work: Owner will perform the following construction operations at Project site. Those operations will be conducted simultaneously with Work under this Contract.
 - 1. Telecommunications Equipment Installation Including Voice, Data, and Cable TV:
 - a. Infrastructure for these systems is a part of the Work of this contract as defined in the Contract Documents.
 - 2. Audio Visual Wiring and Equipment Installation:
 - a. Infrastructure for these systems is a part of the Work of this contract as defined in the Contract Documents.
 - 3. Installation of new Fixtures, Furniture, and Equipment (FF&E) that is not otherwise indicated as part of the scope of the construction contract.

1.5 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFICI) PRODUCTS

- A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:
 - 1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
 - 2. Provide for delivery of Owner-furnished products to Project site.
 - 3. Upon delivery, inspect, with Contractor present, delivered items.
 - a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.
 - 4. Obtain manufacturer's inspections, service, and warranties.
 - 5. Inform Contractor of earliest available delivery date for Owner-furnished products.
- B. Contractor's Responsibilities: The Work includes the following, as applicable:
 - 1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
 - 2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
 - 3. Receive, unload, handle, store, protect, and install Owner-furnished products.
 - 4. Make building services connections for Owner-furnished products.
 - 5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
 - 6. Repair or replace Owner-furnished products damaged following receipt.
- C. Owner-Furnished/Contractor-Installed (OFICI) Products:
 - 1. As scheduled.

1.6 OWNER-FURNISHED/OWNER-INSTALLED (OFOI) PRODUCTS

- A. The Owner will furnish and install products indicated.
- B. Owner-Furnished/Owner-Installed (OFOI) Products:
 - 1. As scheduled.

Castleberry ISD Projects Responsibility Matrix • Design, Furnish, and Install					
SYSTEM/COMPONENT	DESIGN BY	FURNISH / INSTALL			
		CONTRACTOR FURNISHED CONTRACTOR INSTALLED	OWNER FURNISHED CONTRACTOR INSTALLED	OWNER FURNISHED OWNER INSTALLED	CUSTOMERS RECEIVED
Administration Spaces					
	Admin				
	Ice/Water Dispenser	Owner			
	Coffee Maker	Owner			
	Printers & Copiers	Owner			
	Task Chairs	Owner			
	Computer Desk	Owner			
	Conference Tables	Owner			
	Tables & Chairs	Owner			
	Reception Desk	A/E			
	Casework	A/E			
	TV/Monitors	Owner			
	TV Credenza	Owner			
	ISS Tables & Chairs	Owner			
	Storage Casework	A/E			
	Clinic				
	Casework	A/E			
	Refrigerator	Owner			
	Undercounter Ice Maker (Nugget Ice)	Owner			
	Beds	Owner			
	Chairs	Owner			
	Clinic Office				
	Casework	A/E			
	Task Chair	Owner			
	Lounges Break Wellness Rooms				
	Undercounter Ice Maker (Nugget Ice)	Owner			
	French Door Refrigerator & Freezer	Owner			
	Garbage Disposal	A/E			
	Microwave	Owner			
	Coffee Maker	Owner			
	Dishwasher	Owner			
	Undercounter Refrigerator	Owner			
	Casework	A/E			
	Chairs	Owner			
	CTE Admin & Go Center				
	Furniture	Owner			
	Task Chairs	Owner			
	TV Credenza	Owner			
	Conference Table & Chairs	Owner			
	BenQ	Owner			
	TV/Monitor	Owner			
	Go Center Tables & Chairs	Owner			
	Connector & Collaboration Spaces				
	Chairs	Owner			
	Sofas	Owner			
	Tables	Owner			
	End Tables	Owner			
	Misc.				
	Magnetic Markerboards	A/E			
	Trackboards	A/E			
	Interior Signage	A/E			
	Trash Receptacles	Owner			
	Restroom Accessories	Owner			
	Free Standing Storage Racks	Owner			
	Misc. Furniture	Owner			
	Lockers	A/E			
	AED Cabinets	Owner			

Castleberry ISD Projects Responsibility Matrix - Design, Furnish, and Install					
SYSTEM/COMPONENT	DESIGN BY	FURNISH / INSTALL			
		CONTRACTOR FURNISHED CONTRACTOR INSTALLED	OWNER FURNISHED CONTRACTOR INSTALLED	OWNER FURNISHED OWNER INSTALLED	CUTSHEETS RECEIVED
AV & SOUND SYSTEM EQUIPMENT					
Cabling					
Video	EMA	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Audio	EMA	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Control	EMA	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Connection to Specialty Systems	EMA	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Patch Cords	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Termination Hardware					
Audio Outlets	EMA	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Electrical Outlets	EMA	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Equipment					
Speakers/Amp	EMA	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Conference Microphones	EMA	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Conference Camera	EMA	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lighting Controls	EMA	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Laptop Interface/Control System	EMA	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Wireless HDMI Connectivity	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Digital Signal Processor	EMA	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
AV Rack	EMA	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Television/Monitors	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Television Mounts	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Projector & Screen	EMA	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Audio Mixer	EMA	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Castleberry ISD Projects Responsibility Matrix - Design, Furnish, and Install						
SYSTEM/COMPONENT	DESIGN BY	Quantity:	FURNISH / INSTALL			
			CONTRACTOR FURNISHED CONTRACTOR INSTALLED	OWNER FURNISHED CONTRACTOR INSTALLED	OWNER FURNISHED OWNER INSTALLED	CUTSHEETS RECEIVED
CTE Spaces						
CTE Multipurpose						
CNC Machine	Owner	1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Pipe & Tube Cutter	Owner	1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Plasma Cutter	Owner	1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Air Compressor	Owner		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cord Reels	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Eye Wash	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PPE Storage	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Shelving	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Wood and Pipe Storage	Owner		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chemical/Flammable Storage Cabinets	Owner		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Horizontal Plywood Sheet Storage	A/E	2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Horizontal Dimensional Lumber Storage	A/E	1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vertical Lumber Storage	A/E	1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vertical Pipe Storage	A/E	3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Drill Press	Owner	2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Band Saw	Owner	2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Butcher Block Work Table & Stools	A/E	8	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Centralized Dust Collector	A/E	1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Portable Dust Collector	Owner	1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Plumbing/Arch & Eng/Elec Classroom						
Wood Top Makerspace Tables	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Makerspace Stools	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
BenQ	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Markerboards	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Teaching Desk	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Teacher Chair	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Document Storage Casework	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Arch Computer Lab						
Perimeter Casework	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Computer Style Tables	Owner	8	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Computer Style Chairs	Owner	29	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Plotter	Owner	1	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Computers & Monitors	Owner	29	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Tray Slot Casework	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Teaching Desk	Owner	1	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Teaching Chair	Owner	1	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
BenQ	Owner	1	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Markerboards	A/E	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Computer Science Lab + Workspace						
Computer Style Tables	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Computer Style Chairs	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Teacher Desk	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Teacher Chair	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
BenQ	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Markerboards	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Health Science Classroom						
Casework	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Student Tables	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Student Chairs	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Teacher Desk	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Teacher Chair	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
BenQ	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Markerboards	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Castleberry ISD Projects Responsibility Matrix - Design, Furnish, and Install					
SYSTEM/COMPONENT	DESIGN BY	FURNISH / INSTALL			
		CONTRACTOR FURNISHED CONTRACTOR INSTALLED	OWNER FURNISHED CONTRACTOR INSTALLED	OWNER FURNISHED OWNER INSTALLED	CUTSHEETS RECEIVED
CTE Spaces		Quantity:			
Health Science Lab					
Casework	A/E	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Refrigerator (Standard)	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Student Tables	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Student Chairs	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Teacher Desk	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Teacher Chair	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
BenQ	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Markerboards	A/E	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
TranStar Stretcher/Bed	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Supertek UV Cabinet (Sanitizer)	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Seca Weight Scale	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Rubber Glove Dispenser	Owner	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Simulation Headwall Package	Owner	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Teacher Desk	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Teacher Chair	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Hospitality					
Casework	A/E	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Student Tables	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Student Chairs	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Teacher Desk	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Teacher Chair	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
BenQ	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Markerboards	A/E	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Entrepreneurship Business					
Student Desks	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Student Chairs	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Teacher Desk	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Teacher Chair	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
BenQ	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Markerboards	A/E	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Education & Training					
Casework	A/E	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Student Desks	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Student Chairs	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Teacher Desk	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Teacher Chair	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
BenQ	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Markerboards	A/E	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Work-Based Learning					
Student Desks	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Student Chairs	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Teacher Desk	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Teacher Chair	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
BenQ	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Markerboards	A/E	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Spirit Store					
Casework	A/E	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Display Refrigerator	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Pegboard/Sideboard	A/E	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clothing Racks	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Tables	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Castleberry ISD Projects Responsibility Matrix - Design, Furnish, and Install							
SYSTEM/COMPONENT	DESIGN BY	FURNISH / INSTALL					
		CONTRACTOR FURNISHED CONTRACTOR INSTALLED	OWNER FURNISHED CONTRACTOR INSTALLED	OWNER FURNISHED OWNER INSTALLED	CUTSHEETS RECEIVED		
CTE Spaces	Shelving	Owner	Quantity:	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Castleberry ISD Projects Responsibility Matrix - Design, Furnish, and Install						
SYSTEM/COMPONENT	DESIGN BY	Quantity:	FURNISH / INSTALL			
			CONTRACTOR FURNISHED CONTRACTOR INSTALLED	OWNER FURNISHED CONTRACTOR INSTALLED	OWNER FURNISHED OWNER INSTALLED	CUTSHEETS RECEIVED
Fine Arts						
Band Hall						
Wenger Instrument Storage	A/E	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Wenger Music Library Storage	A/E	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Music Stands	Owner	1	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Student Chairs	Owner	2	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Copier	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Ice Machine (Cube Ice)	Owner	1	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Casework	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Markerboards	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BlackBox Theatre						
Curtain Rigging	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Theatrical Lighting	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stage Area	Owner	1	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Student Chairs	Owner	2	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Teacher Desk	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Teacher Chair	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
BenQ	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Markerboards	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Storage Cabinets	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Art Classrooms						
Casework	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BenQ	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Markerboards	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Kih	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Castleberry ISD Projects Responsibility Matrix - Design, Furnish, and Install						
SYSTEM/COMPONENT	DESIGN BY	Quantity:	FURNISH / INSTALL			
			CONTRACTOR FURNISHED CONTRACTOR INSTALLED	OWNER FURNISHED CONTRACTOR INSTALLED	OWNER FURNISHED OWNER INSTALLED	CUTSHEETS RECEIVED
Science Labs						
Science Labs						
Demonstration Desk	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Science Lab Tables & Chairs	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fume Hood	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Science Casework	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Goggle Cabinet	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fire Extinguisher	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
First Aid	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fire Blanket	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Shower/Eye Wash Station	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Markerboards	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BenQ	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Refrigerator (Standard)	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Dishwasher	Owner	4	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Flammable & Acid Storage Cabinets	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Teacher Desk	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Teacher Task Chair	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Castleberry ISD Projects Responsibility Matrix - Design, Furnish, and Install					
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		CONTRACTOR FURNISHED CONTRACTOR INSTALLED	OWNER FURNISHED CONTRACTOR INSTALLED	OWNER FURNISHED OWNER INSTALLED	CUTSHEETS RECEIVED
SECURITY/ACCESS CONTROL SYSTEM					
Cabling					
Access Control	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Panic Button	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Equipment					
Cameras/Housing/Mounts	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Card Readers	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Network Interface	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Access Control/Power Panels	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Housing and PTZ Power Panels	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Video Management	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
NVR Server	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
POE Network Switches	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Public Address (PA)	A/E	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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			CONTRACTOR FURNISHED CONTRACTOR INSTALLED	OWNER FURNISHED CONTRACTOR INSTALLED	OWNER FURNISHED OWNER INSTALLED	CUTSHEETS RECEIVED
SPED						
SPED						
Electric Range	Owner	2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Residential Range Hood	Owner	2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Dishwasher	Owner	1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Refrigerator (Standard)	Owner	2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Undercounter Ice Maker (Nugget Ice)	Owner	1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Washer & Dryer	Owner	1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Pantry Shelving/Casework	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Curtain and Curtain Rod (Calming Room)	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Adult Changing Table	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Portable Lift	Owner		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

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StormShelter Gym		Quantity:			
Training Room					
Training Bed	Owner	1	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Ice Machine (Cube Ice)	Owner	1	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Refrigerator (Standard)	Owner	1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Concessions					
Concessions Ice Machine (Nugget Ice)	Owner	1	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Concessions Display Refrigerators	Owner	1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Microwave	Owner	1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Gymnasium					
Scorer's Table	Owner	1	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Side/Ine Chairs	Owner	TBD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Volleyball Poles & Nets	Owner	2 sets	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Volleyball Official's Stand	Owner	2	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Side-Retracting Goal	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Main Goal on Stanchion	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Wall Pads	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Volleyball Sleeve	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Scoreboards	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Locker Rooms					
Shower Curtains and Rods	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Towel Hook	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lockers	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mirrors	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Benches	A/E		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Castleberry ISD Projects Responsibility Matrix - Design, Furnish, and Install					
SYSTEM/COMPONENT	DESIGN BY	FURNISH / INSTALL			
		CONTRACTOR FURNISHED CONTRACTOR INSTALLED	OWNER FURNISHED CONTRACTOR INSTALLED	OWNER FURNISHED OWNER INSTALLED	CUTSHEETS RECEIVED
TECHNOLOGY					
Pathways					
Backbone Conduit	A/E	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Horizontal Conduit	A/E	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Conduit to AV/Security Devices	A/E	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Back Boxes (AV and Security Included)	A/E	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Floor Cores	A/E	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Poke-thrus	A/E	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
J-hooks	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Fireslop	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cabling					
Backbone Fiber	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Horizontal Copper (Security Included)	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Horizontal Copper (CAT6A)	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Vape Sensors	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Termination Hardware					
Outlets / Jacks	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Fiber LIU	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Patch Cables	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Equipment					
Data Racks	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Power Distribution Units (PDU)	Owner	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Ground Bar	A/E	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rackmount UPS	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Network Switches	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Network PoE Switches	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Access Points	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Servers	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cable Managers	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
PCs / Laptops	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Printers / Copiers / Faxes	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Telephones	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Telephone System	A/E	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

1.7 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Unrestricted Use of Site: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- C. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.8 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy Project site and existing building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
 - 2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

1.9 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Coordinate with Owner on work days and hours, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
 - 1. Weekend Hours: Coordinate with Owner.
 - 2. Early Morning Hours: Coordinate with Owner.
 - 3. Work in Existing Building: Coordinate with Owner.
 - 4. Hours for Utility Shutdowns: Coordinate with Owner.
 - 5. Hours for Noisy Activities: Coordinate with Owner.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify Owner not less than two days in advance of proposed disruptive operations.
 - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Wind-Borne Dust Control
 - 1. Submit narrative that describes measures proposed for the control of wind-borne dust and debris during construction operations, including during periods of work activity and during non-working hours. Comply with the following:
 - a. Federal regulations including those of the Environmental Protection Agency.
 - b. City and county codes and regulations.
 - c. Utilize water trucks on site available throughout the day during site grading and excavation to keep soil damp enough to prevent PM10 levels raised by activities associated with project construction.
 - d. Wet down areas to be graded or that are being graded or excavated during late morning and after work is completed for the day.
- F. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet (8 m) of entrances, operable windows, or outdoor-air intakes.

- G. Smoking and Controlled Substance Restrictions: Use of tobacco products , alcoholic beverages, and other controlled substances on Project site and on Owner's property is not permitted.
- H. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- I. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
 - 1. Maintain list of approved screened personnel with Owner's representative.

1.10 WEATHER DAYS

- A. Weather days shall be defined as indicated in the Owner-Construction Manager Agreement, or if not otherwise defined, then as described in this Section as follows:
 - 1. The Contractor may be granted an extension of time because of abnormal inclement weather conditions. Contractor shall submit reports on monthly intervals indicating the rainfall and temperature on inclement weather days to document for each month the days in excess of normal inclement weather conditions that may contribute to future time extension requests.
 - a. Provide reports each month whether or not Contractor believes at that time that time extension will be necessary. In months not exceeding normal inclement weather days and for which additional time will not be requested, reports need not be provided.
 - b. Available float shall be used before any request is made for time extension due to inclement weather.
 - c. Provide daily jobsite reports noting weather conditions on the days identified to substantiate weather data provided by independent meteorological reports.
 - 2. All claims for additional time shall be limited to time extensions only. Claims for additional costs due to time extensions for weather shall not be considered.

1.11 LIQUIDATED DAMAGES

- A. As indicated in the Owner Contractor Contract.

1.12 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
 - 3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
 - 4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.
 - 1. For additional contracting requirements, refer to separate bid document provided by Contractor.
- C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - 2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings and published as part of the U.S. National CAD Standard.
 - 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 21 00

ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.
 - 2. Unit-cost allowances.

1.2 DEFINITIONS

- A. Allowance: A quantity of work or dollar amount included in the Contract, established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1.3 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

1.4 ACTION SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

1.5 INFORMATIONAL SUBMITTALS

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.6 LUMP-SUM ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.7 UNIT-COST ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.8 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, required maintenance materials, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
 - 3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit-cost allowances.
 - 4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs due to a change in the scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
 - 1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
 - 2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1: Unit-Cost Allowance: Include the sum for pier casings, as determined by Architect.
 - 1. This allowance includes material cost receiving, handling, and installation and Contractor overhead and profit.
- B. Allowance No. 2: Lump-Sum Allowance: Include sum of for vinyl wall graphics, as determined by Architect.
 - 1. This allowance includes material cost receiving, handling, and installation and Contractor overhead and profit.
- C. Allowance No. 3: Lump-Sum Allowance: Include the sum for theatrical curtain and rigging in the black box theater, as determined by Architect.
 - 1. This allowance includes material cost receiving, handling, and installation and Contractor overhead and profit.

END OF SECTION

SECTION 01 22 00

UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.

1.2 DEFINITIONS

- A. Unit price is an amount incorporated into the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.3 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the Part 3 "Schedule of Unit Prices" Article contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

- A. Unit Price No. 1 – Moisture Vapor Emission Control System: Refer to Section 09 05 61 “Common Work Results for Flooring Preparation”.
 - 1. Provide cost per square foot for complete system, including shot-blasting concrete substrate, application of penetrant, post-application moisture and alkalinity testing, application of cementitious underlayment, and manufacturer's 15-year warranty.
- B. Unit Price No. 2 – Drilled Piers:
 - 1. For actual depth versus anticipated depth indicated on Drawings.
 - 2. Cost of providing and placing casings is not included Base Contract.
 - 3. Reconciliation: Per pier diameter category for net add or deduct, not per individual pier.
 - 4. Diameter Categories: Refer to Structural Drawings.
 - 5. For each diameter category pier required, provide:
 - a. Unit price per additional lineal foot of completed pier.
 - b. Unit price per deleted lineal foot of completed pier. Unit price shall be no less than 75 percent of unit price for additional lineal foot.
- C. Unit Price No. 3 – Deletion of Casing: Base Bid price shall include casing of piers to a depth indicated in the Geotechnical Report. Provide Unit Price for deletion of steel casing in its entirety in the event casing of piers is not required:
 - 1. Include cost of providing and placing casings in Base Contract.
 - 2. Reconciliation: Per pier diameter category for net deduct per individual pier.

D. Unit Price No. 4 – Electrical Power: Provide unit prices for adding electrical power in the event that additional electrical power is determined to be required. Price assumes walls are not closed up and accessible for installation of conduit and boxes from at least one side and does not include any finishes/repair that may be required.

	<u>ADD</u>	<u>DEDUCT</u>
1. Add power outlet on nearby power circuit:	\$___/each	Not Applicable
2. Add dedicated power with home run to panel, on spare breaker:	\$___/each	Not Applicable

E. Unit Price No. 5: Reinforcing steel price per pound.

F. Unit Price No. 6: Concrete sidewalk and reinforcing per square foot.

G. Unit Price No. 7: 5-inch thick concrete pavement and reinforcing per square foot.

H. Unit Price No. 8: 6-inch thick concrete pavement and reinforcing per square foot.

I. Unit Price No. 9: 8-inch thick concrete pavement and reinforcing per square foot.

J. Unit Price No. 10: Rock excavation and haul off per cubic yard.

K. Unit Price No. 11: New topsoil installed per cubic yard.

L. Unit Price No. 12: Sod installation per square foot.

M. Unit Price No. 13: Cost per data drop.

N. Unit Price No. 14: Cost per each RF/Video drop.

O. Unit Price No. 15: Remedial floor coating per square foot.

P. Unit Price No. 16: Alternate flooring adhesive per square foot.

END OF SECTION

SECTION 01 23 00

ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.
- B. Execute accepted alternates under the same conditions as other Work of the Contract.
- C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate No. 1: Band Hall and Black Box Theater.
 - 1. Base Bid: Renovation of existing rubber gym and fine arts spaces for new band hall and black box theater.
 - 2. Deduct Alternate Bid: No renovations scope. Existing to remain.
- B. Alternate No. 2: Retaining Walls.
 - 1. Base Bid: Retaining walls and landscaping on the east façade of existing school buildings.
 - 2. Deduct Alternate Bid: No scope of work for retaining walls on the east side of existing school buildings.
- C. Alternate No. 3: Unit E.
 - 1. Base Bid: Existing to remain in Unit E.
 - 2. Add Alternate Bid: Renovation of the library and media center.
- D. Alternate No. 4: Façade Improvements.
 - 1. Base Bid: Façade improvements on Unit D and E.
 - 2. Deduct Alternate Bid: Remove façade improvements on cafeteria (Unit D), media center/rubber gym building (Unit E).
- E. Alternate No. 5: Renovation of 1958 Wing.
 - 1. Base Bid: No scope.
 - 2. Add Alternate Bid: Includes renovation of 1958 wing (Unit F).
- F. Alternate No. 6: Renovation of Child Nutrition and Classroom 528.
 - 1. Base Bid: No scope.
 - 2. Add Alternate Bid: Includes renovation of existing child nutrition and classroom 528 into the weight room (Unit D0).

- G. Alternate No. 7: Gym Flooring.
 - 1. Base Bid: Provide gym flooring and volleyball sleeves at storm shelter gymnasium as shown
 - 2. Deduct Alternate Bid: Remove gym flooring and volleyball sleeves at storm shelter from bid.
- H. Alternate No. 8: Retractable Bleachers.
 - 1. Base Bid: Provide retractable bleachers at storm shelter gymnasium.
 - 2. Deduct Alternate Bid: Retractable bleachers at unit B gymnasium at storm shelter to be removed from scope.
- I. Alternate No. 9: Data Cabling.
 - 1. Base Bid: Provide data cabling as part of base bid
 - 2. Deduct Alternate Bid: Remove data cabling from scope.
- J. Alternate No. 10: Catch Basins.
 - 1. Base Bid: No scope.
 - 2. Add Alternate Bid: Provide catch basins in the existing crawlspace of unit E level 0.5.

END OF SECTION

SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit documentation in PDF electronic format identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use form provided in Project Manual.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
 - 3. Any substitution request made that is not on required form, is not completely filled in, or does not provide required backup documentation will be rejected without review.

4. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven business days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 business days of receipt of request, or seven business days of receipt of additional information or documentation, whichever is later.
 - a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.
 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Substitution request is fully documented and properly submitted.
 - e. Requested substitution will not adversely affect Contractor's construction schedule.
 - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - g. Requested substitution is compatible with other portions of the Work.
 - h. Requested substitution has been coordinated with other portions of the Work.
 - i. Requested substitution provides specified warranty.
 - j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

Project Name: <input style="width: 95%;" type="text"/>	Date of Request: <input style="width: 95%;" type="text"/>
Architect: WRA Architects, Inc. 12377 Merit Drive, Suite 1800 Dallas, Texas 75251 214.750.0077 www.wraarchitects.com	Requesting Company: <input style="width: 95%;" type="text"/> Address: <input style="width: 95%;" type="text"/>
Spec. Section No: <input style="width: 95%;" type="text"/> Spec. Section Name: <input style="width: 95%;" type="text"/>	Contact Name: <input style="width: 95%;" type="text"/> Phone Number: <input style="width: 95%;" type="text"/> Email Address: <input style="width: 95%;" type="text"/>

Reason for Not Providing Specified Item:

History of Proposed Material: New Product 2-5 years old 5-10 years old More than 10 years old

Similar Installation - Project: Address: Architect:
Date Installed: Owner:

Savings to Owner for Accepting Substitution: (\$)
Proposed Substitution Changes in Contract Time: [+][-]() days

Please fill out information on BOTH the specified item AND the proposed substitution in order for the substitution request to be processed.

Specified Item

Proposed Substitution

Product Name: <input style="width: 95%;" type="text"/>	Product Name: <input style="width: 95%;" type="text"/>
Product Description: <input style="width: 95%; height: 30px;" type="text"/>	Product Description: <input style="width: 95%; height: 30px;" type="text"/>
Manufacturer: <input style="width: 95%;" type="text"/> Address: <input style="width: 95%;" type="text"/>	Manufacturer: <input style="width: 95%;" type="text"/> Address: <input style="width: 95%;" type="text"/>
Trade Name: <input style="width: 95%;" type="text"/>	Trade Name: <input style="width: 95%;" type="text"/>
Series or Line: <input style="width: 95%;" type="text"/>	Series or Line: <input style="width: 95%;" type="text"/>
Model No: <input style="width: 95%;" type="text"/>	Model No: <input style="width: 95%;" type="text"/>
Dimensions: <input style="width: 95%;" type="text"/>	Dimensions: <input style="width: 95%;" type="text"/>
Functional Clearances: <input style="width: 95%; height: 30px;" type="text"/>	Functional Clearances: <input style="width: 95%; height: 30px;" type="text"/>
Maintenance Info: <input style="width: 95%; height: 30px;" type="text"/>	Maintenance Info: <input style="width: 95%; height: 30px;" type="text"/>
Warranty Info: <input style="width: 95%; height: 30px;" type="text"/>	Warranty Info: <input style="width: 95%; height: 30px;" type="text"/>
Other Info: <input style="width: 95%; height: 30px;" type="text"/>	Other Info: <input style="width: 95%; height: 30px;" type="text"/>
Attached Data Sheet(s) for Side by Side Comparison: <input type="checkbox"/> Yes	Attached Data Sheet(s) for Side by Side Comparison: <input type="checkbox"/> Yes

A/E's Review and Action:

- Approved
- Approved as Noted
- Rejected - Use Specified Materials
- Incomplete Form - Use Specified materials

A/E Reviewer:

Signature:

Date of Response:

SECTION 01 26 00

CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710.

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Within 7 days after submittal of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - 2. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 3. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 4. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 5. Include costs of labor and supervision directly attributable to the change.
 - 6. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - 7. Comply with requirements in Section 01 25 00 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 - 8. Proposal Request Form: Use form acceptable to Architect.
- C. Do not proceed with changes until receipt of written approval by Architect and Owner.

1.4 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Section 01 21 00 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

- B. Unit-Price Adjustment: See Section 01 22 00 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 29 00

PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.3 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Owner's name.
 - c. Owner's Project number.
 - d. Name of Architect.
 - e. Architect's Project number.
 - f. Contractor's name and address.
 - g. Date of submittal.
 - 2. Arrange schedule of values consistent with format of AIA Document G703.
 - 3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
 - 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
 - 5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.

6. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
7. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
8. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
9. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.4 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
 1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.

4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Products list (preliminary if not final).
 5. Schedule of unit prices.
 6. Submittal schedule (preliminary if not final).
 7. List of Contractor's staff assignments.
 8. List of Contractor's principal consultants.
 9. Copies of building permits.
 10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 11. Initial progress report.
 12. Report of preconstruction conference.
 13. Certificates of insurance and insurance policies.
 14. Data needed to acquire Owner's insurance.
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 01 77 00 "Closeout Procedures."
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Certification of completion of final punch list items.
 3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 4. Updated final statement, accounting for final changes to the Contract Sum.
 5. AIA Document G706.
 6. AIA Document G706A.
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 9. Final liquidated damages settlement statement.
 10. Proof that taxes, fees, and similar obligations are paid.
 11. Waivers and releases.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 00

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
 - 1. Coordination drawings.
 - 2. RFIs.
 - 3. Digital project management procedures.
 - 4. Web-based Project management software package.
 - 5. Project meetings and conferences.
 - 6. Electrical boxes and data outlet coordination review.

1.2 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in Project meeting room, in temporary field office, in web-based Project software directory, and in prominent location in built facility. Keep list current at all times.

1.4 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's construction schedule.
 - 2. Preparation of the schedule of values.
 - 3. Installation and removal of temporary facilities and controls.
 - 4. Delivery and processing of submittals.
 - 5. Progress meetings.
 - 6. Preinstallation conferences.

7. Project closeout activities.
8. Startup and adjustment of systems.

1.5 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - c. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - e. Indicate required installation sequences.
 - f. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
 - g. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides the coordination of the information and resolution of conflicts between installed components before submitting to review.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
 1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 6. Refer to Division 23 Section – Basic Mechanical Materials and Methods and Division 26 Section – Basic Electrical Materials and Methods for specific Coordination Drawing requirements for mechanical and electrical installations.
 7. Mechanical and Plumbing Work: Work to be shown shall include, but not be limited to, the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 8. Electrical Work: Work to be shown shall include, but not be limited to, the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.

- c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 9. Fire-Protection System: Work to be shown shall include, but not be limited to, the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 10. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
 11. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 33 00 "Submittal Procedures."
 - C. Coordination Drawing Process: Prepare coordination drawings in the following manner:
 1. Schedule submittal and review of Fire Sprinkler, Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
 2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
 3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
 4. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
 5. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
 6. Communications and Electronic Safety and Security Installer will indicate cable trays and cabling runs and equipment in purple color. Communications and Electronic Safety and Security Installer shall forward completed drawing files to Contractor.
 7. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Architect to review and resolve conflicts on the coordination drawings.
 - D. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
 1. File Preparation Format:
 - a. Same digital data software program, version, and operating system as original Drawings.
 2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.
 3. BIM File Incorporation: Develop and incorporate coordination drawing files into BIM established for Project.
 - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
 4. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.
- 1.6 REQUEST FOR INFORMATION (RFI)
- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
 - B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 1. Project name.
 2. Owner name.

3. Owner's Project number.
 4. Name of Architect.
 5. Architect's Project number.
 6. Date.
 7. Name of Contractor.
 8. RFI number, numbered sequentially.
 9. RFI subject.
 10. Specification Section number and title and related paragraphs, as appropriate.
 11. Drawing number and detail references, as appropriate.
 12. Field dimensions and conditions, as appropriate.
 13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 14. Contractor's signature.
 15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
1. Attachments shall be electronic files in PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 26 00 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 5 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number, including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within three days if Contractor disagrees with response.
- 1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES
- A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model will be provided by Architect for Contractor's use during construction, .
1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.

2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
 3. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.
 - a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of Agreement acceptable to Owner and Architect .
 4. The following digital data files will be furnished for each appropriate discipline:
 - a. Floor plans.
 - b. Reflected ceiling plans.
- B. Web-Based Project Management Software Package: Use Architect's web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.
1. Architect's Software: Part 3.
- C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.8 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of seven days prior to meeting.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule and phasing.
 - c. Critical work sequencing and long lead items.
 - d. Designation of key personnel and their duties.
 - e. Lines of communications.
 - f. Use of web-based Project software.
 - g. Procedures for processing field decisions and Change Orders.
 - h. Procedures for RFIs.
 - i. Procedures for testing and inspecting.
 - j. Procedures for processing Applications for Payment.
 - k. Distribution of the Contract Documents.
 - l. Submittal procedures.
 - m. Preparation of Record Documents.
 - n. Use of the premises.
 - o. Work restrictions.
 - p. Working hours.
 - q. Owner's occupancy requirements.
 - r. Responsibility for temporary facilities and controls.
 - s. Procedures for moisture and mold control.

- t. Procedures for disruptions and shutdowns.
 - u. Construction waste management and recycling.
 - v. Parking availability.
 - w. Office, work, and storage areas.
 - x. Equipment deliveries and priorities.
 - y. First aid.
 - z. Security.
 - aa. Progress cleaning.
 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.
 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility requirements.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written instructions.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of Record Documents.

- b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Procedures for completing and archiving web-based Project software site data files.
 - d. Submittal of written warranties.
 - e. Requirements for preparing operations and maintenance data.
 - f. Requirements for delivery of material samples, attic stock, and spare parts.
 - g. Requirements for demonstration and training.
 - h. Preparation of Contractor's punch list.
 - i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - j. Submittal procedures.
 - k. Owner's partial occupancy requirements.
 - l. Installation of Owner's furniture, fixtures, and equipment.
 - m. Responsibility for removing temporary facilities and controls.
 - 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at weekly intervals.
- 1. Coordinate dates of meetings with preparation of payment requests.
 - 2. Attendees: In addition to representatives of Owner and Architect , each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site use.
 - 9) Temporary facilities and controls.
 - 10) Progress cleaning.
 - 11) Quality and work standards.
 - 12) Status of correction of deficient items.
 - 13) Field observations.
 - 14) Status of RFIs.
 - 15) Status of Proposal Requests.
 - 16) Pending changes.
 - 17) Status of Change Orders.
 - 18) Pending claims and disputes.
 - 19) Documentation of information for payment requests.
 - 20) Safety.
 - 21) Work hours.
 - 22) Review recording of changes on record field set.
 - 4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

1.9 ELECTRICAL BOXES COORDINATION REVIEW

- A. The purpose of the electrical box coordination review is to provide Owner's personnel a final review and confirmation of exact box locations to avoid conflicts with Owner's operational requirements and conflicts with other wall mounted items whether or not such items are indicated in the Drawings and Specifications. After installing the large majority or all wall boxes in and on walls, and prior to installing conduit and wiring or interior wall board, Contractor shall review all wall box locations with Owner's designated personnel to confirm box locations and to allow to make corrections before such corrections become more difficult or costly.
- B. Schedule and conduct a coordination review of all floor boxes and all wall-mounted electrical boxes including electrical power, lighting switches and controls, HVAC and other equipment and systems wall mounted controls, and other electrical systems. Electrical systems are intended to be comprehensive of wall box locations for all electrical systems.
- C. Owner and Contractor shall jointly review the location of each box. Contractor shall either note the use of each box or shall have personnel included in the review walk who are able to identify the use of each box upon Owner inquiry. Contractor shall have a set of current construction documents ready at hand for review. Any boxes not yet installed shall be visibly marked as to their locations and uses. Contractor shall record in Owner's presence the number of boxes requiring to be relocated that are not due to Contractor error and shall make necessary notes to ensure that all boxes indicated for relocation will be accurately relocated as required.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 32 00

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Contractor's Construction Schedule.
 - 2. Daily construction reports.
 - 3. Material location reports.
 - 4. Site condition reports.
 - 5. Unusual event reports.
 - 6. Submittals schedule.
 - 7. Construction schedule updating reports.
 - 8. As-Built documentation.
 - 9. Special reports.
 - 10. Construction photographs.

1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file.
 - 2. PDF file.
- B. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

- D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 - 1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
 - 3. Total Float Report: List of activities sorted in ascending order of total float.
 - 4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.
 - E. Construction Schedule Updating Reports: Submit with Applications for Payment.
 - F. Daily Construction Reports: Submit at weekly intervals.
 - G. Weekly Reports: Submit brief description of work achieved that week with four photos. Note weather Conditions.
 - H. Material Location Reports: Submit location report of materials stored off-site at monthly intervals.
 - I. Site Condition Reports: Submit at time of discovery of differing conditions.
 - J. Unusual Event Reports: Submit at time of unusual event.
 - K. Qualification Data: For scheduling consultant.
- 1.4 QUALITY ASSURANCE
- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:
 - 1. Review software limitations and content and format for reports.
 - 2. Verify availability of qualified personnel needed to develop and update schedule.
 - 3. Discuss constraints, including work stages.
 - 4. Review delivery dates for Owner-furnished products.
 - 5. Review schedule for work of Owner's separate contracts.
 - 6. Review submittal requirements and procedures.
 - 7. Review time required for review of submittals and resubmittals.
 - 8. Review requirements for tests and inspections by independent testing and inspecting agencies.
 - 9. Review time required for Project closeout and Owner startup procedures.
 - 10. Review and finalize list of construction activities to be included in schedule.
 - 11. Review procedures for updating schedule.
- 1.5 COORDINATION
- A. Coordinate Contractor's Construction Schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.
- 1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE
- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
 - B. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
 - C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.

2. Temporary Facilities: Indicate start and completion dates for the following as applicable:
 - a. Securing of approvals and permits required for performance of the Work.
 - b. Temporary facilities.
 - c. Construction of mock-ups, prototypes and samples.
 - d. Owner interfaces and furnishing of items.
 - e. Interfaces with Separate Contracts.
 - f. Regulatory agency approvals.
 - g. Punch list.
 3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 4. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 5. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 6. Commissioning Time: Include no fewer than 15 days for commissioning.
 7. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 8. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Use-of-premises restrictions.
 - e. Seasonal variations.
 - f. Environmental control.
 2. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Startup and placement into final use and operation.
 - m. Commissioning.
 3. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.
 - f. Substantial Completion.
- E. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
1. See Section 01 29 00 "Payment Procedures" for cost reporting and payment procedures.

- F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 - 1. Unresolved issues.
 - 2. Unanswered Requests for Information.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
 - 5. Pending modifications affecting the Work and the Contract Time.
- G. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
 - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 - 3. As the Work progresses, indicate Final Completion percentage for each activity.
- H. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- I. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.7 STARTUP CONSTRUCTION SCHEDULE

- A. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

1.8 CPM SCHEDULE REQUIREMENTS

- A. Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 14 days of date established for commencement of the Work. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.
 - 1. Develop network diagram in sufficient time to submit CPM schedule, so it can be accepted for use no later than 60 days after date established for commencement of the Work.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
 - 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 - 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 - 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
 - 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.

- d. Delivery.
- e. Fabrication.
- f. Utility interruptions.
- g. Installation.
- h. Work by Owner that may affect or be affected by Contractor's activities.
- i. Testing and inspection.
- j. Commissioning.
- k. Punch list and Final Completion.
- l. Activities occurring following Final Completion.
2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.
 - a. Each activity cost shall reflect an appropriate value subject to approval by Architect.
 - b. Total cost assigned to activities shall equal the total Contract Sum.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
 1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
 10. Dollar value of activity (coordinated with the schedule of values).
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.
- H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
 1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
 2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
 3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.

4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
 - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
 - b. Submit value summary printouts one week before each regularly scheduled progress meeting.

1.9 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Testing and inspection.
 8. Accidents.
 9. Meetings and significant decisions.
 10. Unusual events.
 11. Stoppages, delays, shortages, and losses.
 12. Meter readings and similar recordings.
 13. Emergency procedures.
 14. Orders and requests of authorities having jurisdiction.
 15. Change Orders received and implemented.
 16. Construction Change Directives received and implemented.
 17. Services connected and disconnected.
 18. Equipment or system tests and startups.
 19. Partial completions and occupancies.
 20. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
 1. Material stored prior to previous report and remaining in storage.
 2. Material stored prior to previous report and since removed from storage and installed.
 3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- D. As-Built Documentation: Contractor shall record changes to the Construction Documents where the constructed work deviates from that which is shown. This "As-Built" documentation shall be recorded in "Red" on a dedicated field set at the trailer.
- E. Special Reports:
 1. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.
 2. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable. Events include, but are not limited to:
 - a. Safety / injury events.
 - b. Security / theft / law enforcement events.
 - c. events involving news media coverage.

PART 2 - PRODUCTS

2.1 AS-BUILT DOCUMENTATION

- A. Contractor shall record changes to the Construction Documents where the constructed work deviates from that which is shown. This "As-Built" documentation shall be recorded in "Red" on a dedicated field set at the trailer.

2.2 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable. Events include, but are not limited to:
 - 1. Safety / injury events.
 - 2. Security / theft / law enforcement events.
 - 3. Events involving news media coverage.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 32 33

PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Concealed Work photographs.
 - 3. Periodic construction photographs.
 - 4. Final Completion construction photographs.

1.2 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph and video recording. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within three days of taking photographs.
 - 1. Submit photos by uploading to web-based Project management software site. Include copy of key plan indicating each photograph's location and direction.
 - 2. Identification: Provide the following information with each image description in file metadata tag:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date photograph was taken.
 - f. Description of location, vantage point, and direction.
 - g. Unique sequential identifier keyed to accompanying key plan.
- C. Video Recordings: Submit video recordings within seven days of recording.
 - 1. Submit video recordings by uploading to web-based Project management software site. Include copy of key plan indicating each video's location and direction.
 - 2. Identification: With each submittal, provide the following information in file metadata tag:
 - a. Name of Project.
 - b. Name and address of photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date video recording was recorded.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

1.3 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels, and with vibration-reduction technology. Use flash in low light levels or backlit conditions.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full high-definition mode with vibration-reduction technology. Provide supplemental lighting in low light levels or backlit conditions.
- C. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
- D. Metadata: Record accurate date and time and GPS location data from camera.
- E. File Names: Name media files with date and sequential numbering suffix.

1.4 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs with maximum depth of field and in focus.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- B. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
 - 1. Flag construction limits before taking construction photographs.
 - 2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
 - 3. Take 20 photographs of existing buildings either on or adjoining property, to accurately record physical conditions at start of construction.
 - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- C. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:
 - 1. Underground utilities.
 - 2. Underslab services.
 - 3. Piping.
 - 4. Electrical conduit.
 - 5. Waterproofing and weather-resistant barriers.
- D. Periodic Construction Photographs: Take 20 photographs monthly coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- E. Time-Lapse Sequence Construction Photographs: Take 20 photographs as indicated, to show status of construction and progress since last photographs were taken.
 - 1. Frequency: Take photographs monthly, on the same date each month.
 - 2. Vantage Points: Following suggestions by Architect and Contractor, photographer shall select vantage points. During each of the following construction phases, take not less than two of the required shots from same vantage point each time, to create a time-lapse sequence as follows:
 - a. Commencement of the Work, through completion of subgrade construction.
 - b. Above-grade structural framing.
 - c. Exterior building enclosure.
 - d. Interior Work, through date of Substantial Completion.
- F. Final Completion Construction Photographs: Take 20 photographs after date of Substantial Completion for submission as Project Record Documents. Architect will inform photographer of desired vantage points.
- G. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
 - 1. Three days' notice will be given, where feasible.
 - 2. In emergency situations, take additional photographs within 24 hours of request.
 - 3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Immediate follow-up when on-site events result in construction damage or losses.
 - b. Photographs shall be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
 - c. Substantial Completion of a major phase or component of the Work.
 - d. Extra record photographs at time of final acceptance.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Submittal schedule requirements.
 - 2. Administrative and procedural requirements for submittals.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
 - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 - 2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 - 3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
 - 4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's final release or approval.
 - g. Scheduled dates for purchasing.
 - h. Scheduled date of fabrication.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.4 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
 - 1. Project name.
 - 2. Date.
 - 3. Name of Architect.
 - 4. Name of Contractor.
 - 5. Name of firm or entity that prepared submittal.
 - 6. Names of subcontractor, manufacturer, and supplier.

7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
 8. Category and type of submittal.
 9. Submittal purpose and description.
 10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 11. Drawing number and detail references, as appropriate.
 12. Indication of full or partial submittal.
 13. Location(s) where product is to be installed, as appropriate.
 14. Other necessary identification.
 15. Remarks.
 16. Signature of transmitter.
- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 business days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow business days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 business days for initial review of each submittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 - 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 - 5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 - 2. BIM Incorporation: Develop and incorporate Shop Drawing files into BIM established for Project.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
 - 1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
 - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 - 3. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
 - 4. Paper Transmittal: Include paper transmittal, including complete submittal information indicated.

5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
 7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.

5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
 6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
 2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
 3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
 4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
 5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
 6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.
- 1.7 DELEGATED-DESIGN SERVICES
- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
 - B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
 - C. BIM Incorporation: Incorporate delegated-design drawing and data files into BIM established for Project.
 1. Prepare delegated-design drawings in the following format: Same digital data software program, version, and operating system as original Drawings.
- 1.8 CONTRACTOR'S REVIEW
- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

- B. Contractor's Approval: Indicate Contractor's approval for each submittal with indication in web-based Project management software. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 - 1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.
 - 1. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.
 - 2. Action Submittals: Architect will review each submittal, mark to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp, and mark the stamp appropriately to indicate the action taken, as follows:
 - a. Final Unrestricted Release: Where the submittal is marked "Approved," the Work covered by the submittal may proceed, provided it complies with the Contract Documents. Final acceptance will depend on that compliance.
 - b. Final-but-Restricted Release: Where the submittal is marked "Approved as Noted," the Work covered by the submittal may proceed, provided it complies both with Architect's notations and corrections on the submittal and the Contract Documents. Final acceptance will depend on that compliance.
 - c. Resubmit: Where the submittal is marked "Not Approved, Revise and Resubmit," do not proceed with the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity for the product submitted. Revise or prepare a new submittal according to Architect's notations and corrections.
 - d. Rejected: Where the submittal is marked "Not Approved, Resubmit" or "Rejected," do not proceed with the Work covered by the submittal. Prepare a new submittal for a product that complies with the Contract Documents.
 - e. Incomplete - Resubmit: Where the submittal is marked "Submit Additional Information," do not proceed with the Work covered by the submittal. Prepare additional information requested, or required by the Contract Documents, that indicates compliance with requirements, and resubmit.
 - f. Other Action: If the submittal is primarily for information purposes, record purposes, special processing, or other Contractor activity, the submittal will be returned marked "Action Not Required."
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 35 13.55

SPECIAL PROJECT PROCEDURES FOR STORM SHELTERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes special procedures for storm shelters.
- B. Related Sections include the following:
 - 1. Section 08 11 69 "Metal Storm Doors and Frames."
 - 2. Section 08 62 23.13 "Tubular Daylighting Devices for ICC 500 Tornado Shelter Compliance."
 - 3. Section 10 14 24 "Storm Shelter Signage."
 - 4. Section 10 43 17 "First Aid Kits."
 - 5. Roof drains.
 - 6. HVAC baffles and louvers.
 - 7. Roof hatch.

1.2 REFERENCES

- A. ICC/NSSA Standard for the Design and Construction of Storm Shelters.

1.3 CONTRACTOR'S WRITTEN STATEMENT OF RESPONSIBILITY

- A. From Paragraph 107.3.3 of the ICC/NSSA Standard for the Design and Construction of Storm Shelters: 107.3.3 Contractor responsibility. Each contractor responsible for the construction, fabrication or installation of a main windforce-resisting system or any component listed in the quality assurance plan shall submit a written statement of responsibility to the authority having jurisdiction, the responsible design professional and the owner prior to the commencement of work on the system or component. The contractor's statement of responsibility shall contain:
 - 1. Acknowledgement of awareness of the special requirements contained in the quality assurance plan.
 - 2. Acknowledgement that control will be exercised to obtain compliance with the construction documents.
 - 3. Procedures for exercising control within the contractor's organization, the method and frequency of reporting and the distribution of reports.
 - 4. Identification and qualifications of the person(s) exercising such control and their position(s) in the organization.Exception: Fabrication of storm shelter components that have been inspected and labeled by an approved agency as meeting the requirements of the applicable building code and this standard.

PART 2 - PRODUCTS

2.1 PRODUCTS, MATERIALS, AND ASSEMBLIES

- A. Refer to sections listed above under "Related Sections."

PART 3 - EXECUTION – NOT USED

END OF SECTION

SECTION 01 35 16

ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes special procedures for alteration work.

1.2 DEFINITIONS

- A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.
- B. Consolidate: To strengthen loose or deteriorated materials in place.
- C. Design Reference Sample: A sample that represents the Architect's prebid selection of work to be matched; it may be existing work or work specially produced for the Project.
- D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.
- E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.
- F. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.
- G. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.
- H. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.
- I. Retain: To keep an element or detail secure and intact.
- J. Strip: To remove existing finish down to base material unless otherwise indicated.

1.3 COORDINATION

- A. Alteration Work Subschedule: A construction schedule coordinating the sequencing and scheduling of alteration work for entire Project, including each activity to be performed, and based on Contractor's Construction Schedule. Secure time commitments for performing critical construction activities from separate entities responsible for alteration work.
 - 1. Schedule construction operations in sequence required to obtain best Work results.
 - 2. Coordinate sequence of alteration work activities to accommodate the following:
 - a. Owner's continuing occupancy of portions of existing building.
 - b. Other known work in progress.
 - c. Tests and inspections.
 - 3. Detail sequence of alteration work, with start and end dates.
 - 4. Utility Services: Indicate how long utility services will be interrupted. Coordinate shutoff, capping, and continuation of utility services.
 - 5. Use of elevator and stairs.
 - 6. Equipment Data: List gross loaded weight, axle-load distribution, and wheel-base dimension data for mobile and heavy equipment proposed for use in existing structure. Do not use such equipment without certification from Contractor's professional engineer that the structure can support the imposed loadings without damage.
- B. Pedestrian and Vehicular Circulation: Coordinate alteration work with circulation patterns within Project building(s) and site. Some work is near circulation patterns and adjacent to restricted areas. Circulation patterns cannot be closed off entirely and in places can be only temporarily redirected around small areas of work. Access to restricted areas may not be obstructed. Plan and execute the Work accordingly.

1.4 PROJECT MEETINGS FOR ALTERATION WORK

- A. Preliminary Conference for Alteration Work: Before starting alteration work, conduct conference at Project site.
1. Attendees: In addition to representatives of Owner, Architect, and Contractor, testing service representative, specialists, and chemical-cleaner manufacturer(s) shall be represented at the meeting.
 2. Agenda: Discuss items of significance that could affect progress of alteration work, including review of the following:
 - a. Alteration Work Subschedule: Discuss and finalize; verify availability of materials, specialists' personnel, equipment, and facilities needed to make progress and avoid delays.
 - b. Fire-prevention plan.
 - c. Governing regulations.
 - d. Areas where existing construction is to remain and the required protection.
 - e. Hauling routes.
 - f. Sequence of alteration work operations.
 - g. Storage, protection, and accounting for salvaged and specially fabricated items.
 - h. Existing conditions, staging, and structural loading limitations of areas where materials are stored.
 - i. Qualifications of personnel assigned to alteration work and assigned duties.
 - j. Requirements for extent and quality of work, tolerances, and required clearances.
 - k. Embedded work such as flashings and lintels, special details, collection of waste, protection of occupants and the public, and condition of other construction that affects the Work or will affect the work.
 3. Reporting: Record conference results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from conference.
- B. Coordination Meetings: Conduct coordination meetings specifically for alteration work at monthly intervals. Coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner, Architect, and Contractor, each specialist, supplier, installer, and other entity concerned with progress or involved in planning, coordination, or performance of alteration work activities shall be represented at these meetings. All participants at conference shall be familiar with Project and authorized to conclude matters relating to alteration work.
 2. Agenda: Review and correct or approve minutes of previous coordination meeting. Review other items of significance that could affect progress of alteration work. Include topics for discussion as appropriate to status of Project.
 - a. Alteration Work Subschedule: Review progress since last coordination meeting. Determine whether each schedule item is on time, ahead of schedule, or behind schedule. Determine how construction behind schedule will be expedited with retention of quality; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities are completed within the Contract Time.
 - b. Schedule Updating: Revise Contractor's Alteration Work Subschedule after each coordination meeting where revisions to schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each entity present, including review items listed in the "Preliminary Conference for Alteration Work" Paragraph in this article and the following:
 - 1) Interface requirements of alteration work with other Project Work.
 - 2) Status of submittals for alteration work.
 - 3) Access to alteration work locations.
 - 4) Effectiveness of fire-prevention plan.
 - 5) Quality and work standards of alteration work.
 - 6) Change Orders for alteration work.
 3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.5 INFORMATIONAL SUBMITTALS

- A. Alteration Work Subschedule:
 - 1. Submit alteration work subschedule within seven days of date established for commencement of alteration work.
- B. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements that are to remain, including finish surfaces, that might be misconstrued as damage caused by Contractor's alteration work operations.
- C. Alteration Work Program: Submit 30 days before work begins.
- D. Fire-Prevention Plan: Submit 30 days before work begins.

1.6 QUALITY ASSURANCE

- A. Specialist Qualifications: An experienced firm regularly engaged in specialty work similar in nature, materials, design, and extent to alteration work as specified in each Section and that has completed a minimum of five recent projects with a record of successful in-service performance that demonstrates the firm's qualifications to perform this work.
 - 1. Field Supervisor Qualifications: Full-time supervisors experienced in specialty work similar in nature, material, design, and extent to that indicated for this Project. Supervisors shall be on-site when specialty work begins and during its progress. Supervisors shall not be changed during Project except for causes beyond the control of the specialist firm.
- B. Alteration Work Program: Prepare a written plan for alteration work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project alteration work program with specific requirements of programs required in other alteration work Sections.
 - 1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.
 - 2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.
- C. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.
- D. Safety and Health Standard: Comply with ANSI/ASSP A10.6.

1.7 STORAGE AND HANDLING OF SALVAGED MATERIALS

- A. Salvaged Materials:
 - 1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.
 - 2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area on-site.
 - 5. Protect items from damage during transport and storage.
- B. Salvaged Materials for Reinstallation:
 - 1. Repair and clean items for reuse as indicated.
 - 2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.
 - 3. Protect items from damage during transport and storage.
 - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.
- C. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.

1.8 FIELD CONDITIONS

- A. Survey of Existing Conditions: Record existing conditions that affect the Work by use of preconstruction photographs.
 - 1. Comply with requirements specified in Section 01 32 33 "Photographic Documentation."
- B. Discrepancies: Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.
- C. Size Limitations in Existing Spaces: Materials, products, and equipment used for performing the Work and for transporting debris, materials, and products shall be of sizes that clear surfaces within existing spaces, areas, rooms, and openings, including temporary protection, by 12 inches (300 mm) or more.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 PROTECTION

- A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration work.
 - 1. Use only proven protection methods, appropriate to each area and surface being protected.
 - 2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
 - 3. Erect temporary barriers to form and maintain fire-egress routes.
 - 4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during alteration work.
 - 5. Contain dust and debris generated by alteration work, and prevent it from reaching the public or adjacent surfaces.
 - 6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
 - 7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
 - 8. Provide supplemental sound-control treatment to isolate demolition work from other areas of the building.
- B. Temporary Protection of Materials to Remain:
 - 1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
 - 2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.
- C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
- D. Utility and Communications Services:
 - 1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration work before commencing operations.
 - 2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration work.
 - 3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.
- E. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is functioning properly.
 - 1. Prevent solids such as adhesive or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from alteration work.
 - 2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.
- F. Existing Roofing: Prior to the start of work in an area, install roofing protection as required by OSHA.

3.2 PROTECTION FROM FIRE

- A. General: Follow fire-prevention plan and the following:

1. Comply with NFPA 241 requirements unless otherwise indicated. Perform duties titled "Owner's Responsibility for Fire Protection."
 2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.
 - a. If combustible material cannot be removed, provide fire blankets to cover such materials.
- B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:
1. Obtain Owner's approval for operations involving use of open-flame or welding or other high-heat equipment. Notify Owner at least 72 hours before each occurrence, indicating location of such work.
 2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
 3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
 4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
 5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
 6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:
 - a. Train each fire watch in the proper operation of fire-control equipment and alarms.
 - b. Prohibit fire-watch personnel from other work that would be a distraction from fire-watch duties.
 - c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.
 - d. Have fire-watch personnel perform final fire-safety inspection each day beginning no sooner than 30 minutes after conclusion of work to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
 - e. Maintain fire-watch personnel at Project site until two hours after conclusion of daily work.
- C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.
- D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.
 1. Remove temporary guards at the end of work shifts, whenever operations are paused, and when nearby work is complete.
- 3.3 PROTECTION DURING APPLICATION OF CHEMICALS
- A. Protect motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.
 - B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in alteration work program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.
 - C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.
 - D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.
 - E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

3.4 GENERAL ALTERATION WORK

- A. Have specialty work performed only by qualified specialists.
- B. Ensure that supervisory personnel are present when work begins and during its progress.
- C. Record existing work before each procedure (preconstruction), and record progress during the work. Use digital preconstruction documentation photographs. Comply with requirements in Section 01 32 33 "Photographic Documentation."
- D. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.
- E. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.
 - 1. Do not proceed with the work in question until directed by Architect.

END OF SECTION

SECTION 01 40 00

QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
 - 4. Additional requirements: Refer to Structural and Civil Drawings for additional testing and inspection requirements.

1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
 - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.
 - 1. Mockups are used for one or more of the following:
 - a. Verify selections made under Sample submittals.
 - b. Demonstrate aesthetic effects.
 - c. Demonstrate the qualities of products and workmanship.
 - d. Demonstrate successful installation of interfaces between components and systems.
 - e. Perform preconstruction testing to determine system performance.
 - 2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
 - 3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."
- I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.3 DELEGATED DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.4 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 ACTION SUBMITTALS

- A. Mockup Shop Drawings:
 - 1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
 - 2. Indicate manufacturer and model number of individual components.
 - 3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
 - 1. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.

4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

- F. Reports: Prepare and submit certified written reports and documents as specified.
- G. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of commencement of work, and not less than days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
 2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
 3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by Commissioning Authority.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
 2. Project title and number.
 3. Name, address, telephone number, and email address of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.

11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement of whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement of whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.

1.9 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
1. Requirements of authorities having jurisdiction supersede requirements for specialists.

- G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
1. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following Contractor's responsibilities, including the following:
1. Provide test specimens representative of proposed products and construction.
 2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 3. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 4. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
 5. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
 6. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups of size indicated.
 2. Build mockups in location indicated or, if not indicated, as directed by Architect.
 3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
 5. Demonstrate the proposed range of aesthetic effects and workmanship.
 6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.
 - a. Allow seven business days for initial review and each re-review of each mockup.
 7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
 8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 10. Demolish and remove mockups when directed unless otherwise indicated.
- L. Specialty Mockups: See Section 01 43 39 "Mockups" for additional construction requirements for integrated exterior mockups.

1.10 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
 - 2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
 - 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - 2. Engage a qualified testing agency to perform quality-control services.
 - a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 - 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
 - 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 - 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 - 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
 - 3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
 - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 - 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 - 6. Do not perform duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00 "Submittal Procedures."
- F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 - 1. Access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
 - 4. Facilities for storage and field curing of test samples.

5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspection equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.
1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
 2. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.
- 1.11 SPECIAL TESTS AND INSPECTIONS
- A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
 6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and authorities' having jurisdiction reference during normal working hours.
1. Submit log at Project closeout as part of Project Record Documents.
- C. Complete and submit other documentation and forms as may be required by Authorities Having Jurisdiction for final inspection and project acceptance.
1. Obtain approval of forms and signatures from Architect and/or Architect's Structural Engineer where required by Authorities Having Jurisdiction.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 00 "Execution."

- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 01 42 00

REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- A. "Day" as used in the Contract Documents means calendar day unless otherwise specifically defined.
- B. "Business Day" as used in the Contract Documents means Monday through Friday and specifically does not include Saturday, Sunday, or holidays.
- C. "Working Day" as used in the Contract Documents means Monday through Friday and specifically does not include Saturday, Sunday, or holidays.
- D. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- E. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- F. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- G. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- H. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- I. "Provide": Furnish and install, complete and ready for the intended use.
- J. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
 - 1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 43 39

MOCKUPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Exterior mockups.

1.2 DEFINITIONS

- A. Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements, consisting of multiple products, assemblies, and subassemblies.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, and installers of major systems whose Work is included in exterior mockups.
 - 2. Review coordination of equipment and furnishings provided by the Owner for room mockups.
 - 3. Review locations and extent of mockups.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: For exterior mockups.
 - 1. Include plans, elevations, sections, and mounting, attachment, and support details.
 - 2. Indicate manufacturer and model number of individual components, subassemblies, and assemblies.
 - 3. Include site location drawing indicating orientation of mockup.
- B. Delegated Design Submittal: For temporary structural supports for mockups not attached to building structure, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

- A. Build mockups to do the following:
 - 1. Verify selections made under Sample submittals.
 - 2. Demonstrate aesthetic effects.
 - 3. Demonstrate the qualities of products and workmanship.
 - 4. Demonstrate acceptable coordination between components and systems.
- B. Fabrication: Before fabricating or installing portions of the Work requiring mockups, build mockups for each form of construction and finish required. Use materials and installation methods as required for the Work.
 - 1. Build mockups of size indicated.
 - 2. Build mockups in location indicated or, if not indicated, as directed by Architect.
 - 3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
 - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 6. Demolish and remove mockups when directed unless otherwise indicated.
- C. Notifications:
 - 1. Notify Architect seven days in advance of the dates and times when mockups will be constructed.
 - 2. Allow seven days for initial review and each re-review of each mockup.
- D. Approval: Obtain Architect's approval of mockups before starting fabrication or construction of corresponding Work.
 - 1. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design support structure for free-standing mockups.
- B. Structural Performance:
 - 1. Wind Loads: As indicated on Drawings.

2.2 EXTERIOR MOCKUPS

- A. Construct exterior mockups according to approved mockup Shop Drawings. Construct mockups to demonstrate constructability, coordination of trades, and sequencing of Work; and to ensure materials, components, subassemblies, assemblies, and interfaces integrate into a system complying with indicated performance and aesthetic requirements.
- B. Design and construct foundation and superstructure to support free-standing exterior mockups.
- C. Build exterior mockups using installers and construction methods that will be used in completed construction.
- D. Use specified products that have been approved by Architect. Coordinate installation of materials and products specified in individual Specification Sections that include Work included in exterior mockups.
- E. The Work of exterior mockups includes, but is not limited to, the following:
 - 1. Masonry veneer.
 - 2. Metal composite material wall panels.
 - 3. Cold-formed metal framing and sheathing.
 - 4. Air and weather barriers.
 - 5. Thermal insulation.
 - 6. Through-wall flashing.
 - 7. Flashing and sheet metal trim.
 - 8. Joint sealants.
 - 9. Aluminum-framed entrances and storefront.
 - 10. Glazed curtain walls.
 - 11. Glazing.
- F. Photographic Documentation: Document construction of exterior mockups with photographs in accordance with Section 01 32 33 "Photographic Documentation." Provide photographs showing details of interface of different materials and assemblies.
- G. Provide and document modifications to construction details and interfaces between components and systems required to properly sequence the Work. Obtain Architect's approval for modifications.
- H. Retain approved mockups constructed in place. Incorporate fully into the Work.

PART 3 - EXECUTION

3.1 OTHER MOCKUPS

- A. In addition to previous items, construct field (project site) mockups and samples for review where indicated in individual specifications sections.

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.2 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Pay water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.
- E. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use with metering while new service is being installed. Provide connections and extensions of services and metering as required for construction operations.

1.3 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.
- C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- D. Erosion and Sedimentation Control Plan: Show compliance with requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- E. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- F. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
 - 1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
 - 2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
 - 3. Indicate methods to be used to avoid trapping water in finished work.
- G. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
 - 1. Locations of dust-control partitions at each phase of work.
 - 2. HVAC system isolation schematic drawing.
 - 3. Location of proposed air-filtration system discharge.
 - 4. Waste-handling procedures.
 - 5. Other dust-control measures.

- H. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by the Owner. Include the following:
1. Methods used to meet the goals and requirements of the Owner.
 2. Concrete cutting method(s) to be used.
 3. Location of construction devices on the site.
 4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
 5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with the Owner.
 6. Indicate locations of sensitive equipment areas or other areas requiring special attention as identified by Owner. Indicate means for complying with Owner's requirements.

1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines, Texas Accessibility Standards (TAS), and ICC/ANSI A117.1.

1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top rails.
- B. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain-link fence, sized to height of fence, in color selected by Architect from manufacturer's standard colors.
- C. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

- A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
1. Furniture required for Project-site documents, including file cabinets, plan tables, plan racks, and bookcases.
 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- (1.2-m-) square tack and marker boards.
 3. Drinking water and private toilet.
 4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F (20 to 22 deg C).
 5. Lighting fixtures capable of maintaining average illumination of 20 fc (215 lx) at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
 - 1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- F. Existing Electric Power Service: Connect to Owner's existing electric power service while new service is being installed. Maintain equipment in a condition acceptable to Owner.
- G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Install electric power service overhead unless otherwise indicated.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

- I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one land-based telephone line(s) for each field office.
 - 1. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Architect's office.
 - f. Engineers' offices.
 - g. Owner's office.
 - h. Principal subcontractors' field and home offices.
 - J. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.
 - 1. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions with wireless connectivity.
 - 2. Internet Service: Broadband modem, router, and ISP, equipped with hardware firewall, providing minimum 10.0 -Mbps upload and 15 -Mbps download speeds at each computer.
- 3.4 SUPPORT FACILITIES INSTALLATION
- A. Comply with the following:
 - 1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
 - 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
 - B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas as indicated on Drawings.
 - 1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
 - C. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
 - 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 - 2. Prepare subgrade and install subbase and base for temporary roads and paved areas in accordance with Refer to Civil Engineer's documents.
 - 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
 - 4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion.
 - D. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
 - E. Parking: Provide temporary offsite parking areas for construction personnel.
 - F. Storage and Staging: Use designated areas of Project site for storage and staging needs.
 - G. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.

- H. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 - 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 - 3. Maintain and touch up signs, so they are legible at all times.
- I. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 73 00 "Execution."
- J. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- K. Temporary Elevator Use: See Division 14 elevator Section for temporary use of new elevators.
- L. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- M. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
 - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
 - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
 - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - 4. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.
- G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.

- H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- J. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.
- K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
 - 1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
 - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 - 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 MOISTURE AND MOLD CONTROL

- A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed material from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.
 - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 - 2. Keep interior spaces reasonably clean and protected from water damage.
 - 3. Periodically collect and remove waste containing cellulose or other organic matter.
 - 4. Discard or replace water-damaged material.
 - 5. Do not install material that is wet.
 - 6. Discard and replace stored or installed material that begins to grow mold.
 - 7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
 - 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 - 2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.

3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00 "Closeout Procedures."

END OF SECTION

SECTION 01 56 39

TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

1.2 DEFINITIONS

- A. Caliper: Diameter of a trunk measured by a diameter tape or the average of the smallest and largest diameters at a height 6 inches (150 mm) above the ground for trees up to and including 4-inch (100-mm) size at this height and as measured at a height of 12 inches (300 mm) above the ground for trees larger than 4-inch (100-mm) size.
- B. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.
- C. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
 - a. Tree-service firm's personnel, and equipment needed to make progress and avoid delays.
 - b. Arborist's responsibilities.
 - c. Quality-control program.
 - d. Coordination of Work and equipment movement with the locations of protection zones.
 - e. Trenching by hand or with air spade within protection zones.
 - f. Field quality control.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and locations of protection-zone fencing and signage, showing relation of equipment-movement routes and material storage locations with protection zones.
 - 2. Detail fabrication and assembly of protection-zone fencing and signage.
 - 3. Indicate extent of trenching by hand or with air spade within protection zones.
- C. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.
 - 1. Species and size of tree.
 - 2. Location on site plan. Include unique identifier for each.
 - 3. Reason for pruning.
 - 4. Description of pruning to be performed.
 - 5. Description of maintenance following pruning.

1.5 INFORMATIONAL SUBMITTALS

- A. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
- B. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

- C. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
 - 1. Use sufficiently detailed photographs or video recordings.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.
 - D. Quality-control program.
- 1.6 QUALITY ASSURANCE
- A. Arborist Qualifications: Certified Arborist as certified by ISA.
 - B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.
 - C. Quality-Control Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work without damaging trees and plantings. Include dimensioned diagrams for placement of protection zone fencing and signage, the arborist's and tree-service firm's responsibilities, instructions given to workers on the use and care of protection zones, and enforcement of requirements for protection zones.
- 1.7 FIELD CONDITIONS
- A. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Moving or parking vehicles or equipment.
 - 3. Foot traffic.
 - 4. Erection of sheds or structures.
 - 5. Impoundment of water.
 - 6. Excavation or other digging unless otherwise indicated.
 - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
 - B. Do not direct vehicle or equipment exhaust toward protection zones.
 - C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
 - 1. Type: Shredded hardwood.
 - 2. Size Range: 3 inches (76 mm) maximum, 1/2 inch (13 mm) minimum.
 - 3. Color: Natural.
- B. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements: Previously used materials may be used when approved by Architect.
 - 1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2-inch (50-mm) opening, 0.148-inch- (3.76-mm-) diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch- (60-mm-) OD line posts, and 2-7/8-inch- (73-mm-) OD corner and pull posts; with 1-5/8-inch- (42-mm-) OD top rails and 0.177-inch- (4.5-mm-) diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
 - a. Height: 48 inches (1200 mm).
 - 2. Gates: Single- swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 24 inches (610 mm).
- C. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:
 - 1. Size and Text: As shown on Drawings.
 - 2. Lettering: 3-inch- (75-mm-) high minimum, white characters on red background.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- B. Prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

- A. Locate and clearly identify trees, shrubs, and other vegetation to remain. Flag each tree trunk at 54 inches (1372 mm) above the ground.
- B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
- C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated. Do not exceed indicated thickness of mulch.
 - 1. Apply 2-inch (50-mm) uniform thickness of organic mulch unless otherwise indicated. Do not place mulch within 6 inches (150 mm) of tree trunks.

3.3 PROTECTION ZONES

- A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people from easily entering protected areas except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
 - 1. Chain-Link Fencing: Install to comply with ASTM F567 and with manufacturer's written instructions.
 - 2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
 - 3. Access Gates: Install where indicated; adjust to operate smoothly, easily, and quietly; free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every 20 feet (6 m) on protection-zone fencing, but no fewer than four signs with each facing a different direction.
- C. Maintain protection zones free of weeds and trash.
- D. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.
 - 1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
 - 2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Civil Engineer's Documents unless otherwise indicated.
- B. Trenching within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots.

- C. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.5 ROOT PRUNING

- A. Prune tree roots that are affected by temporary and permanent construction. Prune roots as shown on Drawings and as follows:
 - 1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
 - 2. Cut Ends: Do not paint cut root ends.
 - 3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
 - 4. Cover exposed roots with burlap and water regularly.
 - 5. Backfill as soon as possible according to requirements in Civil Engineer's documents.
- B. Root Pruning at Edge of Protection Zone: Prune tree roots 12 inches (300 mm) outside of the protection zone by cleanly cutting all roots to the depth of the required excavation.
- C. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use narrow-tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.

3.6 CROWN PRUNING

- A. Prune branches that are affected by temporary and permanent construction. Prune branches as directed by arborist.
 - 1. Prune to remove only injured, broken, dying, or dead branches unless otherwise indicated. Do not prune for shape unless otherwise indicated.
 - 2. Do not remove or reduce living branches to compensate for root loss caused by damaging or cutting root system.
 - 3. Pruning Standards: Prune trees according to ANSI A300 (Part 1).
 - a. Type of Pruning: Cleaning where indicated.
- B. Unless otherwise directed by arborist and acceptable to Architect, do not cut tree leaders.
- C. Cut branches with sharp pruning instruments; do not break or chop.
- D. Do not paint or apply sealants to wounds.
- E. Provide subsequent maintenance pruning during Contract period as recommended by arborist.
- F. Chip removed branches and spread over areas identified by Architect.

3.7 FIELD QUALITY CONTROL

- A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.8 REPAIR AND REPLACEMENT

- A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Architect.
 - 1. Submit details of proposed pruning and repairs.
 - 2. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
 - 3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.
- B. Trees: Remove and replace trees indicated to remain that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.
 - 1. Small Trees: Provide new trees of same size and species as those being replaced for each tree that measures 6 inches (150 mm) or smaller in caliper size.

2. Large Trees: Provide one new tree(s) of 6-inch (150-mm) caliper size for each tree being replaced that measures more than 6 inches (150 mm) in caliper size.
 - a. Species: As selected by Architect.
 - C. Excess Mulch: Rake mulched area within protection zones, being careful not to injure roots. Rake to loosen and remove mulch that exceeds a 2-inch (50-mm) uniform thickness to remain.
 - D. Soil Aeration: Where directed by Architect, aerate surface soil compacted during construction. Aerate 10 feet (3 m) beyond drip line and no closer than 36 inches (900 mm) to tree trunk. Drill 2-inch- (50-mm-) diameter holes a minimum of 12 inches (300 mm) deep at 24 inches (600 mm) o.c. Backfill holes with an equal mix of augered soil and sand.
- 3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS
- A. Disposal: Remove excess excavated material, displaced trees, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION

SECTION 01 57 13

EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes providing temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction. Temporary measures include the following.
 - 1. Silt fences and straw bales.
 - 2. Sediment barriers and check dams.
 - 3. Stabilized construction entrance.
 - 4. Construction of temporary swales and sedimentation basins as required.
 - 5. Seeding, sodding, and hydromulching.
- B. Comply with all local, state, and federal regulations regarding erosion control including the applicable provisions of the National Pollution Discharge Elimination System (NPDES) regulations from the Federal Clean Water Act.
- C. Should any provisions of this section be at variance with erosion control plan prepared by the civil engineer, the civil engineer's directive shall take precedence.

1.2 NOTICE OF INTENT

- A. Contractor and Owner shall jointly submit an EPA Notice of Intent (NOI) prior to construction.
- B. Contractor shall prepare the report, coordinate with Owner, and file in accordance with regulations.

PART 2 - PRODUCTS

2.1 SILT FENCE

- A. Filter Fabric: Non-woven polypropylene, polyethylene or polyamide thermoplastic fibers with non-raveling edges. The fabric shall be non-biodegradable, inert to most soil chemicals, ultraviolet resistant, unaffected by moisture or other weather conditions, and permeable to water while retaining sediment. The filter fabric shall be supplied in rolls a minimum of 36 inches wide.
 - 1. Basis-of-Design Product: Lundin "Silt Buster," Mirafi "Envirofence" or acceptable substitution.
- B. Wire Fence Support: Welded wire fabric 2 inches by 4 inches - W1.0 by W1.0.
- C. Fence Posts: Painted or galvanized steel Tee or Y-posts with anchor plates, not less than 5 feet in length with a minimum weight of 1.3 pounds per foot. Hangers shall be adequate to secure fence and fabric to posts. Posts and anchor plates shall conform to ASTM A-702.

2.2 STRAW BALES

- A. Standard rectangular hay bales bound by baling wire.

2.3 SEDIMENT TRAPS

- A. Standard manufacture designed to fit the intended inlet.

2.4 STABILIZED CONSTRUCTION ENTRANCE

- A. Aggregate: Graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448 and TEX 401-A coarse-aggregate; with 0 percent being retained by a 5-inch sieve and 100 percent being retained by a 3-inch sieve.

2.5 GRASS

- A. Materials and seeding and sodding shall conform to applicable Division 32 section.

2.6 FERTILIZER

- A. Use commercial grade fertilizers to insure germination and growth. Analysis by weight shall be 16-4-8 or 15-5-10 for Nitrogen, Phosphoric Acid and Potash.

2.7 WATER

- A. Use clean potable water for maintaining the grass.

PART 3 - EXECUTION

3.1 GENERAL

- A. Keep disturbed areas to a minimum required to adequately perform the work. At all times maintain the site in such a manner that minimizes erosion of the site. The execution of work under this section shall be in conformance with the NPDES rulings and the site Storm Water Pollution Prevention Plan.

3.2 SILT FENCES

- A. Silt fence shall be a minimum of 24 inches (0.6 meter) high. Posts shall be embedded a minimum of 12 inches in the ground, placed a maximum of 8 feet apart and set on a slight angle toward the anticipated runoff source.
 - 1. When directed by the Engineer or designated representative, posts shall be set at specified intervals to support concentrated loads.
- B. Securely attach filter fabric to posts and wire support fence, with the bottom 12 inches of filter fabric buried in a trench a minimum of 6 inches deep and 6 inches (150 mm) wide to prevent sediment from passing under the fence.
 - 1. When silt fence is constructed on impervious material, a 12-inch flap of fabric shall be extended upstream from the bottom of the silt fence and weighted to limit particulate loss.
 - 2. No horizontal joints will be allowed in the filter fabric.
 - 3. Vertical joints shall be overlapped a minimum of 12 inches with the ends sewn or otherwise securely tied.
- C. Silt fence shall be maintained for the duration of the project, and repaired, replaced, and/or relocated when necessary or as directed by the Engineer or designated representative. Accumulated silt shall be removed when it reaches a depth of 6 inches.

3.3 EROSION CONTROL BARRIERS

- A. Provide erosion control barriers at intervals along swales and ditches as shown on the Drawings or as necessary to meet the requirements of the Storm Water Pollution Prevention Plan.
- B. Barriers: Silt fence or hay bales placed as indicated on the Drawings.
- C. Maintain barriers in good working condition and replace when damaged.

3.4 STABILIZED CONSTRUCTION ENTRANCE

- A. Remove trees, brush, stumps, obstructions, and other objectionable material and disposed of in a manner that will not interfere with the excavation, grading, and construction of the entrance as indicated on the Drawings.
 - 1. Stabilized construction entrance shall not drain onto the public right-of-way and shall not allow surface water runoff to exit the construction site.
 - 2. When necessary, vehicle wheels shall be cleaned to remove sediment prior to entrance onto public right of way.
 - a. When vehicle washing is required, it shall be done on an area stabilized with crushed stone, which drains into an approved sediment trap or sediment basin.
 - 3. Sediment shall be prevented from entering any storm drain, ditch or watercourse through use of sand bags, gravel, boards, silt fence or other methods approved by the Engineer or designated representative.
- B. The entrance shall be maintained in a condition that will prevent tracking or disposition of sediment onto public right of way. Provide periodic top dressing with additional stone as conditions demand, as well as the repair and/or cleanout of any measures used to trap sediment. Sediment that is spilled, dropped, washed, or tracked onto public right-of-way shall be removed immediately.

3.5 TEMPORARY AND PERMANENT SWALES

A. Description:

1. Provide temporary and permanent drainage swales as required to carry drainage away from the work area to an approved outfall point.
2. Unless otherwise shown on the drawings, swales shall be earthen "V" shaped channels graded to a sufficient depth and slope to carry the anticipated runoff, but at least 2 feet deep with a slope of 0.1 percent.
3. Swales not designated to remain in place at the completion of the contract shall be cleaned of any muck, debris and other unsuitable material and filled with approved fill before final grading operations begin.
4. Swales shall have erosion control barriers as required.
5. All permanent swales shall be sodded to a minimum width of 10 feet on either side of the centerline of the swale.

B. Maintenance:

1. During the course of construction maintain temporary swales constructed for this contract so as to allow proper drainage from the construction area. Before Contractor leaves the site at the end of construction, place temporary swales to remain in good working condition.
2. Work with other contractors at the site in maintaining existing swales and ditches.
3. Where necessary for access to the work areas, install adequately sized culverts and maintain to provide the access without disturbing the site drainage.
4. Take care not to rut and damage sodded swales. Immediately repair damaged swales.
5. Keep sodded swales mowed.

3.6 DRAINAGE DITCHES

- A. Immediately hydromulch drainage ditches upon final grading.
- B. Repair erosion of the banks of the drainage ditches immediately and re-stabilize.
- C. Place sediment barriers at intervals along the ditch as shown on the plans or as necessary to help trap sediment on the site. Daily remove sediment and other debris trapped by the barriers.
- D. Maximum Ditch Side Slopes: 3 feet horizontal to 1 foot vertical.
- E. Maintenance of the ditches during construction shall include but not be limited to mowing, re-grading, sediment removal, re-hydromulching, bank repair and debris removal.
- F. Sediment removed from the ditches may be respread on the site as directed by the Owner.

3.7 FILL AND CUT SLOPES

- A. Fill slopes in all cases shall be no steeper than 3:1 unless specifically stated on the plans or approved by the Owner's soils engineer.
- B. When cut slopes exceed 2:1 for depths over 3 feet, proper bracing and shoring per OSHA requirements shall be used and maintained.
- C. For permanent slopes, cut or fill, between 2:1 and 10:1, erosion protection shall be provided with hydromulching, sodding, seeding, or other method as approved.

3.8 SEDIMENTATION BASINS

A. Description:

1. Provide sedimentation ponds where indicated.
2. Route drainage from cleared areas through the sedimentation basin.
3. Operate and maintain the pond during construction.

B. Maintenance:

1. Maintain the pond and the outfall and sediment retarding structure in good working condition throughout the time the pond is to be in operation.
2. When sediment and debris fill the pond to over one third (1/3) its designed capacity, clean out the pond.
3. Stockpile, in its' own separate area, the sediment from the clearing operation, or remove from the site, as required. Make adequate drainage provisions such that drainage from the sediment stockpile drains back into the sediment pond. When approved by the Owner, sediment removed from the pond may be spread over the site.

3.9 SEEDING

- A. Seed disturbed portions of the site and stockpile areas within 14 days if the phasing of the construction operations are anticipated to leave those portions of the areas unworked for 21 days or more.
- B. Maintain seeded areas until the project is accepted by the Owner. Maintain by watering, fertilizing, reseeding, mowing and erosion repair as may be required. Cut grass when the average height of the grass reaches 6 inches. Clippings may be mulched back into the seeded areas.

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
 - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
 - 1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.
- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.
- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
 - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
 - 2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 01 33 00 "Submittal Procedures."
- F. Substitution: Refer to Section 01 25 00 "Substitution Procedures" for definition and limitations on substitutions.

1.3 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
 - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.
 - 3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.4 COORDINATION

- A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.
- C. Storage:
 - 1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
 - 2. Store products to allow for inspection and measurement of quantity or counting of units.
 - 3. Store materials in a manner that will not endanger Project structure.
 - 4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
 - 5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 - 6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 7. Protect stored products from damage and liquids from freezing.
 - 8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
 - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 77 00 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected," Architect will make selection.
 - 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Product Selection Procedures:
 - 1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
 - 2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
 - 3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
 - a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
 - 4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
 - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.

5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
 - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
 6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
 - a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
 7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 01 25 00 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 25 00 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:
1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.
- B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 01 33 00 "Submittal Procedures."
1. Form of Approval of Submittal: As specified in Section 01 33 00 "Submittal Procedures."
 2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

- C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 73 00

EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Owner-installed products.
 - 5. Cutting and patching.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
 - 9. Correction of the Work.

1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 PREINSTALLATION MEETINGS

- A. Cutting and Patching Conference: Conduct conference at Project site.
 - 1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:
 - a. Contractor's superintendent.
 - b. Trade supervisor responsible for cutting operations.
 - c. Trade supervisor(s) responsible for patching of each type of substrate.
 - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.
 - 2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- B. Layout Conference: Conduct conference at Project site.
 - 1. Prior to establishing layout of new perimeter and structural column grid(s), review building location requirements. Review benchmark, control point, and layout and dimension requirements. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with Project layout to attend, including the following:
 - a. Contractor's superintendent.
 - b. Professional surveyor responsible for performing Project surveying and layout.
 - c. Professional surveyor responsible for performing site survey serving as basis for Project design.
 - 2. Review meanings and intent of dimensions, notes, terms, graphic symbols, and other layout information indicated on the Drawings.
 - 3. Review requirements for including layouts on Shop Drawings and other submittals.
 - 4. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Certified Surveys: Submit two copies signed by land surveyor.

- C. Certificates: Submit certificate signed by land surveyor, certifying that location and elevation of improvements comply with requirements.
- D. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 - 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 - 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 - 4. Dates: Indicate when cutting and patching will be performed.
- E. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.5 CLOSEOUT SUBMITTALS

- A. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.6 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 - 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - 1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
 - 2. List of detrimental conditions, including substrates.
 - 3. List of unacceptable installation tolerances.
 - 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 01 31 00 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.
- B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices:
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.

4. Inform installers of lines and levels to which they must comply.
 5. Check the location, level and plumb, of every major element as the Work progresses.
 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb, and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.6 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.7 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

- E. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
 - 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 - 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- G. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.8 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 50 00 "Temporary Facilities and Controls."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.11 CORRECTION OF THE WORK

- A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Restore permanent facilities used during construction to their specified condition.
- D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

SECTION 01 77 00

CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.

1.2 DEFINITIONS

- A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest-control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.6 QUALITY CONTROL

- A. Closeout Conference: Schedule and conduct a closeout conference to be held one to three months prior to the anticipated date of Substantial Completion. Required attendees include Contractor's on-site personnel and Project Manager, Architect, and designated Owner's representative(s). Discuss any items that could impede progress to scheduled date of Substantial Completion, closeout procedures, and the following:
 - 1. Any pending or anticipated time extension requests that may affect the projected date of Substantial Completion.
 - 2. Progress or scheduled progress of Contractor's preparation of project record documents.
 - 3. current status of Contractor's As-Built documents, and plans to address any deficiencies/
 - 4. Required Owner training, and process for scheduling training with Owner's staff.
 - 5. Required submittals to Architect prior to requesting inspection for Substantial Completion, including the Substantial Completion Readiness Checklist.
 - 6. Requirements for testing and balancing and for submitting Test / Adjust / Balance reports.
 - 7. Commissioning.
 - 8. Maximum time allowed between Substantial and Final Completion, and Contractor's plan to ensure that all incomplete work is completed on schedule.
 - 9. Written action plans required to address deficiencies (if any).
- B. Contractor shall record Closeout Conference minutes, including all Contractor's action items, and distribute to attendees within one week. Contractor shall attach plans to address deficiencies for any items identified in the Closeout Conference that require a written action plan.

1.7 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.
 - 5. Submit testing, adjusting, and balancing records.
 - 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 3. Complete startup and testing of systems and equipment.
 - 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 - 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01 79 00 "Demonstration and Training."
 - 6. Advise Owner of changeover in utility services.
 - 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 - 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 - 9. Complete final cleaning requirements.
 - 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
 - 1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 - 2. Results of completed inspection will form the basis of requirements for Final Completion.

1.8 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
 - 1. Submit a final Application for Payment in accordance with Section 01 29 00 "Payment Procedures."

2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report.
 5. Submit Final Completion photographic documentation.
 6. Submit final test/adjust/balance report, prior to or concurrent with application for final payment.
 - a. A final report with all deficiencies addressed shall be submitted concurrent with or prior to application for final payment.
 - b. If the time of project completion does not allow for the opposite season test adjust and balance to have been performed, then Contractor shall submit the report for the current season and shall also submit by or before the application for final payment evidence that the opposite season report has been scheduled, as well as the anticipated date of delivery of the opposite season report to Owner, signed by the test and balance company.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.9 LIST OF INCOMPLETE ITEMS (PUNCHLIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
 2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in the following format:
 - a. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

1.10 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize entire collection of approved warranty documents into an orderly sequence based on the Table of Contents of Project Manual, with tabs between CSI division sections; i.e.; group all Division-7 building components under one tab, group all Division-8 components under another tab, etc. Utilize CSI specification sections 2 through 33 for each division tab. Provide three copies of each Final Warranty binder.
1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binder, thickness as necessary to accommodate contents, and sized to receive 8-1/2 by 11-inch paper.
 2. Provide Title Page, Contractor's general One-Year Warranty (corrective period) with agreed upon date and signature of authorized representative, Table of Contents, and subcontractor list at the beginning of each binder.

3. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 4. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
 5. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked Table of Contents at beginning of document.
- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
1. Submit by uploading to web-based project software site.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
 - i. Vacuum and mop concrete.
 - j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - l. Remove labels that are not permanent.
 - m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

- p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
 - r. Clean strainers.
 - s. Leave Project clean and ready for occupancy.
 - C. Pest Control: Comply with pest control requirements in Section 01 50 00 "Temporary Facilities and Controls." Prepare written report.
 - D. Construction Waste Disposal: Comply with waste-disposal requirements in Section 01 50 00 "Temporary Facilities and Controls."
- 3.2 REPAIR OF THE WORK
 - A. Complete repair and restoration operations required by Section 01 73 00 "Execution" before requesting inspection for determination of Substantial Completion.
 - B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction specified condition.
 - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

END OF SECTION

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.

1.2 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.3 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit by uploading to web-based project software site. Enable reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.
- E. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.4 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.5 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for Architect.
 - 7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 - 8. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 - 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.6 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
 - 1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
 - 2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
 - 3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.7 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
 - 1. Type of emergency.
 - 2. Emergency instructions.
 - 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 - 1. Fire.
 - 2. Flood.
 - 3. Gas leak.
 - 4. Water leak.
 - 5. Power failure.

6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.
- 1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS
- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- D. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original project record documents as part of maintenance manuals.

1.10 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.

1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set(s) of marked-up record prints.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.
- E. Reports: Submit written report indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.3 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.

- I. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
 - B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
 1. Format: Same digital data software program, version, and operating system as for the original Contract Drawings.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect for resolution.
 - C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.
- 1.4 RECORD SPECIFICATIONS
- A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
 5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.
 - B. Format: Submit record specifications as annotated PDF electronic file.
- 1.5 RECORD PRODUCT DATA
- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.
- C. Format: Submit Record Product Data as annotated PDF electronic file.
 - 1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.6 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file.
 - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.7 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 79 00

DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 - 2. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Attendance Record: For each training module, submit list of participants and length of instruction time.
- C. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.3 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date of video recording.
 - 2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
 - 3. At completion of training, submit complete training manual(s) for Owner's use prepared in same PDF file format required for operation and maintenance manuals specified in Section 01 78 23 "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.
- D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.
 - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.

3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.6 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.
 - f. Identification systems.
 - g. Warranties and bonds.
 - h. Maintenance service agreements and similar continuing commitments.
 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.

5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

1.7 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 1. Owner will furnish an instructor to describe Owner's operational philosophy.
 2. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 1. Schedule training with Owner, through Architect, with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.9 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 1. At beginning of each training module, record each chart containing learning objective and lesson outline.

- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode.
 - 1. Submit video recordings on CD-ROM or thumb drive.
 - 2. File Hierarchy: Organize folder structure and file locations according to Project Manual table of contents. Provide complete screen-based menu.
 - 3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
 - 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged according to Project Manual table of contents:
 - a. Name of Contractor/Installer.
 - b. Business address.
 - c. Business phone number.
 - d. Point of contact.
 - e. Email address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
 - 1. Film training session(s) in segments not to exceed 15 minutes.
 - a. Produce segments to present a single significant piece of equipment per segment.
 - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
 - 1. Furnish additional portable lighting as required.
- E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.
- F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 91 00

BUILDING SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Commissioning this project shall include MEP systems installation and operations. The commissioning process shall generally follow the ASHRAE Guideline 0 and ASHRAE Std 90.1 I-P. Commissioning for this project shall be as necessary for full compliance with 2021 IECC commissioning requirements.
- B. Commissioning Agent (CA): The owner will engage the CA under separate contract.
- C. Mechanical and plumbing commissioning shall be done by the registered design professional or approved agency.
- D. For electrical commissioning, the registered design professional shall provide evidence that the system is operating in accordance with the construction documents.
- E. Commissioning: Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent and the owner's operational requirements. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:
 - 1. Observe and document equipment and systems installations and operations.
 - 2. Observe and document proper performance of equipment and systems per the construction documents.
 - 3. Review systems manual and closeout documentation.
- F. The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product, equipment, or system.
- G. Abbreviations: The following are common abbreviations used in the specifications and in the Commissioning Plan.

A/E	Architect & Design Engineers	FT	Functional Performance Test
CA/CxA	Commissioning Agent	GC	General Contractor
CC	Construction Manager	MC	Mechanical Contractor
Cx	Commissioning	PC	Project Checklist
CxP	Commissioning Plan	Subs	Sub Contractors
EC	Electrical Contractor	MC	Mechanical Contractor
PLC	Plumbing Contractor	TAB	Test And Balance Contractor
FC	Fire Alarm Contractor	SC	Security Contractor
CTC	Controls Contractor	TC	Technology Contractor

- H. Divisional specifications sections related to commissioning activities are as follows:
 - 1. Division 01 - General Requirements
 - 2. Division 22 - Plumbing
 - 3. Division 23 - HVAC&R
 - 4. Division 26 - Electrical

1.2 COORDINATION

- A. Commissioning Team: The members of the commissioning team consist of the Commissioning Agent (CA), the General Contractor (GC or Contractor), the architect and design engineers (particularly the mechanical engineer), the Mechanical Contractor (MC), the Electrical Contractor (EC), the TAB representative, the Controls Contractor (CC), any other installing subcontractors or suppliers of

equipment. If known, the Owner's building or plant operator/engineer is also a member of the commissioning team.

- B. Management: The CA will report directly to the Owner for commissioning related functions and copy the Architect and Contractor as required. The CA directs and coordinates the commissioning activities and reports with the CM and PM. All team members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents.
- C. Scheduling: The CA will work with the CM and GC according to established protocols to schedule the commissioning activities. The CM will notify the CA as to the readiness of systems and equipment for functional testing. The CA will provide sufficient notice to the CM and GC for scheduling commissioning activities for such equipment and systems upon notification from the CM that said systems will be ready for testing and or commissioning. The GC will integrate all commissioning activities into the master project schedule and will provide a copy of the schedule, including all updates, to the CA for his use in commissioning this project. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process. It is understood that the progress for commissioning of systems will be dependent upon the progress of the following:
 - 1. Response Times: Timelines for delivering information requested, required, or providing responses to the CA are essential to providing the construction product to the owner on time as well as facilitating the commissioning process. The contractor shall adhere to the following to meet this objective:
 - a. Written response to Issue Log, Punchlist, Site Observation report, or request for information, clarification, or other documentation necessary to facilitate and carry out the commissioning process: 07 Calendar days from the date request was received by contractor in writing.
 - b. Discrepancies identified in record drawings during the construction phase: 15 calendar days.

1.3 COMMISSIONING PROCESS

- A. Commissioning Plan: The Commissioning Plan provides guidance in the execution of the commissioning process. The CA will update the plan which is then considered the "final" plan, though it will continue to evolve and expand and be updated on a regular basis for content by the CA as the project progresses. The Specifications will take precedence over the Commissioning Plan.
- B. Commissioning Process: The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur.
- C. Equipment documentation is submitted to the CA during normal submittals and concurrent with the design team submittal submission, including detailed start-up procedures.
- D. In general, the check-out and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels with CHECKLISTS being completed before functional testing.
- E. The Subs, under their own direction, execute and document the CHECKLISTS and perform start-up and initial check-out.
- F. The checklist procedures are executed by the contractor responsible for their respective systems and under their respective scope of work. An example of a coordinated procedure would be an AHU that requires Electrical, FA Duct Smoke Detector, DDC Controls, and a VFD for operation. This would require a signature from the Mechanical, Electrical, Fire Alarm, Controls contractor, and TAB sub.
- G. Functional Testing of the MEP SYSTEMS shall be scheduled by the CA and GC and shall be conducted by the appropriate sub-contractor. The CA will direct the testing and sub-contractor will carry out the test.
- H. Items of non-compliance in material, installation, or setup are corrected and the system is to be retested at the contractor's expense.
- I. The CA reviews the O&M documentation for completeness.
- J. Commissioning is completed before Substantial Completion.
- K. Deferred or seasonal testing is to be conducted as specified and as required.

1.4 RESPONSIBILITIES

- A. Commissioning Team: The responsibilities of various parties in the commissioning process are provided in this section and are typically referenced as follows: Division 01 - General Requirements, Division 22 - Plumbing, Division 23 - HVAC & R, and 26 - Electrical. It is noted that the services for the Owner's Project Manager, Construction Manager, Architect, MEP, Special systems design consultants, and Commissioning Agent are not provided for in this contract. That is, the Contractor is not responsible for providing their services except where stated in other divisional specs sections. Their responsibilities are listed here to clarify the commissioning process.
1. The commissioning team, at a minimum, shall consist of the following:
 - a. Owner
 - b. Commissioning Authority
 - c. Architect
 - d. Design Engineer
 - e. Prime Contractor
 - f. Divisional Contractors and Subcontractors
 - g. Vendors or Factory reps where required by the divisional specs
- B. All Parties
1. Follow the Commissioning Plan and specifications.
 2. Attend commissioning scoping meetings and commissioning meetings as necessary.
 3. Assist the CA in carrying out commissioning process activities.
- C. Architect (A/E)
1. Construction and Acceptance Phase
 - a. Owner Manages the CA contract.
 - b. Attend the commissioning scoping meeting and selected commissioning team meetings.
 - c. Perform normal submittal review, construction observation, as-built drawing preparation, O&M manual preparation, etc., as contracted. Provide submittals for MEP the CA concurrent with the design consultant's submittal review.
 - d. Provide all design narrative documentation and updates as requested by the CA for systems to be commissioned.
 - e. Coordinate resolution of system and component deficiencies identified during commissioning activities.
 - f. Copy the CA on all responses to RFI/RFC/Revisions as issued by the design team related to systems being commissioned.
 - g. Furnish a copy of all construction documents, addenda, change orders, RFI's, ASI's, and approved submittals and shop drawings related to commissioned equipment to the CA.
 - h. Review and approve O&M documentation.
 - i. Warranty Period: Coordinate resolution of design non-conformance issues, design deficiencies, and contractor related deficiencies identified during warranty-period commissioning.
- D. MEP & Special Systems Designers/Engineers (of the A/E)
1. Construction and Acceptance Phase
 - a. Perform normal submittal review, construction observation, as-built drawing preparation, etc., as contracted. Conduct site observations as contracted and required by the owner and A/E.
 - b. Provide an updated design narrative and sequences documentation requested by the CA for functional testing of MEP systems. The designers shall assist (along with the contractors) in clarifying the operation and control of commissioned MEP equipment in areas where the specifications, control drawings, or equipment documentation is not sufficient for writing detailed testing procedures.
 - c. Attend commissioning scoping meetings and other selected commissioning team meetings.
 - d. Participate in the resolution of system deficiencies identified during commissioning, according to the contract documents.
 - e. Prepare and submit the final as-built design intent and operating parameters documentation. Review and approve the O&M manuals.
 - f. Review, comment and approve the functional test procedures for sufficiency prior to their use.

- g. Utilizing the sampling method, review and provide comments and recommendations for the checklists for major pieces of equipment for sufficiency prior to their use.
 - h. Warranty Period: Participate in the resolution of non-compliance, non-conformance, and design deficiencies identified during warranty-period commissioning.
- E. Commissioning Agent (CA)
- 1. Construction and Acceptance Phase
 - a. The CA is not responsible for design concepts, design criteria, compliance with codes and industry design standards, design or general construction scheduling, cost estimating, test and balance, or construction management. The CA may assist with issue resolution for non-conformance or deficiencies, but ultimately that responsibility resides with the general contractor and the A/E. The primary function of the CA is to develop and coordinate the execution of a testing plan, observe and document and verify using sampling techniques that systems are functioning in accordance with the documented OPR and the Construction Documents. The Contractors will provide all of their own tools to install, start, check out, and functionally test equipment and systems.
 - b. Coordinates and directs the commissioning activities in a logical, sequential, and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules, and technical expertise.
 - c. Coordinate the commissioning work and, with the GC and CM, ensure that commissioning activities are being scheduled into the master project schedule.
 - d. Revise the Commissioning Plan during the construction phase as necessary.
 - e. Request and review information required to perform commissioning tasks, including O&M materials, contractor start-up, and check-out procedures as necessary.
 - f. Before start-up, gather and review the current control sequences and interlocks and work with contractors and design engineers until sufficient clarity has been obtained, in writing, to be able to write testing procedures as necessary.
 - g. Write and distribute systems functional performance Test requirements.
 - h. Attend selected planning and job-site meetings to obtain information on construction progress. Review construction meeting minutes for revisions and substitutions relating to the Commissioning process. Assist in resolving discrepancies.
 - i. Perform site observations as necessary to observe component and system installations for testing of systems.
 - j. Oversee sufficient functional testing of the control system.
 - k. With assistance from installing contractors and A/E, write the functional performance test procedures for equipment and systems. This may include energy management control system trending or manual functional testing.
 - l. Analyze any functional performance trend logs and monitoring data as required to verify performance.
 - m. Coordinate, witness, and approve manual functional performance tests performed by installing contractors. Coordinate retesting with the GC and A/E as necessary or required.
 - n. Maintain a master issue and resolution log and a separate testing record. Provide the owner and CM/GC with periodic written progress reports and test results with recommended actions.
 - o. Witness performance testing of control systems and document these tests and include this documentation in Commissioning Record in O&M manuals.
 - p. Compile and maintain a commissioning record and review building systems manual.
 - q. Review and approve the preparation of the O&M manuals.
 - r. Provide a final commissioning report.
 - s. Warranty Period: Coordinate and supervise required seasonal or deferred testing and deficiency corrections.
- F. Owner's Manager (PM)
- 1. Construction and Acceptance Phase
 - 2. Assist the CA as necessary to carry out commissioning activities.
 - 3. Manage the contract of the CA, A/E, and GC.
 - 4. Arrange for facility operating and maintenance personnel to attend various field commissioning activities and field training sessions.
 - 5. Provide final approval for the completion of the commissioning work.

6. Warranty Period: Ensure that any seasonal or deferred testing and any deficiency issues are addressed or that a plan is in place to address issues pending resolution.
- G. General Contractor (GC)
1. Contractor and their subcontractors and vendors shall assign capable, skilled, and knowledgeable representatives with expertise and authority to act on their behalf and schedule them to participate in and perform commissioning process activities.
 2. Construction and Acceptance Phase
 - a. Facilitate the coordination of the commissioning work by the CA and ensure that commissioning activities are being addressed in the master construction project schedule.
 - b. Include the cost of commissioning tasks to be carried out by the contractor and subs, for commissioning of the building systems in the contract price. This will not include the CA's contract. The CA's contract for commissioning services shall be between the owner and CA.
 - c. In each purchase order or subcontract written, include requirements for submittal data, O&M data, commissioning tasks, and training.
 - d. Ensure that all Subs execute their commissioning responsibilities according to the Contract Documents and schedule.
 - e. A representative shall attend a commissioning scoping meeting and other necessary meetings scheduled by the CA to facilitate the Cx process.
 - f. Coordinate and conduct owner training on building and systems operation for equipment provided and installed.
 - g. Prepare close-out documents including O&M documents, according to the Contract Documents, including clarifying and updating the original control sequences of operation and As-built drawings.
 - h. Warranty Period: Ensure that Subs execute seasonal or deferred functional performance testing, to be witnessed by the CA, according to the specifications.
 - i. Ensure that Subs correct deficiencies and make necessary adjustments to O&M manuals and final as-built drawings and warranty documents for applicable issues identified in any seasonal and deferred testing.
- H. Equipment Suppliers
1. Construction and Acceptance Phase
 - a. Provide all requested submittal data, including detailed start-up procedures, blank start-up docs and checklists, and specific responsibilities of the Owner to keep warranties in force.
 - b. Assist in equipment start-up, energizing, and pre-testing per agreements with Subs.
 - c. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid price to the Contractor, except for stand-alone data logging equipment that may be used by the CA. Such tools not required for routine maintenance, operation, and service and not required to be turned over to the owner under other divisional spec sections, shall be returned to the user providing such tools. Examples of this intent would be a flow hood used by the TAB contractor would be returned and remain the property of the TAB contractor whereas a special key for unlocking the chiller control cabinet would be turned over to the owner.
 - d. Provide information requested by CA regarding equipment sequence of operation and testing procedures.
 - e. Review system start-up and test procedures for equipment installed by factory representatives.
- I. Mechanical Contractor
1. Provide start-up for all HVAC equipment.
 2. Assist and cooperate with the TAB contractor and CA by:
 - a. Putting all HVAC equipment and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.
 - b. Including cost of sheaves and belts that may be required by TAB.
 - c. Providing test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing. Provide an approved rubber or steel plug to seal traverse holes.
 - d. Providing temperature and pressure taps according to the Construction Documents for TAB and commissioning testing.

3. Install a P/T plug at each water sensor which is an input point to the control system and both inlet and discharge side of ALL pumps for TAB.
 4. List and clearly identify on the as-built drawings the locations of all air-flow stations.
 5. Notify the GC or CA depending on protocol, when pipe and duct system testing, flushing, cleaning, start-up of each piece of equipment, and TAB will occur. Be responsible to notify the GC or CA, ahead of time, when commissioning activities not yet performed or not yet scheduled could delay construction. Be proactive in seeing that commissioning processes are executed and that the CA has the scheduling information needed to efficiently execute the commissioning process.
- J. Controls Contractor
1. Sequences of Operation Submittals: The Controls Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications or drawings. The engineer shall be provided written documentation for any revisions to the HVAC&R design documents including engineered approved control sequences. Upon review of the DDC control submittals, the engineer shall provide his approval or rejection in writing to the controls contractor. The Controls Contractor's submittals of control drawings shall include:
 - a. An overview narrative of the system (1 or 2 paragraphs) generally describing its purpose, components, and function.
 - b. All interactions and interlocks with other systems.
 - c. Detailed delineation of control between any packaged controls and the building automation system, listing what points the BAS monitors only and what BAS points are control points and are adjustable.
 - d. Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included but will generally require additional narrative).
 - e. Start-up sequences.
 - f. Warm-up mode and Optimum Start sequences.
 - g. Normal operating mode sequences.
 - h. Unoccupied mode sequences.
 - i. Shutdown sequences.
 - j. Capacity control sequences and equipment staging.
 - k. Temperature and pressure control: setbacks, setups, resets, etc.
 - l. Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
 - m. Effects of power or equipment failure with all standby components including HVAC and Emergency powered systems with VFD's and responses (Restart, Alarm, etc.).
 - n. Sequences for all alarms and emergency shutdowns.
 - o. Seasonal operational differences and recommendations.
 - p. Initial and recommended values for all adjustable settings, set points parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
 - q. Schedules, if known and provided by owner.
 - r. All sequences shall be written in small statements, each with a number for reference. For a given system, numbers will not repeat for different sequence sections, unless the sections are numbered.
 2. Control Drawings Submittal
 - a. The control drawings shall have a key and legend for all abbreviations and symbols.
 - b. The control drawings shall contain graphic schematic depictions of the systems and each component.
 - c. The schematics will include the system and component layout of any equipment that the control system monitors, enables, or controls, even if the equipment is primarily controlled by packaged or integral controls.
 - d. Provide a full points list with at least the following included for each point:
 - 1) Controlled system Point abbreviation
 - 2) Point description
 - 3) Display unit
 - 4) Control point or set point (Yes / No)
 - 5) Monitoring point (Yes / No)

- 6) Intermediate point (Yes / No)
 - 7) Calculated point (Yes / No)
 - (a) Key:
 - (1) Point Description: DB temp, airflow, etc.
 - (2) Control or Setpoint: Point that controls equipment and can have its set points changed (OSA, SAT, etc.)
 - (3) Intermediate Point: A Point whose value is used to make a calculation which then controls equipment (space temperatures that are averaged to a virtual point to control reset).
 - (4) Monitoring Point: A Point that does not control or contribute to the control of equipment; but is used for the operations, maintenance, or performance verification.
 - (5) Calculated Point: "Virtual" point generated from calculations of other point values. The Controls Contractor shall keep the CA informed of all changes to this list during programming and setup in all phases of the project.
 3. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls O&M manual submittal.
 4. Assist, coordinate, and cooperate with the TAB contractor in the following manner:
 - a. Meet with the TAB contractor prior to beginning TAB work and review the TAB plan to determine the capabilities of the control system toward completing TAB. Provide the TAB any needed unique instruments for setting terminal unit boxes and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.).
 - b. For a given area, have all required checklists, calibrations, start-up, and selected Pre-commissioning documentation of the system available during TAB activities.
 - c. Provide a qualified technician to operate the controls, to assist the TAB contractor in performing TAB work, during scheduled TAB activities. Remote operation of control system, during scheduled TAB and Functional Testing, will not be acceptable. The Controls contractor may provide training to the TAB technician for inputting data into the control software and logic. However, the controls contractor shall be ultimately responsible for entering and saving the data, provided by the TAB contractor, into the control system.
 5. Assist and cooperate with the CA in the following manner:
 - a. Execute the functional testing of the controls system as specified for the controls contractor in Controls Specification Section.
 - b. Assist in the functional testing of all equipment specified.
 - c. Execute all control system trend logs specified.
 6. Provide a signed and dated certification to the CA and GC upon completion of the check-out of each controlled device, equipment, and system prior to TAB and functional testing. This shall be for each piece of equipment or system, Confirmation that all system programming, installation of control components, debugging, pre-testing, checkout is complete, and the control system is made fully operational as to all respects of the Contract Documents. This shall be completed prior to any TAB work or functional testing of the building systems under DDC control.
 7. Beyond the control points necessary to execute all documented control sequences provide monitoring, control, and virtual points.
 8. List and clearly identify on the as-built duct and piping drawings the locations of ALL: static and differential pressure sensors (air, water, and building pressure), hydronic control valves/actuators, electrical control relays for lighting, and control boards.
 9. The Controls Contractor shall be responsible for Pre-commissioning of all control systems and components provided and installed by the controls contractor. See other sections of this specification and divisional specifications for training requirements. During TAB and functional testing, the controls contractor shall produce, at the request of the engineer or commissioning authority, graphic screenshots of the building systems operation as indicated on the building controls graphics.
- K. Test and Balance Contractor (TAB)
1. Prior to starting TAB, submit to the CA and GC, the lead TAB technicians contact information.
 2. Submit the outline of the TAB plan, to the CA, GC, and Controls Contractor prior to starting the TAB. The TAB contractor will be provided with a set of final approved mechanical and HVAC&R control submittals by the GC, 60 calendar days prior to beginning TAB activities.
 3. The submitted TAB plan may include:

- a. Certification that the TAB contractor has reviewed the construction documents and the systems with the design engineers and contractors to sufficiently understand the design intent for each system.
 - b. An explanation of the intended use of the building control system. The controls contractor will comment on feasibility of the plan.
 - c. All field check-out sheets and logs to be used that list each piece of equipment to be tested, adjusted, and balanced with the data cells to be gathered for each.
 - d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - e. Final test report forms to be used.
 - f. Detailed step-by-step procedures for TAB work for each system and issue.
 - g. Terminal flow calibration (for each terminal type), diffuser proportioning, branch and submain proportioning, total flow calculations, rechecking, diversity issues, expected problems and solutions, etc. Criteria for using air flow straighteners or relocating flow stations and sensors will be discussed. Provide analogous explanations for the waterside.
 - h. List of all airflow, water flow, sound level, system capacity, and efficiency measurements to be performed and a description of specific test procedures, parameters, and formulas to be used.
 - i. Details of how total flow will be determined (Air: sum of terminal flows via BAS calibrated readings or via hood readings of all terminals, supply (SA), and return air (RA) pitot traverse, SA or RA flow stations. Water: pump curves, circuit setter, flow station, ultrasonic, etc.).
 - j. The identification and types of measurement instruments to be used and their most recent calibration date.
 - k. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and provide methods to verify this.
 - l. Confirmation that TAB understands the outside air ventilation criteria under all operational conditions.
 - m. Details of whether and how minimum outside air CFM will be verified and set and for what level (total building, zone, etc.).
 - n. Details of how building static and exhaust fan/relief damper capacity will be checked.
 - o. Proposed selection points for sound measurements and sound measurement methods.
 - p. Details of methods for making any specified coil or other system plant capacity measurements.
 - q. Details of any TAB work to be done in phases (by floor, etc.), or of areas to be built out later.
 - r. Details regarding specified deferred or seasonal TAB work.
 - s. Details of any specified false loading of systems to complete TAB work.
 - t. Details of all exhaust fan balancing and capacity verifications, including any required room pressure differentials.
 - u. Details of any required interstitial cavity differential pressure measurements and calculations.
 - v. Plan for hand-written field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests, and lists of completed tests (scope and frequency).
 - w. Plan for formal progress reports (scope and frequency).
 - x. Plan for formal deficiency reports (scope, frequency, and distribution).
4. A running log of events and issues shall be kept by the TAB field technicians. Submit hand-written reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests, and lists of completed TAB work. All issues found during daily TAB activities shall be provided to the GC on-site and prior to leaving the job site for the day.
 5. Communicate in writing to the controls contractor all set point and parameter changes made or problems and discrepancies identified during TAB which affect the control system setup and operation.
 6. Provide a draft TAB report within five calendar days of starting Functional Testing of the HVAC & R systems. Field notes that are legible shall be allowed to be submitted in place of a full draft TAB report.
 7. Provide the CA with requested system data findings, gathered or collected during TAB work, but not shown on the TAB reports.
 8. Provide a final and complete TAB report for the CA and A/E within 15 calendar days from end of TAB work and as requested by the CA. Punch list items or issues discovered during scheduled TAB activities, reported to the GC for correction by the GC's subs or vendors, which cause delay in the TAB contractor's ability to complete his work on time per the project schedule, will have the additional time required to complete the TAB work, charged to the GC who may choose to back

- charge his/her subs. Charges shall be on a Time and Material basis and shall be documented with a line item breakdown for Manpower, time, systems TAB'd, and date of work. Such documentation shall be made available for review by the GC and A/E, prior to any approval by the GC.
9. Assist the CA as needed and required to carry out all HVAC & R functional testing. Conduct functional performance tests and checks on the original TAB as specified for TAB in Division 23 and controls specification section. Make follow-up visits to the site as necessary and required to correct any work deficiencies or variances to contract documents made by the TAB technician.
- L. Electrical Contractor
1. Include the cost of commissioning by the electrical sub in the contract price.
 2. Include requirements for submittal data, O&M data, and owner training.
 3. Attend a commissioning scoping meeting and other necessary meetings scheduled by the CA to facilitate the Cx process.
 4. Contractor shall provide normal cut sheets and shop drawing submittals to the CA of electrical systems to be commissioned.
 5. Provide requested electrical systems documentation to the CA when requested by the CA, for development of functional testing procedures.
 - a. Typically, this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, fan and pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation and check-out materials that are actually shipped inside the equipment and the actual field check-out sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent.
 - b. The Commissioning Agent may request further documentation necessary for the commissioning process.
 - c. This data request may be made prior to or post normal submittals.
 6. Provide a copy of the electrical systems O&M manuals submittals of commissioned equipment, through normal channels, to the CA.
 7. Contractors shall assist (along with the design engineers) in clarifying the operation and control of electrical commissioned equipment in areas where the specifications, control drawings, or equipment documentation is not sufficient for writing detailed electrical testing procedures.
 8. Provide assistance to the CA in developing and conducting all CA directed electrical testing. Subs shall review all test procedures to ensure feasibility, safety, and equipment protection and provide necessary written alarm limits to be used during the tests.
 9. In a clear and legible format, document all completed installation, start-up, and system operational check-out procedures, providing a copy to the A/E and CA.
 10. Address current A/E punch list and Cx Issues Log items before final payment is released.
 11. Provide skilled technicians to execute energizing and starting of electrical equipment and to execute all required electrical tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments, and issue resolution.
 12. Perform functional performance testing under the direction of the CA or A/E for specified electrical equipment tests. Assist the CA in interpreting any monitoring data, as necessary.
 13. Correct deficiencies (differences between specified and observed performance) as interpreted by the CA, GC, and A/E and retest the equipment.
 14. Prepare O&M manuals and red-line as-built drawings according to the Contract Documents, including updating the electrical as-built conditions.
 15. Provide training of the Owner's operating personnel as specified.
 16. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
 17. Warranty Period: Execute and assist the CA in carrying out deferred functional performance testing according to the specifications.
 18. Correct deficiencies and make necessary adjustments to electrical systems O&M manuals and electrical as-built drawings for applicable issues identified in any seasonal or deferred testing.
- M. Plumbing Contractor
1. Provide installation and operation for all plumbing equipment.
 2. Assist and cooperate with the CA by putting all plumbing equipment, fixtures, domestic water systems, water heaters, recirc pumps, etc., into operation as requested by the CA for testing and

- confirming the operation of such equipment and components installed under the plumbing scope of services.
3. List and clearly identify on the as-built drawings the locations of all plumbing valves installed above ceiling, in building walls, and underground.
 4. Be responsible to notify the GC and CA, ahead of time, when commissioning Activities related to plumbing systems not scheduled could delay construction.
 5. Include the cost of commissioning by the plumbing sub in the contract price.
 6. Include requirements for plumbing submittal data, O&M data, and participation in owner training for plumbing systems.
 7. Attend a commissioning scoping meeting and other necessary meetings scheduled by the CA to facilitate the Cx process.
 8. Contractor shall provide normal cut sheets and shop drawing submittals to the CA for plumbing systems to be commissioned. Submissions shall follow proper protocol for distribution of materials. Typically, from Vendor to Sub to GC to Architect, or CM to CA.
 9. Provide requested plumbing systems documentation to the CA when requested by the CA for development of plumbing checklists and testing procedures.
 - a. Typically, this will include detailed manufacturer installation and start-up, operating, troubleshooting, and maintenance procedures, full details of any owner-contracted tests and pump curves, factory test reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation and check-out materials that are actually shipped inside the plumbing equipment and the actual field check-out sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent.
 - b. The Commissioning Agent may request further documentation necessary for the commissioning process.
 - c. This data request may be made prior to or post normal submittals.
 10. Provide a copy of the plumbing systems O&M manuals submittals of commissioned equipment, through normal channels, to the CA.
 11. Contractors shall assist (along with the design engineers) in clarifying the operation and control of plumbing systems commissioned, in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
 12. Provide assistance to the CA for developing and conducting all CA directed plumbing system and equipment testing. Subs shall review all test procedures to ensure feasibility, safety, and equipment protection and provide necessary written alarm limits to be used during the tests.
 13. Develop a full installation check-out plan using manufacturer's installation, start-up procedures, and the checklists from the CA and other requested equipment documentation to CA and A/E for review.
 14. During the start-up and initial check-out process for Plumbing systems, equipment requiring electrical power will require coordination with the electrical sub to execute and document the electrical-related portions of the plumbing checklists and likewise for HVAC and Electrical devices where plumbing systems and equipment are installed as part of the complete HVAC or electrical system, the plumbing sub must coordinate with those disciplines for sign off of the checklist documents.
 15. In a clear and legible format, document all completed installation, start-up, and system operational check-out procedures, providing a copy to the A/E and CA through the GC.
 16. Provide skilled technicians to execute energizing and starting of electrical equipment and to execute all required electrical tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments, and issue resolution.
 17. Perform functional performance testing under the direction of the CA or A/E for specified plumbing equipment tests.
 18. Correct deficiencies (differences between specified and observed performance) as interpreted by the CA, GC, and A/E and retest the equipment.
 19. Address current A/E punch list and Cx Issues Log items before final payment is released.
 20. Prepare O&M manuals and red-line as-built drawings according to the Contract Documents, including updating the plumbing as-built conditions.
 21. Provide training of the Owner's operating personnel for operation and maintenance of plumbing systems.
 22. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

23. Warranty Period: Execute and assist the CA in carrying out deferred testing according to the specifications.
24. Correct deficiencies and make necessary adjustments to plumbing systems O&M manuals and as-built drawings for applicable issues identified in any seasonal or deferred testing.

1.5 DEFINITIONS

- A. Acceptance Phase - Phase of construction after start-up and initial check-out when functional performance tests, O&M documentation review, and training occurs.
- B. Approval - Acceptance that a piece of equipment or system has been properly installed and is functioning in the tested modes according to the Contract Documents.
- C. Architect/Engineer (A/E) - The prime consultant (architect) and sub-consultants who comprise the design team; generally the HVAC mechanical designer/engineer and the electrical designer/engineer.
- D. Basis of Design (BOD) - The basis of design is the documentation of the primary thought processes and assumptions behind design decisions that were made to meet the design intent. The basis of design describes the systems, components, conditions, and methods chosen to meet the intent. Some reiterating of the design intent may be included.
- E. Checklist (PC) - A list of items to inspect and elementary component tests to conduct to verify proper installation of equipment. Checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.). However, some Checklist items entail simple testing of the function of a component, a piece of equipment, or system (such as measuring the voltage imbalance on a three phase pump motor of a chiller system). The word pre-functional refers to before functional performance testing. Checklists augment and are combined with the manufacturer's start-up checklist. Even without a commissioning process, contractors typically perform some checklist items. However, few contractors document in writing the execution of these checklist items. Therefore, for most equipment, the contractors execute the checklists on their own.
- F. Commissioning Agent (CA) - An independent agent, not otherwise associated with the A/E team members or the Contractor, though CA may be hired as a subcontractor to them. The CA directs and coordinates the day-to-day commissioning activities. The CA does not take an oversight role like the CM. The CA is part of the Construction Manager (CM) team or shall report directly to the CM.
- G. Commissioning Plan - An overall plan, developed before or after bidding that provides the structure, schedule, and coordination planning for the commissioning process.
- H. Contract Documents - The documents binding on parties involved in the construction of this project (drawings, specifications, change orders, amendments, contracts, Cx Plan, etc.).
- I. Contractor - The general contractor or authorized representative.
- J. Control System - The central building energy management control system.
- K. Construction Manager (CM) - The Owner's representative in the day-to-day activities of construction. In general, the construction management services contractor (CM) is hired by the owner to assist in the overall management of the project including supervising and on-site managing authority over a project's construction. The General Contractor reports to the CM. The CM is the owner's on-site representative.
- L. Data Logging - Monitoring flows, currents, status, pressures, etc. of equipment using DDC control system.
- M. Deferred Functional Tests - FTs that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design, or other site conditions that disallow the test from being performed.
- N. Deficiency - A condition in the installation or function of a component, piece of equipment, or system that is not in compliance with the Contract Documents (it does not perform properly or is not complying with the design intent).

- O. Design Intent - A dynamic document that provides the explanation of the ideas, concepts, and criteria that are considered to be very important to the owner. It is initially the outcome of the programming and conceptual design phases.
- P. Design Narrative or Design Documentation - Sections of the Design Intent or BOD.
- Q. Factory Testing - Testing of equipment on-site or at the factory by factory personnel with an Owner's representative present.
- R. Functional Performance Test (FT) - Test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure set point). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional testing, in the commissioning sense of the word. TAB's primary work is setting up the system flows and pressures as specified, while functional testing is verifying that which has already been set up. The commissioning agent develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor. FTs are performed after CHECKLISTS and start-up is complete.
- S. General Contractor (GC) - The prime contractor for this project generally refers to all the GC's subcontractors as well. Also is referred to as the Contractor in some contexts.
- T. Indirect Indicators - Indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed.
- U. Manual Test - Using hand-held instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").
- V. Monitoring - The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or the trending capabilities of control systems.
- W. Non-Compliance - See the definition of Deficiency.
- X. Non-Conformance - See the definition of Deficiency.
- Y. Over-Written Value - Writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 50°F to 75°F to verify economizer operation). See also "Simulated Signal."
- Z. Owner-Contracted Tests - Tests paid for by the Owner outside the GC's contract and for which the CA does not oversee. These tests will not be repeated during functional tests if properly documented.
- AA. Phased Commissioning - Commissioning that is completed in phases (by floors, for example) due to the size of the structure or other scheduling issues, in order to minimize the total construction time.
- BB. Project Manager (PM) - The contracting and managing authority for the owner over the design and/or construction of the project.
- CC. Sampling - Functionally testing only a fraction of the total number of identical or near identical pieces of equipment.
- DD. Seasonal Performance Tests - FT that are deferred until the system(s) will experience conditions closer to their design conditions.
- EE. Simulated Condition - Condition that is created for the purpose of testing the response of a system (e.g., applying heated air to a space sensor using a hair dryer to see the response in the HVAC system).

- FF. Simulated Signal - Disconnecting a sensor and using a signal generator to send an amperage, resistance, or pressure to the transducer and DDC system to simulate a sensor value.
- GG. Specifications - The construction specifications of the Contract Documents.
- HH. Start-up - The initial starting or activating of dynamic equipment, including executing Checklists.
- II. Subs - The subcontractors to the GC who provide and install building components and systems.
- JJ. Systems/Subsystems/Equipment & Components - Where these terms are used together or separately, they shall mean "As-Built" systems, subsystems, equipment, and component.
- KK. Test Procedures - The step-by-step process which must be executed to fulfill the test requirements. The test procedures are developed by the CA.
- LL. Test Requirements - Requirements specifying what modes and functions, etc. shall be tested. The test requirements are not detailed test procedures. The test requirements are specified in the Contract Documents.
- MM. Trending - Monitoring using the building control system.
- NN. Vendor - Supplier of equipment.
- OO. Warranty Period - The warranty period for the entire project, including equipment components. Warranty begins at Substantial Completion and extends for at least one year, unless specifically noted otherwise in the Contract Documents and accepted submittals.

1.6 SYSTEMS TO BE COMMISSIONED

- A. The following systems and their sub-components are anticipated to be commissioned on this project. The actual systems commissioned will be based on the systems listed in the commissioning contract with the owner. Systems included for this project will be confirmed during the CA construction phase.
- B. These systems and sub-components will be commissioned using sampling techniques. Percentage of sampling shall be determined by the CA in the field but no less than 20% of like systems shall be sampled for HVAC systems and lighting systems. All chillers, space heat boilers, and cooling towers, (except existing systems), shall be tested. No sampling will be allowed for these major components (chillers, space heat boilers, and cooling towers). Reference the Mechanical, Electrical, and Plumbing systems equipment schedules and sheets contained in the contract drawings for equipment design information.

Cx Systems	Require Fx Testing	Items Tested
HVAC		
<input type="checkbox"/> Chilled Water Plants	Yes	Controls, Sequence of Operations, Alarms
<input type="checkbox"/> Hot Water Plants	Yes	Controls, Sequence of Operations, Alarms
<input type="checkbox"/> Air Handling Units	Yes	Controls, Sequence of Operations, Alarms, Economizer
<input type="checkbox"/> Packaged Units (RTU and HP)	Yes	Controls, Sequence of Operations, Alarms, Economizer
<input type="checkbox"/> Terminal Units/VAVs	Yes	Controls, Sequence of Operations, Economizer
<input type="checkbox"/> Exhaust and Relief fans	Yes	Controls, Sequence of

Cx Systems	Require Fx Testing	Items Tested
		Operations, Alarms
<input type="checkbox"/> DDC Control System (<i>Component Installation and System Operation</i>)	Yes	System calibration and function
Electrical Systems		
<input type="checkbox"/> Lighting Controls	Yes	Control Software and Hardware Properly Adjusted and Programmed
<input type="checkbox"/> Occupancy Sensors	Yes	Aiming, Status Indicator, Light Staging
<input type="checkbox"/> Time Switch Controls	Yes	Programmed Schedules, Battery Backup, Override Limit, Simulate Occupied and Unoccupied Conditions
<input type="checkbox"/> Daylight Responsive Controls	Yes	Accurate Locations, Calibration, Setpoint, Threshold
Plumbing Systems		
<input type="checkbox"/> Service Water Heating Systems	Yes	Controls, Sequence of Operations, Alarms

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. All standard testing equipment required to perform start-up and initial check-out and required functional performance testing shall be provided by the primary Division contractor for the equipment being tested. For example, the mechanical contractor of Division 23 shall ultimately be responsible for all standard testing equipment for the HVAC system and controls system in Division 23, except for equipment specific to and used by TAB in their commissioning responsibilities. Two-way radios shall be provided as necessary for communication between the CA and contractors during performance testing, by the Division Contractor.
- B. Special equipment, tools, and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and turned over to the owner for his use and shall become the sole property of the owner, except for temporary stand-alone data logging equipment that may be used by the CA and any special testing and inspection equipment used for testing of piping, ductwork, and electrical and special systems unless such equipment is required for such systems to function and operate.
- C. Any and all data logging by electronic device shall be by the DDC control system where applicable, and as otherwise contracted by the owner with others.
- D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year and a resolution of + or - 0.3°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.1 REPORTING

- A. The CA will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through memos, progress reports, etc.
- B. Non-conformance and deficiency issues will be recorded on the commissioning issues log and a copy will be provided to the GC for making corrections. A copy will be provided to the owner and made available to other project team members as directed by the owner. Frequency of these reports will be determined by the progress of construction and issues discovered during the CA and owner-site observations. Issues recorded on the Cx Issues Log will be noted as complete and the CA will initial the date and verified by block only after the CA has confirmed that the item has been corrected by the contractor or noted in writing, by the owner, as accepted as is by the owner.
- C. A final summary report (about four to six pages, not including backup documentation) by the CA will be provided to the owner, focusing on evaluating commissioning process issues and identifying areas where the process could be improved. All acquired documentation, logs, minutes, reports, deficiency lists, communications, findings, unresolved issues, etc., will be compiled in appendices and provided with the summary report. As appropriate, checklists, functional tests, and monitoring reports may be included to supplement the summary report. These documents will also be included in the Project Commissioning Record.

3.2 SUBMITTALS

- A. Normal submittal: For MEP Systems, submittals will be provided by the GC to the CA through the Architect and concurrently with the A/E consultants review period. At a minimum, the submittal will include the manufacturer and model number, the manufacturer's printed installation and detailed start-up procedures, full sequences of operation, O&M data, performance data, any performance test procedures, control drawings, and details of owner contracted tests. In addition, the installation and check-out materials that are actually shipped inside the equipment and the actual field check-out sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent. All documentation requested by the CA will be included by the Subs in their O&M manual contributions. Where items are uploaded to an FTP or web-based site, the CA will be notified.
- B. The CA may request additional design narrative from the A/E and Controls Contractor, depending on the completeness of the design intent documentation and sequences provided with the Specifications.

3.3 PHASED COMMISSIONING

- A. Where the project requires TAB, start-up, and performance testing to be executed in phases, phasing shall be coordinated with the owner, GC, CA, and A/E and be reflected in the overall project schedule and shall include commissioning activities in the schedule by the contractor. Final performance testing of all systems will be as required by the phasing plan. The performance testing of the "systems as a whole" will be performed before final turnover of the project.

3.4 FUNCTIONAL PERFORMANCE TESTING

- A. Requirements. The performance testing shall demonstrate that each system is operating according to the documented design intent and contract documents. Performance testing facilitates bringing the systems from a state of individual substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified, corrected, and the system retested, improving the operation of the systems.
- B. Coordination and Scheduling. The contractor shall provide sufficient notice, regarding their completion schedule for the construction checklists and start-up of all equipment and systems to allow the performance testing to be scheduled. The commissioning team shall oversee, witness, and document the performance of all equipment and systems. The contractor in association with the subcontractors shall execute the tests. The CA shall witness and document the results of the test. Performance testing shall be conducted after the construction checklists, and start-up has been satisfactorily completed. The control system shall be sufficiently tested and approved by the CA and engineer of record before it is used, to verify performance of other components or systems. The air side balancing and water side balancing shall be completed before performance testing of air or water-related equipment or systems.

Testing proceeds from components to sub-systems to systems. When the proper performance of all interacting individual systems has been achieved, the coordinated response between systems shall be verified.

C. Development of Test Procedures:

1. Before test procedures are finalized, the contractor shall provide to the A/E and the CA all requested documentation including changes affecting equipment or systems, an updated control points list, control schematics, control sequences, and testing parameters. Using the testing parameters and requirements in the technical specifications, the CA shall develop and update specific testing requirements and documentation for the purpose of verifying and documenting the actual performance of the related systems and equipment. Each respective contractor/subcontractor or vendor shall provide assistance to the CA as necessary and required in developing the final equipment and systems test procedures. Should the CA test and the manufacturer test requirement be at variance with one another, the manufacturer operational test requirements shall prevail.
2. Before test procedures are written, the CA shall obtain all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences, and parameters. The CA shall develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Each Sub or vendor responsible to execute a test shall provide assistance to the CA in developing the procedures review (answering questions about equipment, operation, sequences, etc.). Prior to execution, the CA shall provide a copy of the test procedures to the contractor who shall review the tests for feasibility, safety, equipment, and warranty protection. The CA may submit the tests to the A/E for review and comment prior to performing the test.

D. Test Methods:

1. Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the building DDC control system.
2. Simulated Conditions. Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
3. Overwritten Values: Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system shall be allowed, but simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a portable hot air device in lieu of overwriting the set point.
4. Simulated Signals: Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
5. Altering Set points: Rather than overwriting sensor values, and when simulating conditions is difficult, altering set points to test a sequence is acceptable. For example, to see the AC compressor lockout work at an outside air temperature below 55°F, when the outside air temperature is above 55°F, temporarily change the lockout set point to be 2°F above the current outside air temperature.
6. Indirect Indicators: Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification is completed during prefunctional testing.
7. Setup: Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Sub executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Sub shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.
8. Sampling: Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity. A small size or capacity difference, alone, does not constitute a difference. The specific recommended sampling rates are listed in these documents. It is noted that no sampling by Subs is allowed in CHECKLIST execution. A common sampling strategy referenced in the Specifications as the "xx% Sampling-yy% Failure Rule" is defined by the following example:
 - a. xx = the percent of the group of identical equipment to be included in each sample.

- b. yy = the percent of the sample that if failing, will require another sample to be tested.
9. The example below describes a 20% Sampling-10% Failure Rule:
 - a. Randomly test at least 20% (xx) of each group of identical equipment. In no case test less than three units in each group. This 20%, or three, constitutes the "first sample."
 - b. If 10% (yy) of the units in the first sample fail the functional performance tests, test another 20% of the group (the second sample).
 - c. If 10% of the units in the second sample fail, test all remaining units in the whole group.
 - d. If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the CA may stop the testing and require the responsible Sub to perform and document a check-out of the remaining units, prior to continuing with functionally testing the remaining units.
- E. Coordination and Scheduling:
 1. The Subs shall provide sufficient notice to the CA regarding their completion schedule for the CHECKLISTS and start-up of all equipment and systems. The CA will schedule functional tests through the GC.
 2. The CA shall observe and document the results of functional testing if the results shall be provided to the owner and A/E for review and record.
 3. The Subs shall execute the tests. In general, functional performance testing is conducted after checklist verification and start-up has been satisfactorily completed and start-up reports and checklists have been reviewed by the A/E. The control system is sufficiently tested for completeness, by the controls contractor and prior to TAB work. The controls sub will provide written notification to the GC, A/E, and CA that the controls have been inspected and pre-Tested prior to beginning TAB and any Functional testing work. The air balancing and water balancing is then completed and debugged before functional testing of air-related or water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.
 - a. Test Equipment: All standard testing equipment required to perform start-up and initial check-out and required functional performance testing shall be provided by the Division contractor for the equipment being tested. All testing equipment shall be of sufficient quality and accuracy to test or measure system performance as required by the construction documents and specifications and functional performance testing.
 - b. Problem Solving: The CA will recommend solutions to issues discovered, however the burden of responsibility to solve, correct and retest problems is with the GC, Subs, and A/E.

3.5 DOCUMENTATION, NON-CONFORMANCE, AND APPROVAL OF TESTS

- A. Documentation: The CA shall witness and document the results of all functional performance tests using the specific procedural forms developed for that purpose. Prior to testing, these forms are provided to the A/E and GC for review and approval.
- B. Non-Conformance:
 1. The CA will record the results of the functional test on the test form. All deficiencies or non-conformance issues shall be documented and reported to the GC for correction and a copy provided to the A/E and owner.
 2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CA. In such cases, the deficiency and resolution will be documented on the procedure form.
 3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the PM and CM. Any issue that requires more than 30 minutes to correct or multiple issues with a combined total of 90 minutes in any given day, shall be deemed failed and shall be documented as such by the Cx agent. A copy of the discrepancy shall be provided to the GC for correction and the project team members for record. Upon written notification from the GC, that the issue or issues are corrected and the system is fully operational and ready for retest, the CA will schedule with the GC for a retest of the failed system. Five working days shall be required by the GC in writing to the CA for any retest.
 4. As tests progress and a deficiency is identified, the CA discusses the issue with the executing contractor.

5. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:
 - a. The CA documents the deficiency and the Sub's response and intentions and they go on to another test or sequence. The CA submits the non-compliance reports to the GC, A/E, and owner. A copy is to be provided to the appropriate Sub by the GC. The Sub corrects the deficiency, signs the statement of correction at the bottom of the form certifying that the equipment is ready to be retested, and sends it back to the GC for verification. The GC provides a copy of the signed form to the A/E and CA for record.
 - b. The CA reschedules the test and the test is repeated.
 6. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
 - a. The deficiency shall be documented with the Sub's response and a copy given to the GC, A/E, PM, and CA and to the Sub representative assumed to be responsible.
 - b. Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is the owner.
 - c. The CA documents the resolution process.
 - d. Once the interpretation and resolution have been decided, the GC and CA will reschedule the test and the test is repeated.
 7. Cost of Retesting:
 - a. If a system scheduled for a Functional Performance Test fails to pass and perform as designed, due to improper installation of start-up by the contractor, the cost for retest including the CA's time and travel, will be charged to the General Contractor who may choose to back charge his subs to recover any losses. Minor corrections will be made on-site and the test will continue where the total time for any given system to be corrected and made fully operational, is less than 15 minutes.
 - b. For a deficiency identified, not related to any Checklists or start-up fault, the following shall apply: The CA and GC will direct the retesting of the system once at no "charge" to the sub or vendor for their time. However, the CA's time and expenses, incurred due to additional retests of any system beyond the one retest, will be charged to the GC, who will choose to recover costs from the responsible Sub.
 - c. The time for the CA and GC to direct any retesting required because a specific Checklist or start-up test item, reported having been successfully completed, but determined during functional testing to be faulty, will be back charged to the GC, who may choose to recover costs from the party responsible for executing the faulty functional test.
 8. The Contractor shall respond in writing to the CA, A/E, and PM at least as often as Commissioning meetings are being scheduled, concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.
 9. The CA retains the original Cx Issues Log until the end of the project.
- C. Approval: The CA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made after review by the CA, A/E, and PM. The CA documents the results of each test.

3.6 OPERATION AND MAINTENANCE MANUALS

- A. Standard O&M Manuals:
 1. The specific content and format requirements for the Standard O&M manuals are detailed in the A/E's project specifications.
 2. CA Review and Approval: Prior to substantial completion, the CA shall review the O&M manuals, documentation, and redline as-builds for systems that were commissioned and as otherwise listed in these documents, to verify compliance with the Specifications. The CA will communicate deficiencies in the manuals to the GC, PM, or A/E, as requested. Upon a successful review of the corrections, the CA recommends approval and acceptance of these sections of the O&M manuals to the GC, PM, or A/E. The CA also reviews the MEP and special systems equipment warranty information. This review by the CA does not supersede the A/E's responsibility to review the O&M manuals according to the A/E's contract.
- B. Commissioning Record in O&M Manuals:
 1. The CA shall include the commissioning record as part of the close-out documentation or as a supplement to the O&M records. This shall be in electronic format for final deliverables to the

owner. The intended format is PDF format provided on electronic medium/discs.

3.7 DEFERRED TESTING

- A. Unforeseen Deferred Tests: If any check or test cannot be completed due to the building structure, required occupancy condition, or other deficiencies, execution of checklists and functional testing may be delayed upon approval of the PM. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated.
- B. Seasonal Testing: Where seasonal testing is necessary or required to verify systems performance under designed conditions, these Tests will be scheduled by the GC, in coordination with the Owner and CA, and executed by the responsible Subs. The owner's facilities staff and the CA shall be notified in writing, by the GC, of the dates such testing will be conducted and shall be available for observing the testing. All such tests shall be scheduled no later than 60 days from substantial completion and shall be conducted no later than seven months from substantial completion. The owner shall have final approval for seasonal test dates. Any adjustments required for updating the accuracy of the O&M manuals, warranties, and as-builts due to the testing will be made by the contractor.

3.8 WRITTEN WORK PRODUCTS

- A. The commissioning process generates a number of written work products described in various parts of the Specifications. The Commissioning Plan-Construction Phase lists all the formal written work products, describes briefly their contents, who is responsible to create them, their due dates, who receives and approves them, and the location of the specification to create them. In summary, the written products are:

Product		Developed By
1.	Final commissioning plan	CA
2.	Commissioning schedule	GC/CA
3.	Equipment documentation submittals	GC/Subs/A/E
4.	Sequence clarifications	A/E/Vendors
5.	Issues log (deficiencies)	CA/GC
6.	Commissioning Progress Record	CA
7.	Deficiency reports	CA/A/E/PM/GC
8.	Functional test forms	CA/AE
9.	Filled out functional tests	CA/GC/Subs
10.	O&M manuals	GC/Subs
11.	Commissioning record book	CA
12.	Final commissioning report	CA
13.	Final TAB report	TAB

END OF SECTION

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SECTION 03 10 00
CONCRETE FORMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Shoring, formwork of structure.
 - 2. Furnish, install and removal of concrete formwork.

1.2 REFERENCES

- A. Codes and Specifications
 - 1. American Concrete Institute (ACI)
 - a. ACI 117, Specification for Tolerances for Concrete Construction and Materials
 - b. ACI 301, Specifications for Structural Concrete
 - c. ACI 318, Building Code Requirements for Structural Concrete
 - d. ACI 347R, Guide to Formwork for Concrete
 - 2. Concrete Reinforcing Steel Institute (CRSI)
 - a. Manual of Standard Practice
 - 3. American Society for Testing Materials (ASTM)
 - a. ASTM C203, Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation
 - b. ASTM D1621, Standard Test Method for Compressive Properties of Rigid Cellular Plastics
 - c. ASTM D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Submit shop drawings for formwork.
 - 2. Submit size and layout of sleeves and openings in structural members, required by trades, prior to releasing reinforcing, formwork and studrail shop drawings for fabrication.
- B. Construction Joints: Submit diagrams of construction joints.
- C. Product Data:
 - 1. Form release agent
 - 2. Fiberboard void forms
 - 3. Void retainer panels
 - 4. Vapor retarder

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials off ground and protected from weather.
 - 1. Prevent warpage, twisting and excessive moisture gain of wood materials.
 - 2. Discard damaged or deformed materials.
- B. Protect smooth faces of form liner materials from abrasion, denting or scarring during handling.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Design, erect, shore, brace and maintain formwork according to ACI 301 to withstand vertical, lateral, static, dynamic and construction loads applied prior to concrete structure reaching adequate strength to support such loads.
- B. Limit form deflections to provide smooth, straight surfaces without unsightly bulges and deformations.
- C. Limit form deformations for architecturally exposed surfaces to 0.0025 times the span of each component (facing material, studs and walers).

2.2 MATERIALS

- A. Wood forms for unexposed concrete surfaces: No. 2 Southern Yellow Pine or Douglas Fir dressed to uniform and smooth contact surfaces.

- B. Wood forms for concrete surfaces exposed to view: Commercial Standard Douglas Fir concrete form plywood, moisture resistant, not less than 5 plies, and minimum thickness of 9/16 inch. Line forms with one of the following:
 - 1. Plywood: Commercial Standard Douglas Fir, concrete form, exterior, 3 ply, not less 1/4 inch thick with one smooth face.
 - 2. Fiberboard: Plastic (ABS) Concrete Formliner by Custom Rock Formliner; Pattern 6017 8" Wide Plank Cedar.
- C. Void retainers:
 - 1. Precast Concrete Panels. 1 1/2 inches thick, 3000 psi lightweight or normal weight concrete, reinforced with 4x4-W1.4 welded wire mesh.
 - 2. Lightweight, ribbed, high density polyethylene panels specially made to prevent migration of backfill soil under foundation elements.
 - a. Example product: Rib Soil Retainers by Supervoid, Prattville, AL
 - 1) Retainer to extend a minimum of 6-inches above and below the void. Connect the top of the retainer to the concrete with pin anchors.
 - b. Example product: SureRetainer by VoidFormProducts, Englewood, CO
 - 1) Required minimum panel height: 14 inches for 8 inch void space and smaller; 20 inches for larger than 8 inch and up to 12 inch void space.

2.3 COMPONENTS

- A. Rustications: steel, polyvinyl chloride or milled and sealed white pine.

2.4 MANUFACTURED UNITS

- A. Fiberboard void forms (void boxes): manufactured using corrugated paper material with water resistant fiberboard material exterior, capable of supporting weight of wet concrete without crushing but non-durable in long-term (deteriorates over time with absorption of moisture). Void forms to be laminated using moisture resistant adhesive.
 - 1. Provide pre manufactured shapes required (rectangular, etc.)
 - 2. Provide special shapes adjacent to round or skewed components.
 - a. Do not cut fiberboard void forms in field.
 - 3. Provide caps at each end of units.
 - 4. Provide a layer of protective cover board over void forms to distribute working load and protect void forms from puncture and other damage during concrete placement.
 - a. Example cover board: 1/4 inch minimum thickness hardboard/fiberboard
- B. Vapor retarder at slab on grade:
 - 1. Vapor Barrier membrane must have the following properties:
 - a. Permeance as tested after mandatory conditioning (ASTM E154) less than 0.01 Perms
 - b. Strength: ASTM E1745 Class A
 - c. Thickness: 15 mils minimum
 - d. Approved Product: VBC-350 by Barrier-Bac, Inc
 - e. Approved Alternate: Stego Wrap 15 mil Vapor Barrier by Stego Industries LLC

2.5 ACCESSORIES

- A. Form ties: bolt rods or patented devices of sufficient strength to withstand pressure due to wet concrete (3000 pounds minimum tensile strength); adjustable in length, and removable to depth of at least 1 inch from face of concrete.
 - 1. Equip ties for exposed concrete surfaces with plastic cones 5/8 inch in diameter.
 - 2. Do not use wire ties, or makeshift ties that leave unsightly marks or depressions on face of concrete.
- B. Form release agent:
 - 1. Does not bond with, stain, or adversely affect concrete surfaces.
 - 2. Meets acceptable air quality standards.

PART 3 - EXECUTION

3.1 DESIGN AND CONSTRUCTION

- A. Design formwork for concrete elements to have correct dimension, shape, alignment, elevation, and position with dimensional tolerances conforming to ACI 117. Reference ACI 347R.
- B. Design formwork to safely support vertical and lateral loads until such loads can be supported by concrete structure. Carry vertical and lateral loads to ground by formwork system or by in-place construction of adequate strength.

- C. Form sides of concrete elements unless specifically noted or shown otherwise in the Contract Documents.
 - 1. Dimensional tolerances to conform to ACI 117.
 - 2. Repair bulges, offsets and formwork conditions that would cause beam sides to become skewed or wider than void box bottom forms prior to placing concrete.
- D. Construct forms to required shapes, lines and dimensions; provide necessary studs, walers, ties, centering, molds and supports.
 - 1. Install forms sufficiently tight to prevent leakage of mortar.
 - 2. Construct forms to be easily removable without damage to finished surfaces.
 - 3. Provide forms without unsightly marks or deformations on exposed faces.
 - 4. Thoroughly clean forms of concrete laitance before re-use.
 - 5. Provide clean-outs at base of vertical forms for removal of foreign materials before concrete placement.
- E. Tying of forms: provide sufficient form ties to prevent bulging or collapse of forms under weight of wet concrete.
 - 1. Place ties in uniform and orderly pattern.
 - 2. Lubricate ties to prevent bonding with concrete.
- F. Special features: place in forms any wood strips, blocking, molding, and liners necessary to produce required shapes.
 - 1. Attach feature strips to forms in a manner that will not leave unsightly marks on exposed concrete surfaces.
 - 2. Coat wood strips, blocking and molding with form sealer.
 - 3. Provide 3/4 inch chamfer strips along edges of permanently exposed concrete unless noted otherwise in Contract Documents.
- G. Coatings:
 - 1. Coat contact surfaces of wood forms with form release agent before each use and before placing reinforcement.
 - 2. Apply form release agent per manufacturer's recommendations.
 - 3. Do not allow excess release agent to accumulate in forms or to contact hardened concrete against which fresh concrete will be placed.
 - 4. Remove release agent from reinforcement before placing concrete.
- H. Construction joints:
 - 1. Locate construction joints as shown on approved submittals.
 - a. Do not locate construction joints between lateral bracing elements of walls and columns.
 - b. Locate construction joints in beams, slabs and joists approximately at midspan between supports.
 - c. In post-tensioned construction, coordinate location of construction joints with tendon layout and stressing sequence.
 - d. Provide plumb and level construction joints. Avoid irregular lines at horizontal construction joints in exposed concrete faces by tacking a continuous strip of dressed lumber, 1 inch thick, to inside of wall or grade beam form, with its lower edge at line of construction joint. About one hour after placing concrete in lower part of wall or grade beam, remove strip, level off irregularities in joint line with wood float and remove laitance.
 - e. Provide shear keys and waterstops as required in construction joints.
- I. Fiberboard Void Boxes:
 - 1. Ensure subgrade is clean and dry before installing void boxes.
 - 2. Place void cartons tightly end-to-end.
 - 3. Place and arrange void cartons so that horizontal concrete surfaces that would otherwise be in contact with soil are protected by void boxes. Protect cartons from rain and mud.
 - 4. Secure void cartons firmly in place so that position will not be altered by activities of workmen or placement of concrete. Secure with waterproof tape.
 - 5. Do not cut fiberboard void box components in field.
 - 6. Replace partially or wholly collapsed cartons.
 - 7. Install vapor barrier in accordance with ASTM E1643
 - 8. Install protective cover board according to manufacturer's instructions.
- J. Void Retainers:
 - 1. Prior to installing retainers, inspect void spaces to ensure voids are intact and that concrete or other material has not entered void space.
 - a. Where void space is not intact, remove excess concrete or other material prior to installing void retainers.
 - 2. Install void retainers as shown in Contract Documents or in accordance with manufacturer's written instructions, including overlap on side of beam or wall and penetration into subgrade. Where discrepancies occur, the most stringent shall govern. At locations required secure retainers to concrete to insure the retainers remain in place during backfilling.

3. Cut retainer material for tight fit at corners. Tape corners to ensure panels remain accurately in place during backfilling and that backfill soil does not enter void space.
 4. Monitor performance of retainer panels continuously during backfilling. If panels shift, or soil enters void space, stop work and adjust installation to assure satisfactory performance.
 5. Void height tolerance: plus 2 inches, minus 0 inches of height shown in Contract Documents.
- K. Earth forming or soil cast:
1. Earth forming is not allowed.

3.2 REMOVAL OF FORMS

- A. Remove forms completely, unless specifically required otherwise.
- B. Remove forms carefully to avoid damage to concrete surfaces.
- C. Do not remove forms until concrete is adequately set.
 1. Clamps and tie rods may be loosened after 24 hours following placement of concrete.
 - a. Maintain sufficient ties to hold forms in place.
 - b. Withdraw through-wall ties toward the inside (or unexposed) face of walls and beams.
 - c. Prevent spalling during tie removal.
 2. Use concrete strength tests as evidence that concrete has adequately set for form removal.
 - a. Minimum strength is 75 percent of design strength.
 - b. For post-tensioned concrete, do not remove forms until engineer of record reviews and approves tendon elongations.
- D. Remove forms sequentially and in small units to prevent shock, overload or undue eccentricity in structure. Do not store materials or place heavy equipment on structures of which forms have been removed unless concrete strength is equal to design strength, or re-shores are installed. Remove forms in a manner that does not require a large portion of the structure to be self-supporting (i.e. a full bay of framing). Install re-shores immediately as form removal progresses.
- E. Do not remove forms until supporting structures are permanently in place and full strength.

END OF SECTION

SECTION 03 11 19

INSULATING CONCRETE FORMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Supply and installation of Insulating Concrete Forms (ICFs) for stay in place structural cast in place concrete walls.
- B. Includes installation of steel reinforcing, placement of concrete, ledgers, anchors and bearing plates for attaching to wall system.
- C. Install required openings for other work associated with ICF walls
- D. Provide adequate bracing and scaffolding that meets and complies with applicable codes.

1.2 QUALITY ASSURANCE

- A. Install materials according to manufacturer's training and printed installation procedures.
- B. Ensure materials that are to be in contact with the Insulating Concrete Forms are compatible with expanded polystyrene used in their construction.
- C. Contractor Experience: Minimum of 1 year experience in the installation of ICF products and demonstrated experience with the scope and scale equivalent to the project.
- D. Pre-installation Meetings: Prior to any work performed, all subcontractors involved with the installation of forms, placing of the rebar and or steel, the concrete, electrical and or mechanical equipment are to meet and discuss aspects of the installation and scope of work to be performed.

1.3 SUBMITTALS

- A. Product Data: Provide data on form materials and installation requirements and procedures.
- B. Drawings and Calculations: Submit project drawings, details of construction, structural calculations as required by the local building department, indicate pertinent dimensions, materials and arrangement.
- C. Steel Reinforcement: Provide structural calculations reinforcement sizing and placement schedule sealed by a Professional Engineer.
- D. Concrete: Submit the concrete mix design in accordance with Section 03 31 00 "Structural Concrete."
- E. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.

1.4 DEFINITIONS

- A. EPS- Acronym for "Expanded Polystyrene" when referencing the insulating foam component of the insulated concrete form.
- B. ICF- Acronym for "Insulated Concrete Form".
- C. ICF Alignment System- a form alignment & scaffold system designed exclusively for use with insulated concrete forms.
- D. Trained Installer- An installation contractor, who has received instructional training in the installation of insulated concrete forms.
- E. Technical Advisor- A technical representative, usually a staff member of a ICF Manufacturer or Distribution Firm, who has received instructional training in the installation of insulating forms (as administered by manufacture) and is in the capacity of supervising or overseeing an installation crew on site.
- F. Window or Door Opening Buck- a pre-manufactured or site constructed frame assembly consisting of engineered wood, plastic or metal material (or combination thereof) used to frame a rough opening within the forming system that will retain concrete around the opening. The frame can also

1.5 SYSTEM DESCRIPTION

- A. Insulated concrete wall forming system shall consist of 2 flame resistant panels of expanded polystyrene (EPS) connected by either high-density polypropylene hinged pin foldable webs or EPS embedded polystyrene fastening strips interconnected with slide in format - high density polypropylene web connectors.
- B. Insulating concrete form system shall provide a minimum insulation panel thickness of 2 5/8-inches (66.7mm) throughout ALL forms and panels forming the form system product inventory (with exception of variance required for brick ledge, tapered top forms and wall areas requiring a one-sided ICF with exposed concrete finish on one face of wall).
- C. All web fastening strips to run full height of form and be fitted top and bottom with reversible fitting, "triple-tooth" interlocking mechanisms to enable positive vertical interlocking of forms with each other. Wall system webs to provide min. 1 1/2" (38mm) wide fastening strips @ 8" (200mm) o/c approximately 1/2" (13mm) below wall face for full wall height to facilitate finish fastening of both interior and exterior finishes.
- D. Full height fastening strips also to be positioned within corner forms to provide capability of connecting finishes full height within 4" (100mm) or less of all corner conditions.
- E. All form units shall be capable of being shipped to site in folded condition to minimize shipping cost and site storage space requirement and be capable of being deployed to installation ready condition by simply unfolding the unit in a single pull motion or pull motion combined with insertion of a single web (at corner condition).
- F. EPS foam panels shall be molded with single socket 1" (25mm) wide reversible tooth interlocks positioned in pairs along top of all panels.
- G. Wall system to provide min. 4", 6", 8", 10" or 12" (100, 160, 200,250 or 300 mm) wall sections (as required) at all locations throughout wall area.
- H. Wall system to provide accurate positioning of steel within form cavity to conform to reinforcing requirements of ACI 318.
- I. EPS foam panels with concrete to provide min. insulation level of R 22.4 across full line of form unit cavity widths:
- J. EPS foam to provide maximum vapor permeation of 3.5 Perm-in. (200 ng/Pa.s.m²)/25mm
- K. Finished wall assembly to provide min. rating of STC sound attenuation performance as follows:
 - 1. 4" (100mm) core form STC 45 (when installed without finish)
 - 2. 6" core and above - STC 50

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver forms to site in original factory packaging with manufacturer's product labeling.
- B. Handle and store product in a location to prevent damage and soiling.
- C. Keep materials in original manufacturer's packaging. If forms are to be staged on the jobsite for extended periods of time protection from direct sunlight is required.

1.7 PROJECT CONDITIONS AND SCHEDULING

- A. During installation bracing and shoring are to be in place to protect walls from wind and weather conditions.
- B. Coordinate penetrations, attachment points and attach items to ICF walls before placement of concrete.
- C. Follow manufacturer's requirements to protect concrete after placement during periods when the weather is below minimums specified by the building codes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. BuildBlock Building System's forms; BuildBlock..
 - 2. FoxBlocks.
 - 3. Basis-of-Design Product: Nudura Integrated Building Technology; ICF Series.

- B. R-Value: Minimum 24.

2.2 MATERIALS

- A. Insulating Concrete Forms: All forms fully reversible all directions. Each form is manufactured with two expanded polystyrene panels connected with polypropylene webs placed vertically on 6 inch center. Webs shall contain support locking fingers for horizontal reinforcing, attachment flanges on each side of the foam panels for attaching interior and exterior finishes and heavy duty hard points on each flange for attaching heavy objects that require extra holding support. All forms shall have interlocking tops and bottoms to lock forms together.
- B. Webs composed of polypropylene meeting ASTM-D-635 for Rate of Burning and/or Extent and time of Burning of Plastics in a Horizontal Position, and ASTM-D-1929 Method for determining Ignition Temperature of Plastics.
- C. Forms are 1.5 lb/ft³ minimum density Expanded Polystyrene.
- D. Flame Spread of beads used meet: ASTM-E-84 Equals 25 or less.
- E. Smoke Development of beads used meet: ASTM-E-84 Equals 450 or less.
- F. Sound Transmission: ASTM-E90-04 Equal to or greater than 55.
- G. Mechanical Fastener Testing Meets: ASTM-D-1761-88 Type 'S' Course Thread Drywall Screw Withdrawal load = 43.1 lbs (safety factor of 3) Lateral Resistance load = 79 lbs (safety factor of 3)

2.3 CONCRETE

- A. Concrete supplied under Structural Engineer's Documents shall be of strength as specified by the design engineer (measured at 28 days). Recommended maximum aggregate size to be 1/2" (13mm) aggregate for 4" & 6" (100 & 160mm) cavity forms and, 3/4" (19mm) aggregate for the 8" (200 mm) cavity forms and higher.
- B. Recommended concrete slump is 6" +/- 1" (150mm +/- 25mm) (subject to design revision to suit application).
- C. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures. Discharge (drop) height for concrete placement, shall not exceed 12 feet (3.9 m) with total placement height not exceeding 16 feet (4.8 m) per placement or less as may be limited by the allowable formwork design pressures. As soon as the first concrete placement has cured adequately. If concrete cannot be placed in a continuous pour, provide construction joints as approved by the Designer of Record. Consolidate placed concrete with mechanical vibrating equipment conforming to ACI 301.

2.4 WATERPROOFING

- A. Where specified, waterproofing shall be self-adhesive modified bituminous sheet waterproofing membrane as supplied by concrete form system manufacturer specific to the form system specified under this section. Material to be supplied under this Section & installed as specified under Section 07 14 16 "Cold Fluid Applied-Waterproofing". Liquid Applied Membranes may be used provided manufacturer can provide warranty when used over ICF system.
- B. Waterproofing material shall be EPS foam compatible.

2.5 TERMITE TREATED FOAM BELOW GRADE

- A. For ICF walls below grade, use ICF forms manufactured with termite resistant EPS, Preventol TM Preservative Insecticide ICC-ES ESR-2918 (500 ppm). The termite resistant forms should extend up form top of footing, to at least a min 6" above the concrete floor slab elevation.

2.6 STEEL REINFORCEMENT

- A. All Steel reinforcement used and placed in ICF shall be as specified by the design engineer with a minimum yield strength of 40,000 psi (276 Mpa) 60,000 psi (414 Mpa) is recommended where applicable.

2.7 ACCESSORIES AND AUXILIARY MATERIALS

- A. Bracing, wall alignment, and Scaffolding: Must meet local building codes.
- B. Window and Door Bucks: May be treated wood, V-Buck, or other approved material specified by engineer.

- C. Bearing Plates and Rim Joist Brackets or anchors: Must meet engineer's specifications.
- D. Anchor Bolts and or Plate Anchors: Must have 5 inches of concrete penetration or meet engineer's specifications.
- E. Sleeves and Penetrations: Sized to meet design specifications.
- F. Waterproofing materials for below grade applications: Per design specifications.
- G. Exterior finishes: As per design specifications.
- H. Interior finish: Must meet 15-minute thermal barrier requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Site conditions verified: Verify building lines, and building dimensions. Verify footings and slabs level within 1/4- inch. Verify elevation of site before proceeding with formwork.
- B. Verify materials, tools, equipment and forms are available for installing formwork.
- C. Verify the proper size and placement of steel vertical dowels as specified by the plans or design.

3.2 SURFACE PREPARATION

- A. Footings and slabs must be clean in areas where forms are to be installed.
- B. If vertical dowels are not present they must be installed according to Engineers designs and manufacturer's recommendations.

3.3 INSTALLATION OF FORMWORK

- A. Install Insulating Concrete Forms according to manufacturer's recommendations. Aspects of formwork must conform to these requirements with regards to the following:
- B. Erection of shoring and bracing to meet design requirements in accordance with ACI 301. Shoring must stabilize formwork for types of construction loads place on the walls. Bracing and shoring must hold formwork plumb and straight.
- C. Placement of ICF at corners alternating corner directions at each row and aligning all furring strips to facilitate wall covering attachments.
- D. Install reinforcement as per engineer's specifications.
- E. Verify window and door openings are placed in correct locations and braced properly.
- F. Install reinforcing, as per engineers shop drawings over openings to provide for lintels within walls.
- G. Final pre-pour checklist per manufacturer's recommendations and job specific specifications. Check with other trades to ensure placement and necessity of accessories, penetrations, openings, sleeves, bolts, anchors, and other items.
- H. Placement of concrete with specified design mix. Concrete placed according to manufacturer's recommendations.
- I. Anchors, Rim Joist brackets, Top Plate Anchors and Straps and Penetrations installed per design and manufacturer's recommendations.
- J. Walls rechecked and adjusted for straight and plumb right after concrete is placed.
- K. Brush and clean forms, bucks, and sweep floors before leaving job site after pour.

3.4 FIELD QUALITY CONTROL

- A. Inspect erected formwork, shoring and bracing to ensure that work is in accordance with design, and that elements are secure.
- B. Ensure that formwork is level, plumb, square and straight and that dimensions are correct per plans or drawings.

3.5 CLEANING

- A. Clean forms as installation proceeds, to remove foreign matter within forms.

- B. Clean formed cavities of debris prior to placing concrete.
- C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
- D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.
- E. Formwork shall be free and clear of concrete overspills. Bucks and openings shall be clean and bracing removed after concrete cures as per engineers specifications. Floors shall be scrapped and cleaned of concrete spills.
- F. Clean up and dispose of debris on job site related to installation of Insulating Concrete Forms.

3.6 UV SURFACE PREPARATION

- A. The expanded polystyrene (EPS) foam used in the manufacture of ICF systems will oxidize when exposed to prolonged periods of ultra violet (UV) light, typically 60 to 120 days. The oxidization manifests on the exposed surface of the ICF form as a chalky dust film. It is recommended that the oxidized layer (chalky dust) remain undisturbed until just prior to the application of any direct applied materials or finish system. The EPS surface should be lightly brushed and washed (hosed down) with clean water to remove the oxidized layer. The EPS surface should be left to fully dry before application of any direct applied materials or finish system, e.g. fluid applied membranes, EIFS system or direct TAFS applications. Additional surface preparations such as but not limited to rasping the surface, may be required as recommended by the fluid applied membrane, EIFS system or direct TAFS supplier or manufacturer.

END OF SECTION

SECTION 03 15 00

EMBEDDED METAL ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel assemblies to be embedded
 - 2. Anchors

1.2 REFERENCES

- A. Codes and Specifications
 - 1. Concrete Reinforcing Steel Institute (CRSI)
 - a. Manual of Standard Practice.
 - 2. American Institute of Steel Construction (AISC)
 - a. AISC 360, Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
 - 3. American Welding Society (AWS)
 - a. AWS D1.1, Structural Welding Code - Steel.
 - b. AWS D1.4, Structural Welding Code - Reinforcing Steel.
 - 4. American Concrete Institute (ACI)
 - a. ACI 318, Building Code Requirements for Reinforced Concrete.
 - b. SP-066, ACI Detailing Manual
 - 5. American Society for Testing and Materials (ASTM)
 - a. ASTM A36, Standard Specification for Carbon Structural Steel.
 - b. ASTM A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - c. ASTM A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - d. ASTM A283, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
 - e. ASTM A307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
 - f. ASTM A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - g. ASTM A706, Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
 - h. ASTM A1064, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - i. ASTM A1011, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
 - j. ASTM F3125, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

1.3 SUBMITTALS

- A. Product Data
 - 1. Submit manufacturer's data indicating product compliance for the following:
 - a. Headed stud anchors
 - b. Deformed bar anchors
 - c. Rust inhibitor
 - d. Zinc coating
- B. Shop Drawings:
 - 1. Submit shop and installation drawings for review by Architect, including:
 - a. Shop and field connection details
 - b. Material grades and sizes
 - c. Details of fabrication
 - 2. Do not begin fabrication prior to review of shop drawings.

3. Review of shop drawings is for member sizes, spacings, detail, and general compliance with Contract Documents only.
 4. Material quantities, lengths, fit, verification of job conditions, and coordination with other trades are responsibility of Contractor.
- C. When requested by Owner or Architect, submit welders' certifications.

1.4 QUALITY ASSURANCE

A. Qualifications

1. Fabricator:
 - a. Minimum of 3 years of experience in related or similar work.
2. Welders:
 - a. Certified for type of welding required within previous 6 months.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store fabricated assemblies and inserts under cover and off ground to protect against corrosion prior to placement.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel

1. W Shapes and WT's: ASTM A992
2. Angles, Channels, Plates and Rods: ASTM A36.
3. Steel straps: ASTM A283 or A1011.
4. Bolts: ASTM A307, with regular hexagon nuts and carbon steel washers.
5. High Strength Bolts: ASTM F3125.

B. Reinforcing Bars

1. Deformed Bars: ASTM A615 of required grades.
2. Welded Wire Reinforcement: Conform to ASTM A1064.
3. Bars to be welded: ASTM A706 of required grades..

C. Fusion Welded Anchors

1. Headed Stud Anchors: Conform to ASTM A108, Grades 1010 through 1020, with sizes and lengths as shown in Contract Documents, and conforming to AWS D1.1, Section 7.
2. Deformed Bar Anchors: Low carbon steel, conforming with ASTM A1064, with sizes and lengths as shown in Contract Documents.
 - a. Example product: Type DA, as manufactured by Blue Arc Stud Welding Division of Erico Industries.

D. Welding Electrodes: AWS E70. For welding of ASTM A706 rebar, use AWS E80 electrodes.

E. Coatings

1. Rust Inhibitor:
 - a. Example product: Hi-Build Epoxoline as manufactured by Themec Co.
2. Hot-dip Galvanizing: Conform to ASTM A153.
3. Cold Galvanizing:
 - a. Example product: Galviline as manufactured by ZRC WORLDWIDE

F. Inserts

1. Miscellaneous: PVC pipes, or other special inserts as shown in Contract Documents, or as required by other trades.

2.2 FABRICATION

- A. Fabricate and assemble structural steel items in shop. Carefully and accurately shear, flame cut, and chip materials as required. Cut, drill, or punch holes at right angles to surface of metal. Do not enlarge holes by burning. Cut holes cleanly without torn or ragged edges. Weld in accordance with AISC Specifications and with AWS D1.1 and D1.4. Permit only AWS certified welders to perform welds.
- B. Weld deformed bar anchors and headed stud anchors by full-fusion process. Weld in accordance with manufacturer's recommendations regarding equipment, conditions of material, and temperature.
1. Example processes:
 - a. Nelson Stud Welding Company
 - b. KSM Welding Services Division, Omark Industries.

- C. Hot-dip galvanize steel assemblies and accessories exposed to weather or soil. Hot-dip galvanize steel embeds used within crawl space environments.
- D. Plainly mark and match-mark assemblies and inserts to correspond to placement drawings and diagrams.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Clean assemblies and inserts of corrosion, dirt, oil, grease and laitance before placing in forms.
- B. Place assemblies and inserts in forms and securely anchor in required positions with correct orientations. Use templates, diagrams and instructions provided by Fabricator for proper alignment and positioning.

3.2 FIELD QUALITY CONTROL

- A. Laboratory Testing: provide independent testing laboratory services as follows:
 - 1. Inspect steel fabrications for sizes, spacings and general quality of fabrication.
 - 2. Inspect welding of steel fabrications for size, length and quality.
 - 3. Inspect positioning of assemblies and inserts in forms.
 - 4. Visually inspect welds at anchors and shear stud connectors. Test studs which do not appear to have full sound 360 degree fillet weld at base. Test by bending 15 degrees. Replace studs which fail this test.
- B. Afford full cooperation and access to Work to testing laboratory and provide adequate notice to laboratory of when Work is ready for testing and inspection so that services can be carried out in full, allowing sufficient time for making corrections without delaying progress of Work.

3.3 ADJUSTING

- A. Field Touch Up
 - 1. Use cold galvanizing compound in accordance with manufacturer's recommendations for field touch-up.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Preparation of shop drawings
 - 2. Fabrication and placement of reinforcing
- B. Products Furnished, not Installed Under This Section
 - 1. Pier reinforcing

1.2 REFERENCES

- A. Codes and Specifications
 - 1. American Concrete Institute (ACI)
 - a. ACI 318, Building Code Requirements for Reinforced Concrete
 - b. SP-066, ACI Detailing Manual
 - 2. Concrete Reinforcing Steel Institute (CRSI)
 - a. Manual of Standard Practice
 - 3. American Welding Society (AWS)
 - a. AWS D1.4, Structural Welding Code - Reinforcing Steel
 - 4. American Society for Testing Materials (ASTM)
 - a. ASTM A1064, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
 - b. ASTM A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - c. ASTM A706, Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement

1.3 SUBMITTALS

- A. Shop Drawings
 - 1. Submit shop and installation drawings for review by Architect, including:
 - a. Reinforcing sizes and quantities
 - b. Reinforcing lengths and bending details
 - c. Placement instructions
 - d. Details and spacing of reinforcing supports
 - e. References to reinforcing designations in Contract Documents
 - f. Notes regarding reinforcing placement in Contract Documents
 - 2. Review of Shop Drawings will be for reinforcing sizes, spacing, and general detail only; excluding quantities, lengths and fit of materials.
- B. Quality Control Submittals
 - 1. Submit certified mill reports, evidencing compliance with Specification requirements.
 - 2. Submit laboratory testing and inspection reports.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in tagged bundles grouped by reinforcing size and length.
- B. Store reinforcing on skids off ground and stacked to permit drainage. Prevent build-up of rust and dirt on reinforcing. Protect reinforcing from contamination that would prevent bonding of concrete.
- C. Do not bend, twist or warp reinforcing during handling.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Reinforcing Steel
 - 1. Deformed bars: new billet steel conforming to ASTM A615 of required grades.
 - 2. Smooth bars: conform to ASTM A615

3. Welded wire reinforcement: conform to ASTM A1064.

2.2 ACCESSORIES

- A. Concrete bricks or chairs with bearing plates: Provide where supports are in contact with soil or vapor barrier.

2.3 FABRICATION

- A. Shop Fabrication
 1. Cut reinforcing to required lengths
 2. Bend reinforcing cold with suitable equipment. Do not heat or stretch material. Provide bend radii and extensions in conformance with ACI 318.
 3. Do not use reinforcing with kinks or unrequired bends.
 4. Do not re-straighten reinforcing bent more than 30 degrees.
- B. Tolerances: conform to ACI 318.
- C. Marking: mark reinforcing to correspond with shop drawings.

2.4 SOURCE QUALITY CONTROL

- A. Testing Laboratory Services
 1. Inspect fabricating and bending procedures
 2. Inspect fabricated materials

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean reinforcing of ice, dirt, loose rust, mill scale, oil, and grease.

3.2 PLACEMENT

- A. Place reinforcing of required sizes and quantities in proper position. Use sufficient supports and spacers to maintain position during concrete placement.
 1. Do not place reinforcing supports against exposed faces of beams, walls or copings.
- B. Secure reinforcing in position with wire ties complying with ACI 318.
 1. Clip or bend tails of tie wire away from exposed faces, do not leave tie wire within 1 1/2" of any exposed surface.
- C. Concrete Cover: comply with ACI 318 and Contract Documents.
- D. Maintain position of reinforcing mats in walls with metal spacers between mats.
- E. Tolerances
 1. Concrete cover to unformed surfaces
 - a. Members 8 inches deep or less: plus 1/4 inch
 - b. Members more than 8 inches deep: plus 1/2 inch
 2. Concrete cover to formed surfaces: plus 1/4 inch
 3. Longitudinal location of bends and ends of reinforcement: plus 2 inches
 4. Spacing between reinforcing bars: 1/4 inch
- F. Support reinforcing in slabs-on-voids and slabs-on-deck on bolsters or blocks. Do not lift reinforcing during concrete placement.

3.3 COLD BENDING OF BARS IN FIELD

- A. Dowels connecting concrete of different pour sequences may be bent in field to facilitate form placement and removal with the following conditions:
 1. Maximum bar size is #5
 2. Maximum bend angle is 90 degrees
 3. Bars may be bent and straightened one time only

3.4 FIELD QUALITY CONTROL

- A. Testing Laboratory Services
 1. Inspect reinforcing sizes, quantities and placement.
 2. Inspect support and securement of reinforcing.
 3. Inspect condition of reinforcing.

END OF SECTION

SECTION 03 31 00

STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Design of concrete mixes
 - 2. Furnishing and placing cast-in-place concrete
 - 3. Curing and finishing of concrete
 - 4. Waterstops
 - 5. Non-shrink grout
- B. Products Furnished, not Installed, under this Section
 - 1. Concrete for drilled piers

1.2 REFERENCES

- A. American Concrete Institute (ACI)
 - 1. ACI 117, Specification for Tolerances for Concrete Construction and Materials
 - 2. ACI 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
 - 3. ACI 213, Guide for Structural Lightweight – Aggregate Concrete
 - 4. ACI 214, Guide to Evaluation of Strength Test Results of Concrete
 - 5. ACI 301, Specifications for Structural Concrete
 - 6. ACI 302.1, Guide to Concrete Floor and Slab Construction
 - 7. ACI 304, Guide for Measuring, Mixing, Transporting, and Placing Concrete
 - 8. ACI 305.1, Specification for Hot Weather Concreting
 - 9. ACI 306.1, Standard Specification for Cold Weather Concreting
 - 10. ACI 308, Guide to External Curing of Concrete
 - 11. ACI 309, Guide for Consolidation of Concrete
 - 12. ACI 318, Building Code Requirements for Structural Concrete and Commentary
 - 13. MNL-15, Field Reference Manual
- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM C31, Standard Method of Making and Curing Concrete Test Specimens in the Field.
 - 2. ASTM C33, Standard Specification for Concrete Aggregates.
 - 3. ASTM C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - 4. ASTM C42, Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - 5. ASTM C94, Standard Specification for Ready-Mixed Concrete.
 - 6. ASTM C138, Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
 - 7. ASTM C143, Standard Test Method for Slump of Portland Cement Concrete.
 - 8. ASTM C150, Standard Specification for Portland Cement.
 - 9. ASTM C156, Standard Test Method for Water Retention by Concrete Curing Materials.
 - 10. ASTM C171, Standard Specification for Sheet Materials for Curing Concrete.
 - 11. ASTM C172, Standard Method of Sampling Fresh Concrete.
 - 12. ASTM C173, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
 - 13. ASTM C231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 - 14. ASTM C260, Standard Specification for Air- Entraining Admixtures for Concrete.
 - 15. ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - 16. ASTM C494, Standard Specification for Chemical Admixtures for Concrete.
 - 17. ASTM C618, Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
 - 18. ASTM C989, Standard Specification for Slag Cement for Use in Concrete and Mortars.
 - 19. ASTM C1017, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
 - 20. ASTM C1064, Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
 - 21. ASTM C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink).

22. ASTM C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
 23. ASTM C1602, Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
 24. ASTM E1155, Standard Test Method for Determining Floor Flatness and Levelness Using the "F Number" System (Inch-Pound) Units.
 25. ASTM E1745, Standard Specification for Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
- C. Corps of Engineers (CRD)
1. CRD-C13, Standard Specification for Air- Entraining Admixtures for Concrete.
 2. CRD-C572, Specifications for Polyvinyl Chloride Water Stops.
 3. CRD-C621, Corps of Engineers Specification for Non-Shrink Grout.

1.3 SUBMITTALS

- A. Product Data: submit manufacturer's data indicating product compliance for the following:
1. Admixtures
 2. Floor hardener
 3. Curing compound
 4. Curing and Sealing compound
 5. Vapor Barrier
 6. Waterstops
 7. Non-shrink grout
- B. Material Certifications: submit certifications showing compliance for the following:
1. Portland cement
 2. Fly ash
 3. Slag cement
 4. Sieve analyses for structural concrete aggregates:
 - a. Coarse aggregate
 - b. Fine aggregate
- C. Structural Concrete Mix Designs for each class of concrete
- D. Concrete Delivery Tickets: Submit sample ready-mixed concrete delivery tickets in accordance with ASTM C94 for each class of concrete.
- E. Construction Joints: submit drawings indicating proposed construction joint locations.

1.4 QUALITY ASSURANCE

- A. Batch Plant Qualifications: Conform to National Ready-Mixed Concrete Association certification requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Transporting: Ready-mixed concrete supplier to have sufficient capacity and adequate facilities to provide continuous delivery at rate required for continuous placement throughout sequence of placement.
- B. Storage of Materials
1. Store cement in weather tight buildings or bins which prevent intrusion of moisture or contaminants. Store different types of cement in separate facilities.
 2. Stockpile aggregates to prevent segregation and contamination with other materials. Thaw frozen aggregates before use.
 3. Drain sand to uniform moisture content before use.
 4. Store admixtures securely to prevent contamination, evaporation, damage or temperature variation in excess of range recommended by manufacturer.
 5. Store waterstops under cover to prevent exposure to sunlight, moisture, soil and other deleterious materials.
- C. Delivery: Truck mixers, agitators and non-agitating units: Conform to ASTM C94

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Ardex Americas
- B. Dayton Superior
- C. Euclid Chemical Company

- D. W.R. Grace & Company
- E. SpecChem
- F. BASF
- G. W.R. Meadows
- H. Sika Corporation
- I. Sonneborn

2.2 MATERIALS

- A. Cementitious materials
 - 1. Portland cement: Conform to ASTM C150, Type I, II or III Portland Cement.
 - 2. Fly Ash: Conform to ASTM C618, carbon content not greater than 3 percent by volume.
 - 3. Slag Cement: Conform to ASTM C989.
- B. Fine aggregate: Conform to ASTM C33, natural bank or river sand, washed and screened, consisting of hard, durable, uncoated particles free of deleterious matter, and graded from coarse to fine to produce a minimum percentage of voids.
- C. Coarse aggregate: Conform to ASTM C33, gravel or crushed stone, suitably processed, washed and screened; consisting of hard, durable particles without adherent coatings.
- D. Water: Conform to ASTM C1602.
- E. Admixtures: Conform to ASTM C494, Type A through G, and used strictly in accordance with manufacturer's recommendations.
- F. Air Entraining Admixtures: Conform to ASTM C260 and CRD-C13.
- G. Calcium chloride thiocyanates or admixture containing more than 0.05 percent chloride ions not permitted in concrete mixtures.
- H. Admixtures containing chlorides not permitted in concrete poured on metal floor deck.

2.3 CURING AND FINISHING PRODUCTS

- A. Liquid Curing Compound
 - 1. Conform to ASTM C309, Types 1 and 1D, Class B
 - 2. Meet federal and state VOC/AIM regulations.
 - 3. Dissipating resin type, which chemically breaks down after approximately 8 weeks.
 - 4. Does not inhibit bonding of flooring adhesives.
 - 5. Does not inhibit bond breaker, where applicable.
 - 6. Sodium silicates prohibited.
 - 7. Use on interior slabs receiving subsequent floor coverings and parking structures.
- B. Curing and Sealing Compounds:
 - 1. Conform to ASTM C1315, Type 1, Class A.
 - 2. Minimum 25 percent solids by volume.
 - 3. Moisture loss not more than 0.30 Kg/M2 when applied at 300 square feet per gallon.
 - 4. Meet federal and state VOC/AIM regulations
 - 5. Do not use in tilt-up construction
- C. Evaporation Retardant:
 - 1. Thin, continuous film which prevents rapid moisture loss from concrete surface.
 - 2. Use in concrete operations performed in direct sun, wind, or high temperatures.
- D. Waterproof Paper:
 - 1. Waterproof paper for curing concrete: 2 ply fiber-reinforced, asphaltic kraft paper conforming to ASTM C171.
- E. Abrasive Aggregate: aluminum oxide aggregate
- F. Floor Hardener:
 - 1. Penetrating liquid for subsequent application
 - 2. Non-staining
 - 3. Combination curing compound and hardener not permitted.
- G. Cement Floor Leveling Compound: Free flowing, self-leveling, pumpable, cementitious compound specially formulated for feather-edge application.
- H. Liquid Densifier / Sealer:
 - 1. Silicate based sealer that penetrates concrete surfaces, increases abrasion resistance, and provides a "low sheen" surface.
 - 2. Clear, non-yellowing, fast curing, chemically neutral, without oils, fillers, extenders and stabilizers.
 - 3. Does not inhibit bonding of flooring adhesives.
 - 4. Does not inhibit bond breaker, where applicable.

- I. Comply with applicable air-quality and environmental regulations.

2.4 MISCELLANEOUS PRODUCTS

A. Waterstops:

1. Bulb Type Waterstops
 - a. Flexible PVC (polyvinyl chloride) extruded from elastomeric plastic material of which basic resin is prime virgin polyvinyl chloride containing no scrap material, reclaimed material or pigment; ribbed, with center bulb and 3/8 inch thickness at base, 6 inch long cross-section. Example product:
 - 1) Greenstreak/Sika #705
 - 2) Southern Metals #15RCB
 - 3) Vinylex #RB638
 - b. Provide factory made waterstop fabrications for changes of direction, intersections, and transitions, leaving only straight butt joint splices for field.
 - c. Provide grommets, pre-punched holes, or hog rings spaced at 12 inches on center along length of waterstop.
 - d. Provide Teflon-coated thermostatically controlled waterstop welding irons for field butt splices.
 2. Adhered Waterstops
 - a. Strip-applied waterstop comprised of a single component, self-sealing mastic. Example product:
 - 1) Greenstreak/Sika Lockstop
 - 2) Southern Metals Stop-Tite
 - 3) Vinylex UltraStop
 - 4) Synko-Flex SF302
 - b. Provide manufacturer's compatible primer adhesive to secure waterstop to concrete
 - c. When required, provide concrete nails in addition to primer adhesive to secure waterstop in vertical applications.
 3. Expanding Waterstops
 - a. Strip-applied, swelling waterstop utilizing high sodium-bentonite content. Example product:
 - 1) Volclay Waterstop-RX
- ### B. Non-Shrink Grout:
1. Pre-mixed, non-shrinking, high strength grout
 2. Compressive strength in 28 days: 5000 psi minimum at 28 days, but not less than specified strength of base concrete.
 3. Conform to ASTM C1107 and CRD-C621.
 4. Non-oxidizing if permanently exposed to view
 5. Exhibits positive expansion when testing in accordance with ASTM C1090.
 6. Example products:
 - a. Euco N-S Grout, manufactured by Euclid Chemical Co.
 - b. Masterflow 713, manufactured by Master Builders Co.
 - c. SikaGrout 212, manufactured by Sika Corporation.

2.5 CONCRETE MIXES

- A. General: Compose concrete of cementitious materials, fine aggregate, coarse aggregate, water, and admixtures where applicable. Design concrete mixes to be workable and appropriate for each application, to bond readily to reinforcement, without segregation or formation of excessive free water on surfaces.
- B. Strength Gain: design concrete mixes to obtain required strength in 28 days or less from date of placement.
- C. Selection of Proportions
 1. Determine ingredient proportions in accordance with ACI 301 to provide required strength, slump, resistance to weathering, placeability, durability and surface hardness for each class of concrete.
 2. Provide admixtures as required or appropriate to enhance workability, control set or improve strength.
 3. Minimum Cement Content: Cement content not less than 320 pounds per cubic yard
 4. Supplementary cementitious materials (fly ash and slag cement)
 - a. Percentage of supplementary cementitious materials not to exceed 25 percent of total cementitious content by weight
 - b. Fly ash not permitted in architecturally exposed concrete
 - c. Supplementary cementitious materials not permitted in concrete receiving dry shake floor

hardeners

D. Required Average Strength for Mix Design:

1. Where suitable strength test records for concrete production facility are available, design strength may be based on standard deviation in accordance with ACI 301.
2. Where strength test records are not available, base design strength on the following:

Specified Strength F' _c - psi	Required Average Strength F' _{cr} - psi
-----	-----
F' _c <3000	F' _c + 1000
3000 ≤ F' _c ≤5000	F' _c + 1200

- E. Documentation of Average Strength: provide evidence of average strength for each class of concrete in accordance with ACI 301 by field strength tests, strength test records or trial mixtures.
- F. Concrete Mix Designs: submit mix designs for each class of concrete.
1. Indicate the following for each mix design:
 - a. Class designation
 - b. Proportions of cement, supplementary cementitious materials, fine and coarse aggregates, and water
 - c. Water-cement ratio, design strength, slump, and air content
 - d. Type of cement, supplementary cementitious materials and aggregates
 - e. Type and dosage of admixtures
 2. Adjust mix designs as required by weather and jobsite conditions to maintain specified strengths throughout course of Work without additional cost to Owner.
 3. As strength data becomes available during progress of Work, mix designs may be adjusted in accordance with ACI 301.
 4. Provide mix with target slump not to exceed 8 inches with no visible signs of segregation.

2.6 PRODUCTION OF CONCRETE

- A. Do not mix concrete for placement until:
1. Mix designs and corresponding strength tests reflect that each proposed mix will develop strengths required
 2. Mix designs have been reviewed for compliance.
- B. Batching and Mixing:
1. Batch and mix ready-mixed concrete in accordance with ASTM C94.
 2. Batch site-mixed concrete with scales accurate to within 0.4 percent of their total capacities. Consistently measure ingredients within 1 percent for concrete and water, 2 percent for aggregates and 3 percent for admixtures during operation of batching equipment. Mix site-batched concrete in accordance ACI 301.
- C. Admixtures: Charge air-entraining admixtures and other chemical admixtures into mixer as solutions and accurately measure by means of a mechanical dispenser. Consider solution as part of mixing water.

2.7 SOURCE QUALITY CONTROL

- A. Laboratory Inspection
1. Verify required plant certifications
 2. Inspect batching equipment periodically
 3. Inspect batching and loading of transit-mix trucks at start of each production day.
- B. Materials Testing
1. Sieve analysis of aggregates

PART 3 - EXECUTION

3.1 PREPARATION

- A. Do not begin delivery of concrete materials until formwork, reinforcement, and embedded items are complete, properly positioned and secured in place.
1. Remove snow, ice, debris and excessive water from forms.
 2. Pre-wet soil and sand subgrades and surfaces of precast concrete to receive fresh concrete.
 3. Position and secure anchors, waterstops, screeds, control joint forms.
 4. Remove hardened concrete and foreign materials from inner surfaces of conveying equipment,

formwork and reinforcing.

- B. Prepare and have ready in good working condition chutes, tremies, pumps, buggies, vibrators and other equipment necessary for orderly and continuous concrete placement.
- C. Where carton-form void forms are used, inspect condition before placing concrete. Replace crushed or weakened boxes and tape joints. Repair sides of grade beam and wall excavations so that not more than 3 inches of ground is visible beyond void box edges.
- D. Inspect and repair vapor barrier where applicable.

3.2 INSTALLATION

- A. Conveying:
 - 1. Prevent separation, segregation and loss of ingredients.
 - 2. Convey concrete from mixer to place of final deposit as rapidly as possible.
 - 3. Take special precautions with belt conveyors to prevent segregation of ingredients, drying and rise in temperature during conveying.
 - 4. Use pumps or pneumatic equipment with adequate pumping capacity. Do not exceed 2 inches of slump loss due to pumping. Do not convey concrete through pipes made of aluminum or aluminum alloy.
 - 5. Thoroughly clean conveying equipment at end of each placement sequence.
- B. Depositing:
 - 1. Place concrete continuously in horizontal layers not more than 12 inches deep. Exercise care to avoid seams or weakened planes within concrete. Deposit concrete into, not away from, previously deposited concrete.
 - 2. Do not place fresh concrete against concrete that would result in cold joints.
 - 3. Do not place concrete which has partially set or that contains foreign material.
 - 4. Avoid splashing forms and reinforcing with concrete.
 - 5. Place concrete in forms as near as practicable to final position. Do not transport concrete in forms with vibrators or screeds.
 - 6. Do not drop concrete directly into standing water. Use a tremie with outlet near bottom of place of deposit.
 - 7. Use tremies, chutes or hoppers to place concrete where a vertical drop greater than 5 feet is required.
 - 8. Do not place concrete when slump tests indicate plasticity greater than required limits.
 - 9. Continuously monitor condition of void box forms during placement of concrete. Avoid piling concrete on void forms. Replace void boxes that partially or wholly collapse under weight of concrete.
 - 10. Indiscriminate addition of water to increase slump is prohibited. When concrete arrives at jobsite with slump below that suitable for placing, water may be added only if neither maximum permissible water-cement ratio nor maximum slump is exceeded.
- C. Consolidating:
 - 1. Conform to ACI 309
 - 2. As soon as concrete is deposited, thoroughly agitate by means of mechanical vibrators and suitable hand tools, to work mixture well into parts and corners of forms, and entirely around reinforcement and inserts.
 - 3. Use mechanical vibrators with minimum frequency of 7000 revolutions per minute.
 - 4. Do not over-vibrate concrete or use vibrators to transport concrete within forms. Insert vibrators vertically at frequent intervals, do not drag vibrators through concrete.
 - 5. Do not insert vibrators into lower courses that have begun to set.
 - 6. Maintain spare vibrators on job site during concrete placing operations.
- D. Placement against hardened concrete:
 - 1. Remove laitance and thoroughly clean and dampen surface of hardened concrete before placement of fresh concrete.
 - 2. If bond is required, roughen surface in an acceptable manner that exposes coarse aggregate and does not leave laitance, loose aggregate particles, or damaged concrete at surface.

3.3 APPLICATION

- A. Construction Joints
 - 1. Each unit of structure to be monolithic in construction except where specifically required to be otherwise.
 - 2. Where required, locate construction joints within middle third of span of conventionally reinforced

- beams and slabs.
- 3. Locate construction joints only where shown in structural Contract Documents or approved submittals.
- B. Weather Conditions:
 - 1. Cold Weather:
 - a. Conform to ACI 306, when average of highest and lowest ambient temperature in a 24-hour period is expected to be less than 40 degrees Fahrenheit for more than 3 successive days.
 - b. Concrete mixture temperature can be adjusted by adding uniformly heated water and/or aggregates that conform to ACI requirements.
 - c. Maintain temperature of deposited concrete between 50 degrees Fahrenheit and 70 degrees Fahrenheit for a minimum of 7 days after placement.
 - d. Clear surfaces to receive concrete and spaces to be filled with concrete of snow, ice, and standing water before placement.
 - e. Discuss cold weather concreting methods with Architect prior to concrete placement.
 - 2. Hot Weather:
 - a. Conform to ACI 305, when ambient temperature is 80 degrees Fahrenheit or higher.
 - b. Maximum allowable fresh concrete temperature is 95 degrees Fahrenheit, unless testing of concrete mixture at higher temperature has been submitted and approved by Architect.
 - c. Concrete mixture temperature can be adjusted by adding chilled water, substituting portions of mixing water with chipped or shaved ice, or other methods that conform to ACI requirements.
 - d. Control concrete surface bleed-water evaporation with application of evaporation reducers, plastic sheeting, fog spray, or wind breaks.
 - e. Discuss hot weather concreting methods with Architect prior to concrete placement.
- C. Composite Concrete/Steel Construction
 - 1. Do not place concrete until inspection and measuring requirements of structural steel, composite metal floor deck and field welded shear studs are complete.
 - 2. Where concrete is to be placed on unshored steel beams, take care to prevent excessive deflection of beams during construction.
 - 3. For beam spans greater than 40 feet, place concrete from center of beams, working towards both ends simultaneously.
 - 4. Screed concrete slabs placed on unshored steel beams to required slab thickness above metal deck. Do not level.
- D. Slab Thickness
 - 1. Allowable deviation from cross sectional dimensions
 - a. Structural slabs on void cartons: minus ¼ inch
 - b. Slabs on ground:
 - 1) Average of samples: minus 3/8 inch
 - 2) Individual sample: minus ¾ inch
- E. Slab Flatness and Levelness:
 - 1. General: Gap under straightedge and between support points of a freestanding 10 foot straightedge conform to the following requirements:
 - a. For slabs on grade and level suspended slabs shored until after testing: plus or minus 1/4 inch in 10 feet in any direction, maximum 1 inch variation between columns, but not to exceed F_L and F_F limits below. Laser leveling of floor slab surface permitted.
 - b. For unshored suspended slabs: plus or minus 1/4 inch in 10 feet in any direction, but not to exceed F_F limits below. See Division 5 Sections for steel frame tolerances. Laser leveling of floor slab surface not permitted.
 - 2. Definitions:
 - a. F_F - maximum variation in floor elevation within any 2-foot length; "flatness"
 - b. F_L - maximum variation in floor elevation between any 2 points separated by 10 feet; "levelness"
 - c. Specified Overall Value - minimum average for Project
 - d. Minimum Local Value - minimum within each column bay
 - 3. Slab flatness and levelness measurements:
 - a. Measure as requested by Owner or Architect when poured slab does not appear to be level. Cost of testing to be at Contractor's expense if the slab results are outside the listed requirements
 - b. Measure in accordance with ASTM E1155 and ACI 117.
 - c. Required minimum flatness and levelness values:
 - 1) Typical Slab
 - a) Slab-on-Grade

- I) Specified Overall Value – F_F 25 / F_L 20
- II) Minimum Local Value – F_F 17 / F_L 15
- b) Level Suspended Slabs Shored Until After Testing
 - I) Specified Overall Value – F_F 25 / F_L 20
 - II) Minimum Local Value – F_F 17 / F_L 15
- c) Unshored Suspended Slabs
 - I) Specified Overall Value – F_F 25
 - II) Minimum Local Value – F_F 17
- 2) Slabs with polished concrete and exposed to view
 - a) Slab-on-Grade
 - I) Specified Overall Value – F_F 36 / F_L 25
 - II) Minimum Local Value – F_F 24 / F_L 15
 - b) Level Suspended Slabs Shored Until After Testing
 - I) Specified Overall Value – F_F 35 / F_L 20
 - II) Minimum Local Value – F_F 24 / F_L 15
 - c) Unshored Suspended Slabs
 - I) Specified Overall Value – F_F 30
 - II) Minimum Local Value – F_F 24

3.4 FINISHING EXPOSED CONCRETE SURFACES

A. General

1. Conform to ACI 302.1.
2. Double screed slabs at required elevations.
3. Provide camber as required.
4. Apply finishing products and cure in accordance with manufacturers' recommendations.

B. Slab Surfaces

1. Scratch Finish
 - a. Locations
 - 1) Surfaces receiving topping slabs
 - 2) Final finish where topping slabs, waterproofing membrane or roofing is placed over finished surface.
 - b. Method: Place, consolidate, strike off, and level concrete. Cut high spots and fill low spots. Roughen surface with stiff brushes or rakes before concrete becomes too stiff to brush or rake.
2. Float finish
 - a. Locations -Walks, steps, and surfaces receiving waterproofing, roofing, insulation, or sand-bed terrazzo.
 - b. Method – Place, consolidate, strike off, and level concrete. Cut high spots and fill low spots. Do not perform further finishing operations until concrete is ready for floating. Floating with hand float, bladed power float equipped with float shoes, or powered disk float. Begin floating when bleed water sheen has disappeared and surface has stiffened sufficiently to permit operation of selected float apparatus. Unless otherwise specified, produce finish that will meet tolerance requirements of ACI 117 for conventional surfaces.
3. Trowel Finish
 - a. Locations – Interior floors.
 - b. Method: Float then trowel concrete surface. Unless otherwise specified, conform to tolerances for a flat surface in accordance with ACI 117. Addition of water to surface to facilitate finishing is prohibited. Do not apply hard-troweled finish to concrete with total air content greater than 3 percent.
4. Broom or belt finish:
 - a. Locations: For parking slabs and exterior surfaces including slabs, ramps, walkways, and steps.
 - b. Method: After concrete has received float finish, give concrete surface a coarse-scored texture by drawing a broom or burlap belt across surface.
 - c. Provide mockup of concrete finish for Architect and Owner approval.
5. Nonslip finish
 - a. Locations: Interior pan type stair treads and platforms, exterior concrete stair treads, ramps, and where specified in Contract Documents.
 - b. Method: Broom or belt finish, or dry-shake finish
 - 1) For dry-shake finish, give surface a dry-shake application of crushed aluminum oxide, at a rate of at least 25 pounds per 100 square feet, unless otherwise specified.
 - c. Provide mockup of concrete finish for Architect and Owner approval.

- C. Saw-Cutting Concrete Slabs-on-Grade
 - 1. Saw joints as soon as possible after finishing, but only after concrete is hard enough. Concrete is hard enough when saw blade does not dislodge aggregate and when edges of sawcut do not ravel.
 - 2. Provide joints a minimum of 1/4 inch wide and 1/4 of slab thickness deep unless noted otherwise in Contract Documents.
 - 3. Formed strips may be used in lieu of saw-cutting in same locations and to equal depth as sawn joints.
- D. Formed Surfaces
 - 1. General: Solidly fill holes resulting from removal of bolts or tie rods with cement grout. Fill holes passing entirely through concrete members from inside face with a plunger-type grease gun or other device to force grout through to outside face.
 - 2. Rough Form Finish
 - a. Locations: For surfaces not exposed to view.
 - b. Remove fins exceeding 1/4 inch in height, and grind bulges that interfere with other trades.
 - c. Fill holes and honeycombs.
 - 3. Smooth Form Finish
 - a. Locations: For surfaces exposed to view.
 - b. Remove fins, bulges and unsightly form marks.
 - c. Fill holes and honeycombs to match surrounding concrete surfaces.
 - d. Provide rubbed finish where satisfactory form finish cannot be achieved.
 - 4. Rubbed Finish
 - a. Locations: For surfaces exposed to view and exposed building grade beams.
 - b. Apply finish as soon as possible after casting concrete, no later than one day following form removal.
 - c. Wet surface and rub with carborundum brick or other abrasive to produce uniform color and texture.
 - d. Patch and dress form tie holes and honeycombs to match color and texture of surrounding concrete.
 - 5. Grout Cleaned Finish
 - a. Locations: For surfaces exposed to view, where specified.
 - b. Thoroughly clean surfaces to be finished.
 - c. Mix 1 part Portland cement and 1 1/2 parts fine sand with sufficient water to produce grout with consistency of thick paint. Use white cement as necessary to match color of surrounding concrete. Wet concrete surfaces to prevent absorption of water from grout. Apply grout uniformly, filling holes and air bubbles. Remove excess grout. After initial set, rub surface with burlap. Wet cure for minimum 36 hours after final rubbing.

3.5 CURING AND PROTECTION

- A. Beginning immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures and mechanical damage. Conform to ACI 308.
- B. Protect surfaces not in contact with forms from moisture loss with one of the following methods immediately after finishing and continuing for a period of at least 7 days:
 - 1. Ponding or continuous sprinkling
 - 2. Application of absorptive mats or fabric kept continuously wet
 - 3. Application of sand kept continuously wet
 - 4. Continuous application of steam or mist
 - 5. Application of waterproof sheet materials
 - 6. Application of curing compound in conformance with ASTM C309. Apply curing compounds in accordance with manufacturer's recommendations.
 - a. Do not use curing compound on any surface against which additional concrete is to be placed or other material is to be bonded, unless it is proven that compound will not inhibit bonding, or positive measures are taken to completely remove compound from areas to received bonded materials.
- C. Protect surfaces cast against forms from moisture loss by keeping forms wet until removed. After form removal, protect exposed surfaces from moisture loss by one of the methods specified for surfaces not in contact with forms
- D. Continue curing for a period of 7 days for Type I cement, 3 days for Type III cement, or until tests indicate that concrete has attained 70 percent of required strength.

3.6 FIELD QUALITY CONTROL

A. Laboratory Testing and Inspection

1. Concrete Compression Testing: Secure composite samples in accordance with ASTM C172. Take samples for strength tests of each mix design placed each day at the following intervals:
 - a. not less than once daily,
 - b. nor less than once for each 150 cubic yards of concrete,
 - c. nor less than once for each 5,000 square feet of surface area for slabs or walls.
2. Mold and cure specimens from each sample in accordance with ASTM C31. Test concrete specimens in accordance with ASTM C39. A single strength test consists of one of the following:
 - a. Four 6 inch by 12 inch cylinders: one cylinder tested at 7 days, two cylinders tested at 28 days, one cylinder held in reserve if needed.
 - b. Five 4 inch by 8 inch cylinders: one cylinder tested at 7 days, three cylinders tested at 28 days, one cylinder held in reserve if needed.
3. Determine slump for each strength test and whenever consistency of concrete appears to vary, in accordance with ASTM C143. Ready mix trucks with Verifi Slump Management System, or approved equal, are permitted.
4. Determine total air content of concrete sample for each strength test.
 - a. Conform to ASTM C231 for normal weight concrete
 - b. Conform to ASTM C138 or C173 for lightweight concrete.
5. Determine concrete temperature by ASTM C1064 for each strength test.
6. Inspection and Monitoring:
 - a. Inspect concrete mixing and loading of transit-mix trucks at plant.
 - b. Water additions during transit permitted in accordance with ASTM C94, with trucks equipped with automated slump and water management systems, such as Verifi Slump Management System.
 - c. Monitor addition of water to concrete at job site and length of time concrete is allowed to remain in truck during pour.
 - d. Certify each delivery ticket indicating class of concrete delivered or poured, amount of water added, time at which cement and aggregate were discharged into truck, and time at which concrete was discharged from truck.

B. Contractor's Responsibilities

1. Furnish necessary labor to assist testing agency in obtaining and handling samples at job-site.
2. Advise testing agency 24 hours in advance of operations to allow for assignment of testing personnel and testing.
3. Provide and maintain for use of testing agency adequate facilities for proper curing of concrete test specimens on project site in accordance with ASTM C31.

C. Evaluation and Acceptance:

1. Strength test is defined as the average of one of the following, made from the same concrete sample tested at 28 days or as determined by Architect:
 - a. Two 6 inch by 12 inch cylinders
 - b. Three 4 inch by 8 inch cylinders
2. Strength level of a given class of concrete will be considered satisfactory if each of the following requirements are met for that class of concrete:
 - a. Average of any three consecutive strength test results equals or exceeds specified strength.
 - b. No strength test result falls below specified strength by more than 500 psi when specified strength is 5,000 psi or less, or by more than 10 percent of specified strength when specified strength is greater than 5,000 psi.
3. Concrete strength tests made and tested by testing laboratory are sole criteria of concrete strength unless in-situ tests are made in accordance with Building Code by a qualified independent testing laboratory. Concrete for which strength tests do not meet criteria for acceptance is considered inadequate until proven otherwise.
4. Where strength tests fail to meet criteria specified herein, Architect is sole judge of structural adequacy of concrete.
 - a. Contractor responsible for burden of proof of structural adequacy. Strength evaluations conform to requirements of ACI 301.
 - b. If Architect determines, based on strength evaluation testing, that structure is of inadequate strength: repair or remove and replace portions of structure in question, as directed by Architect, at no additional expense to Owner.
 - c. If strength tests fall below specified strength, but not so low as to cause concern for structural

adequacy, Architect may request improved conditions of curing or modification of design mixes to improve strength.

3.7 CLEANING AND REPAIR

- A. Upon completion of work, perform the following cleaning and repair procedure:
 - 1. Remove forms, equipment, protective coverings and resulting rubbish from premises.
 - 2. Sweep with ordinary broom and remove mortar, concrete droppings, loose dirt, and mud.
 - 3. Wash concrete floors and platforms with soapsuds and scrub with steel fiber brush.
 - 4. Mop up suds and flush surfaces with clean water.
 - a. Provide adequate measures during scrubbing, mopping, and flushing operations to keep excessive or injurious amounts of water off floors.
 - 5. Promptly, effectively and satisfactorily repair any damage occasioned to such floors by or on account of such operations.
 - 6. Leave finished concrete surfaces in clean condition.
- B. Remove concrete not required by Contract Documents caused by overpour, bulging or collapse of forms or error in form construction.

END OF SECTION

SECTION 03 33 00

ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cast-in-place architectural concrete, including form facings, reinforcement accessories, concrete materials, concrete mixtures, concrete placement, and concrete finishes.
 - 2. Requirements in the Structural Engineer's documents apply to this Section.

1.2 DEFINITIONS

- A. Cast-in-Place Architectural Concrete: Concrete that is exposed to view, is designated as architectural concrete, and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.
- B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- C. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Require representatives of each entity directly concerned with cast-in-place architectural concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Cast-in-place architectural concrete Subcontractor.
 - 2. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction joints, control joints, isolation joints, and joint-filler strips.
 - c. Reinforcement accessory installation.
 - d. Cold- and hot-weather concreting procedures.
 - e. Concrete finishes and finishing.
 - f. Curing procedures.
 - g. Forms and form-removal limitations.
 - h. Shoring and reshoring procedures.
 - i. Concrete repair procedures.
 - j. Protection of cast-in-place architectural concrete.
 - k. Initial curing and field curing of field test cylinders (ASTM C31/C31M).
 - l. Protection of field-cured field test cylinders.

1.4 ACTION SUBMITTALS

- A. Product Data: For each of the following:
 - 1. Form-facing panels.
 - 2. Form liners.
 - 3. Form joint tape.
 - 4. Form joint sealant.
 - 5. Wood sealer.
 - 6. Form-release agent.
 - 7. Surface retarder.
 - 8. Form ties.
 - 9. Bar supports.
 - 10. Portland cement.
 - 11. Fly ash.
 - 12. Slag cement.

13. Blended hydraulic cement.
 14. Silica fume.
 15. Performance-based hydraulic cement.
 16. Aggregates.
 17. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
 18. Repair materials.
- B. Design Mixtures: For each concrete mixture, include the following:
1. Mixture identification.
 2. Minimum 28-day compressive strength.
 3. Durability exposure class.
 4. Maximum w/cm.
 5. Calculated equilibrium unit weight, for lightweight concrete.
 6. Slump limit.
 7. Air content.
 8. Nominal maximum aggregate size.
 9. Amounts of mixing water to be withheld for later addition at Project site if permitted.
 10. Intended placement method.
 11. Alternative design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Shop Drawings:
1. Formwork: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.
 - a. Show formwork construction, including form-liner layout, form-liner termination details, dimensioned locations of form-facing material joints, rustications, construction and contraction joints, form joint-sealant details, form-tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.
 - 1) Included separate layout for formwork used in field sample panels.
 - 2) Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.
 - 3) Location of construction joints is subject to approval of Architect.
- D. Samples: For each of the following materials:
1. Form-facing panels.
 2. Form ties.
 3. Form liners, 24 by 24 inches Sample, indicating texture.
 4. Chamfers and rustications.
- E. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
1. Concrete Class designation.
 2. Location within Project.
 3. Exposure Class designation.
 4. Formed Surface Finish designation and final finish.
 5. Curing process.
- F. Placement Schedule: Submit before start of placement operations.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For the following:
1. Installer: Include copies of applicable ACI certificates.
 2. Ready-mixed concrete manufacturer.
- B. Material Certificates: For each of the following:
1. Cementitious materials.
 2. Admixtures.
 3. Form materials and form-release agents.

4. Repair materials.
 - C. Material Test Reports: For the following, by a qualified testing agency:
 1. Portland cement.
 2. Fly ash.
 3. Slag cement.
 4. Blended hydraulic cement.
 5. Silica fume.
 6. Performance-based hydraulic cement.
 - D. Research Reports: For concrete admixtures in accordance with ICC AC198.
 - E. Preconstruction Test Reports: For each mix design.
 - F. Concrete Repair: Submit a written, detailed description of materials, methods, equipment, and sequence of operations to be used for repairing architectural concrete, including protection of surrounding materials and Project site.
 1. If materials and methods other than those indicated are proposed for any repairs to architectural concrete, add a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project and Installer's ability to use such materials and methods properly.
 - G. Minutes of preinstallation conference.
- 1.6 QUALITY ASSURANCE
- A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
 - B. Installer Qualifications: An experienced cast-in-place architectural concrete installer, as evidenced by not less than five consecutive years' experience, specializing in installing cast-in-place architectural concrete similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
 1. Provide written evidence of qualifications and experience.
 2. Include locations, descriptions, and photographs of completed projects, including name of architect, substantiating the quality of the installer's experience.
 - C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Technical Manager.
 1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Level I.
 2. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Level II.
 - D. Field Sample Panels: After approval of verification sample and before casting architectural concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, cast vertically, approximately 48 by 48 by 6 inches (1200 by 1200 by 150 mm) minimum, to demonstrate the expected range of finish, color, and texture variations.
 1. Locate panels as indicated or, if not indicated, as directed by Architect.
 2. Demonstrate methods of curing, aggregate exposure, wood sealers, and coatings, as applicable.
 3. In presence of Architect, damage part of an exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
 4. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
 5. Demolish and remove field sample panels when directed.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.
 - 1. Include the following information in each test report:
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.
 - d. Seven-day compressive strength.
 - e. 28-day compressive strength.
 - f. Permeability.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301 (ACI 301M).

1.9 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with the Structural Engineer's documents.
- B. Hot-Weather Placement: Comply with the Structural Engineer's documents.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 (ACI 301M) unless modified by requirements in the Contract Documents.

2.2 FORM-FACING MATERIALS

- A. Comply with Structural Engineer's Documents for formwork and other form-facing material requirements, and as specified in this Section.
- B. Source Limitations: Obtain each type of form-facing material from single source from single manufacturer.
- C. Form-Facing Panels for As-Cast Finishes:
 - 1. Steel- and glass-fiber-reinforced plastic, or other approved nonabsorptive panel materials that provide continuous, true, and smooth architectural concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- D. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface treatments and finishes of concrete.
 - 1. Basis-of-Design Manufacturer: Custom Rock Formliner.
- E. Rustication Strips: Metal or rigid plastic, with sides beveled and back kerfed; nonstaining; in longest practicable lengths.
- F. Chamfer Strips: Metal, rigid plastic, elastomeric rubber, or dressed wood, 3/4 by 3/4 inch (19 by 19 mm), minimum; nonstaining; in longest practicable lengths.
- G. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800; minimum 1/4 inch (6 mm) thick.
- H. Form Joint Sealant: Elastomeric sealant complying with ASTM C920, Type M or Type S, Grade NS, that adheres to form joint substrates, does not stain, does not adversely affect concrete surfaces, and does not impair subsequent treatments and finishes of concrete surfaces.
- I. Wood Sealer: Penetrating, clear, polyurethane wood sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood and does not stain, does not adversely affect concrete surfaces, and does not impair subsequent treatments and finishes of concrete surfaces.
- J. Form-Release Agent: Commercially formulated, colorless form-release agent that does not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments and finishes of architectural concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
 - 2. Form-release agent for form liners shall be acceptable to form-liner manufacturer.

- K. Form Ties: Factory-fabricated, glass-fiber-reinforced plastic ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish glass-fiber-reinforced plastic ties, not less than 1/2 inch (13 mm) and not more than 1 inch (25 mm) in diameter, of color selected by Architect from manufacturer's full range.

2.3 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place.
 - 1. Manufacture bar supports in accordance with CRSI's "Manual of Standard Practice."
 - 2. Where legs of wire bar supports contact forms, use gray, all-plastic bar supports.

2.4 CONCRETE MATERIALS

- A. Cementitious Materials: Refer to the Structural Engineer's documents.
- B. Normal-Weight Aggregates: ASTM C33/C33M, Class 5S coarse aggregate or better, graded. Provide aggregates from single source from single manufacturer.
 - 1. Maximum Coarse-Aggregate Size: 1 inch (25 mm).
 - 2. Gradation: Uniformly graded.
- C. Normal-Weight Fine Aggregate: ASTM C33/C33M, manufactured or natural sand, free of materials with deleterious reactivity to alkali in cement, from same source for entire Project.
- D. Air-Entraining Admixture: As indicated in the Structural Engineer's documents.
- E. Chemical Admixtures: As indicated in the Structural Engineer's documents and certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
- F. Water and Water Used to Make Ice: ASTM C94/C94M, potable.

2.5 CURING MATERIALS

- A. Comply with the Structural Engineer's documents.
 - 1. For concrete indicated to be sealed, curing materials shall be compatible with sealer.

2.6 REPAIR MATERIALS

- A. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- B. Epoxy Bonding Adhesive: ASTM C881/C881M two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements.
 - 1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.7 CONCRETE MIXTURES, GENERAL

- A. Obtain each color, size, type, and variety of concrete mixture from single manufacturer with resources to provide cast-in-place architectural concrete of consistent quality in appearance and physical properties.
- B. Prepare design mixtures for each type and strength of cast-in-place architectural concrete proportioned on basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301 (ACI 301M).
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs, based on laboratory trial mixtures.
- C. Admixtures: As indicated in the Structural Engineer's documents. Use admixtures in accordance with manufacturer's written instructions.

2.8 CONCRETE MIXING

- A. Ready-Mixed or Project-Site-Mixed Architectural Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.
 - 1. Clean equipment used to mix and deliver cast-in-place architectural concrete to prevent contamination from other concrete.
 - 2. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.

3. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
4. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

- A. Comply with Section 03 10 00 "Concrete Forming and Accessories" for formwork, embedded items, and shoring and reshoring, and as specified in this Section.
- B. Limit deflection of form-facing panels to not exceed ACI 301 (ACI 301M) requirements.
- C. Limit cast-in-place architectural concrete surface irregularities, as follows:
 1. Surface Finish: ACI 117 (ACI 117M) Class C, in dimension as recommended by manufacturer.
 2. Surface Finish-3.0: ACI 117 (ACI 117M) Class A, 1/8 inch (3.0 mm).
- D. Construct forms to result in cast-in-place architectural concrete that complies with ACI 117 (ACI 117M).
- E. Seal form joints, chamfers, rustication joints, and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.
 1. Provide closure backing materials if indented rustication is used over a ribbed form line, and seal joint between rustication strip and form with joint sealant.
- F. Chamfer exterior corners and edges of cast-in-place architectural concrete.
- G. Coat contact surfaces of wood rustications and chamfer strips with wood sealer before placing reinforcement, anchoring devices, and embedded items.
- H. Coat contact surfaces of forms with form-release agent, in accordance with manufacturer's written instructions, before placing reinforcement, anchoring devices, and embedded items.
- I. Place form liners accurately to provide finished surface texture indicated.
 1. Provide solid backing and attach securely to prevent deflection and maintain stability of liners during concreting.
 2. Secure form liners in place using fasteners that will not transfer impressions onto surface of concrete.
 3. Prevent form liners from sagging and stretching in hot weather.
 4. Seal joints of form liners and form-liner accessories to prevent mortar leaks.
 5. Coat form liner with form-release agent.

3.2 INSTALLATION OF REINFORCEMENT AND ACCESSORIES

- A. Comply with the Structural Engineer's documents for fabricating and installing steel reinforcement and accessories.

3.3 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
 1. Schedule form removal to maintain surface appearance that matches approved field sample panels.
 2. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved its 28-day design compressive strength.
 3. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
 4. Cut off and grind glass-fiber-reinforced plastic form ties flush with surface of concrete.
- B. Clean and repair surfaces of forms to be reused in the Work.
 1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
 2. Apply new form-release agent.

- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
 - 1. Align and secure joints to avoid offsets.
 - 2. Do not use patched forms for cast-in-place architectural concrete surfaces.

3.4 JOINTS

- A. Construction Joints: Install construction joints true to line, with faces perpendicular to surface plane of cast-in-place architectural concrete, so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete. Align construction joint within rustications attached to form-facing material.
 - 3. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- B. Contraction Joints: Form weakened-plane contraction joints true to line, with faces perpendicular to surface plane of cast-in-place architectural concrete, so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.

3.5 CONCRETE PLACEMENT

- A. Comply with the Structural Engineer's documents.

3.6 FINISHING FORMED SURFACES

- A. Comply with the Structural Engineer's documents.
- B. Architectural Concrete Finish: Match Architect's design reference sample, identified and described as indicated, to satisfaction of Architect.
- C. As-Cast Surface Finishes: Comply with the Structural Engineer's documents for the following:
 - 1. ACI 301 (ACI 301M) Surface Finish-3.0 (SF-3.0).
- D. Final Concrete Finish: Comply with the Structural Engineer's documents for the following:
 - 1. Smooth-rubbed finish, unless otherwise indicated.
- E. Form-Liner Finish: Produce a textured surface free of pockets, streaks, and honeycombs, and of uniform appearance, color, and texture.
- F. Maintain uniformity of architectural concrete finishes over construction joints unless otherwise indicated.

3.7 CONCRETE CURING

- A. Comply with the Structural Engineer's documents using identical curing procedures to that used for field sample panels.

3.8 REPAIR

- A. Comply with ACI 301 (ACI 301M).
- B. Repair damaged finished surfaces of cast-in-place architectural concrete when repairing is approved by Architect.
- C. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved field sample panels.
- D. Remove and replace cast-in-place architectural concrete that cannot be repaired to Architect's approval.

3.9 FIELD QUALITY CONTROL

- A. Comply with the Structural Engineer's documents.

3.10 CLEANING

- A. Clean cast-in-place architectural concrete surfaces after finish treatment to remove stains, markings, dust, and debris.
- B. Wash and rinse surfaces in accordance with concrete finish applicator's written instructions.
 - 1. Protect other Work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

3.11 PROTECTION

- A. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.
- B. Protect cast-in-place architectural concrete from staining, laitance, and contamination during remainder of construction period.

3.12 FINAL ACCEPTANCE

- A. Final acceptance of completed architectural concrete Work will be determined by Architect by comparing approved field sample panels with installed Work, when viewed at a distance of 20 feet (6 m).

END OF SECTION

SECTION 03 49 00

GLASS-FIBER-REINFORCED CONCRETE (GFRC)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes glass-fiber-reinforced concrete (GFRC) panels consisting of GFRC, panel frames, anchors, and connection hardware.
 - 1. GFRC panels include column covers and precast stair treads.

1.2 DEFINITIONS

- A. Design Reference Sample: Sample of GFRC color, finish, and texture that has been preapproved by Architect before execution of the Contract.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include GFRC design mixes.
- B. Shop Drawings: Show fabrication and installation details for GFRC panels including the following:
 - 1. Panel elevations, sections, and dimensions.
 - 2. Thickness of facing mix, GFRC backing, and bonding pads for typical panels.
 - 3. Finishes.
 - 4. Joint and connection details.
 - 5. Erection details.
 - 6. Panel frame details for typical panels including sizes, spacings, thicknesses, and yield strengths of various members.
 - 7. Locations and details of connection hardware attached to structure.
 - 8. Sizes, locations, and details of flex and gravity for typical panels.
 - 9. Other items sprayed into panels.
 - 10. Erection sequence for special conditions.
 - 11. Relationship to adjacent materials.
 - 12. Description of loose, cast-in, and field hardware.
- C. Samples for Verification: For each type of finish indicated on exposed GFRC surfaces, representative of finish, color, and texture variations expected, approximately 12 by 12 inches (305 by 305 mm) by actual thickness.
- D. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.

1.4 INFORMATIONAL SUBMITTALS

- A. Steel Sheet Certificates: For steel sheet used in cold-formed steel panel framing, mill certificates signed by manufacturers of steel sheet, or test reports from a qualified testing agency, indicating that steel sheet used in cold-formed metal panel framing complies with requirements including uncoated steel thickness, yield strength, tensile strength, total elongation, chemical requirements, and galvanized-coating thickness.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Designated a PCI-certified plant for Group G - Glass Fiber Reinforced Concrete.
- B. Installer Qualifications: Manufacturer of GFRC panels.
- C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - a. Include typical components, attachments to building structure, and methods of installation.
 - b. Include sealant-filled joint complying with requirements in Section 07 92 00 "Joint Sealants."
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handle and transport GFRC panels supported on nonstaining material and with nonstaining resilient spacers between panels.
- B. Store GFRC panels off of ground on firm, level, and smooth surfaces supported on nonstaining material and with nonstaining resilient spacers between panels. Place stored panels so identification marks are clearly visible.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain GFRC panels from single source from single manufacturer.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Armstrong World Industries, Inc.
 - 2. Concreteworks East.
- C. Basis-of-Design Product for Column Covers: Armstrong World Industries, Inc.; Castworks.
 - 1. Color: As selected by Architect from manufacturer's full range.
- D. Basis-of-Design Manufacturer for Precast Stair Treads: Concreteworks East.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design GFRC panels, including panel frames, anchors, and connections.
- B. Structural Performance: GFRC panels, including panel frames, anchors, and connections, shall withstand the following design loads as well as the effects of thermal- and moisture-induced dimensional changes within limits and under conditions indicated:
 - 1. Loads: As indicated.
 - 2. Deflection Limits: Design panel frames to withstand design loads without lateral deflections greater than 1/240 of wall span.
 - 3. Thermal Movements: Provide for thermal movements resulting from annual ambient temperature changes of 80 deg F (26 deg C).
 - 4. Design panel frames and connections to accommodate deflections and other building movements.
 - 5. Design panel frames to transfer window loads to building structure.
- C. PCI Manuals: Comply with requirements and recommendations in the following PCI manuals unless more stringent requirements are indicated:
 - 1. PCI MNL 128, "Recommended Practice for Glass Fiber Reinforced Concrete Panels."
 - 2. PCI MNL 130, "Manual for Quality Control for Plants and Production of Glass Fiber Reinforced Concrete Products."
- D. AISC Specifications: Comply with AISC 360, "Specification for Structural Steel Buildings."

2.3 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that provides continuous GFRC surfaces within tolerances; nonreactive with GFRC and capable of producing required finish surfaces.
 - 1. Mold-Release Agent: Commercially produced liquid-release agent that does not bond with, stain, or adversely affect GFRC surfaces and does not impair subsequent surface or joint treatments of GFRC.

2.4 GFRC MATERIALS

- A. Portland Cement: ASTM C 150/C 150M; Type I, II, or III.
 - 1. For surfaces exposed to view in finished structure, use gray of same type, brand, and source throughout GFRC production.
- B. Metakaolin: ASTM C 618, Class N.
- C. Glass Fibers: Alkali resistant, with a minimum zirconia content of 16 percent, 1 to 2 inches (25 to 50 mm) long, specifically produced for use in GFRC, and complying with ASTM C 1666/C 1666M.

- D. Sand: Washed and dried silica, complying with composition requirements in ASTM C 144; passing a No. 20 (0.85-mm) sieve with a maximum of 2 percent passing a No. 100 (0.15-mm) sieve.
- E. Facing Aggregate: ASTM C 33/C 33M, except for gradation, and PCI MNL 130, 1/4-inch (6-mm) maximum size.
 - 1. Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match sample.
 - 2. Fine Aggregate: Natural or manufactured sand with a maximum of 5 percent passing a No. 100 (0.15-mm) sieve and a maximum of 3 percent passing a No. 200 (0.075-mm) sieve.
- F. Coloring Admixture: ASTM C 979/C 979M, synthetic mineral-oxide pigments or colored water-reducing admixtures, temperature stable, nonfading, and alkali resistant.
- G. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of GFRC and complying with chemical limits in PCI MNL 130.
- H. Polymer-Curing Admixture: Acrylic thermoplastic copolymer dispersion complying with PCI MNL 130.
- I. Chemical Admixtures: ASTM C 494/C 494M, containing not more than 0.1 percent chloride ions.

2.5 ANCHORS, CONNECTORS, AND MISCELLANEOUS MATERIALS

- A. Stainless-Steel Plates: ASTM A 240/A 240M or ASTM A 666, Type 304.
- B. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M, finished as follows:
 - 1. Finish: Zinc coated by electrodeposition according to ASTM B 633, SC 3.
- C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- D. Carbon-Steel Bars: ASTM A 108, Grade 1018, not less than 1/4 inch (6 mm) in diameter, finished as follows:
 - 1. Finish: Zinc coated by electrodeposition according to ASTM B 633, SC 3.
- E. Bolts: ASTM A 307 (ASTM F 568M) or ASTM F 3125/F 3125M, Grade A325 (Grade A325M) finished as follows:
 - 1. Finish: Zinc coated by electrodeposition according to ASTM B 633, SC 3.

2.6 PANEL FRAME MATERIALS

- A. Cold-Formed Steel Framing: Manufacturer's standard C-shaped steel studs, complying with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members," with minimum uncoated steel thickness of 0.053 inch (1.35 mm) of web depth indicated; with stiffened flanges, U-shaped steel track; and of the following steel sheet:
 - 1. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, structural-steel sheet, G60 (Z180) zinc coating, of grade required by structural performance of framing.

2.7 GFRC MIXES

- A. Face Mix: Proportion face mix of portland cement, sand, facing aggregates, and admixtures to comply with design requirements.
- B. Backing Mix: Proportion backing mix of portland cement, glass fibers, sand, and admixtures to comply with design requirements. Provide nominal glass-fiber content of not less than 5 percent by weight of total mix.
- C. Air Content: 8 to 10 percent; ASTM C 185.
- D. Coloring Admixture: Not to exceed 10 percent of cement weight.

2.8 PANEL FRAME FABRICATION

- A. Fabricate panel frames and accessories plumb, square, true to line, and with components securely fastened.
 - 1. Fabricate panel frames using jigs or templates.
 - 2. Cut cold-formed metal framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed metal framing members by welding. Comply with AWS D1.3/D1.3M.
 - 4. Weld anchors to panel frames.
- B. Reinforce framing assemblies, as necessary, to withstand erection stresses.
- C. Galvanizing Repair: Touch up damaged galvanized surfaces according to ASTM A 780/A 780M.

2.9 MOLD FABRICATION

- A. Construct molds that result in finished GFRC complying with profiles, dimensions, and tolerances indicated, without damaging GFRC during stripping. Construct molds to prevent water leakage and loss of cement paste.
 - 1. Coat contact surfaces of molds with form-release agent.

2.10 GFRC FABRICATION

- A. Proportioning and Mixing: For backing mix, meter sand/cement slurry and glass fibers to spray head at rates to achieve design mix proportions and glass-fiber content according to PCI MNL 130 procedures.
- B. Spray Application: Comply with general procedures as follows:
 - 1. Spray or place face mix in thickness indicated on Shop Drawings.
 - 2. Consolidate backing mix by rolling or other technique to achieve complete encapsulation of glass fibers and compaction.
 - 3. Measure thickness with a pin gage or other acceptable method at least once for every 5 sq. ft. (0.5 sq. m) of panel surface. Take no fewer than six measurements per panel.
- C. Hand form and consolidate intricate details, incorporate formers or infill materials, and overspray before material reaches initial set to ensure complete bonding.
- D. Attach panel frame to GFRC before initial set of GFRC backing, maintaining a minimum clearance of 1/2 inch (13 mm) from GFRC backing, and without anchors protruding into GFRC backing.
- E. Build up homogeneous GFRC bonding pads over anchor feet, maintaining a minimum thickness of 1/2 inch (13 mm) over tops of anchor feet, before initial set of GFRC backing. Measure bonding pad thickness at 25 percent of anchor locations.
- F. Inserts and Embedments: Build up homogeneous GFRC bosses or bonding pads over inserts and embedments to provide enough anchorage and embedment to comply with design requirements.
- G. Curing: Employ initial curing method that ensures sufficient strength for removing units from mold. Comply with PCI MNL 130 procedures.
 - 1. Keep moisture off of the surfaces of mixes with polymer curing admixtures during the first three hours of curing. Maintain temperature between 60 and 120 deg F (16 and 49 deg C) during the first 16 hours.
 - 2. Prevent drying of moist curing mixes during the first 24 hours. Maintain units in surface-damp condition at a temperature above 60 deg F (16 deg C) and 95 percent relative humidity for seven days.
- H. Panel Identification: Mark each GFRC panel to correspond with identification mark on Shop Drawings. Mark each panel with its casting date.

2.11 SOURCE QUALITY CONTROL

- A. Quality-Control Testing: Establish and maintain a quality-control program for manufacturing GFRC panels according to PCI MNL 130.
 - 1. Test materials and inspect production techniques.
 - 2. Quality-control program shall monitor glass-fiber content, spray rate, unit weight, product physical properties, anchor pull-off and shear strength, and curing period and conditions.
 - 3. Prepare test specimens and test according to ASTM C 1228, PCI MNL 130, and PCI MNL 128 procedures.
 - 4. Test GFRC inserts and anchors according to ASTM C 1230 to validate design values.
 - 5. Produce test boards at a rate of no fewer than one per work shift per operator for each spray machine and for each mix design.
 - a. For each test board, determine glass-fiber content according to ASTM C 1229 and flexural yield and ultimate strength according to ASTM C 947.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine structure and conditions for compliance with requirements for installation tolerances, bearing surfaces, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

- A. Install clips, hangers, and other accessories required for connecting GFRC panels to supporting members and backup materials.
- B. Install GFRC panels level, plumb, square, and in alignment. Provide temporary supports and bracing as required to maintain position, stability, and alignment of panels until permanent connections are completed.
 - 1. Maintain horizontal and vertical joint alignment and uniform joint width.
 - 2. Remove projecting hoisting devices.
- C. Connect GFRC panels in position by bolting or welding, or both, as indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as possible after connecting is completed.
- D. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.3/D1.3M requirements for welding, appearance, quality of welds, and methods used in correcting welding work.
 - 1. Protect GFRC panels from damage by field welding or cutting operations, and provide noncombustible shields as required.
- E. At bolted connections, use lock washers or other acceptable means to prevent loosening of nuts.

3.3 REPAIRS

- A. Repairs are permitted provided structural adequacy of GFRC panel and appearance are not impaired, as approved by Architect.
- B. Mix patching materials and repair GFRC so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces.
- C. Prepare and repair accessible damaged galvanized coatings with galvanizing repair paint according to ASTM A 780/A 780M.
- D. Remove and replace damaged GFRC panels when repairs do not comply with requirements.

3.4 CLEANING AND PROTECTION

- A. Perform cleaning procedures, if necessary, according to GFRC manufacturer's written instructions. Clean soiled GFRC surfaces with detergent and water, using soft fiber brushes and sponges, and rinse with clean water. Prevent damage to GFRC surfaces and staining of adjacent materials.

END OF SECTION

SECTION 03 54 16

HYDRAULIC CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Polymer-modified, self-leveling, hydraulic cement underlayment for application below interior floor coverings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.

1.4 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.
 - 1. Place hydraulic cement underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F (10 and 27 deg C).

PART 2 - PRODUCTS

2.1 HYDRAULIC CEMENT UNDERLAYMENTS

- A. Hydraulic Cement Underlayment: Polymer-modified, self-leveling, hydraulic cement product that can be applied in minimum uniform thickness of 1/4 inch (6 mm) and that can be feathered at edges to match adjacent floor elevations.
 - 1. Products Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ARDEX; K-15 Self-Leveling Underlayment Concrete.
 - b. Dayton Superior Corporation; LeveLayer.
 - c. MAPEI Corporation; Ultraplan Easy.
 - d. Maxxon Corporation; Level-Right.
 - e. Specialty Construction Brands, Inc.; an H.B. Fuller company; TEC Smooth Start.
- B. Cement Binder: ASTM C 150/C 150M, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.
- C. Compressive Strength: Not less than 4000 psi (27.6 MPa) at 28 days when tested according to ASTM C 109/C 109M.
- D. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm); or coarse sand as recommended by underlayment manufacturer.
 - 1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.
- E. Water: Potable and at a temperature of not more than 70 deg F (21 deg C).
- F. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.
- G. Surface Sealer: Designed to reduce porosity as recommended by manufacturer for type of floor covering to be applied to underlayment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for conditions affecting performance of the Work.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Prepare and clean substrate according to manufacturer's written instructions.
 - 1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
 - 2. Fill substrate voids to prevent underlayment from leaking.
- B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.
 - 1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test, ASTM F1869: Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/100 sq. m) in 24 hours.
 - b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 85 percent relative humidity level measurement, or as recommended by hydraulic cement underlayment manufacturer.
- C. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

3.3 APPLICATION

- A. General: Mix and apply underlayment components according to manufacturer's written instructions.
 - 1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
 - 2. Coordinate application of components to provide optimum adhesion to substrate and between coats.
 - 3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
- B. Apply underlayment to produce uniform, level surface.
 - 1. Apply a final layer without aggregate to product surface.
 - 2. Feather edges to match adjacent floor elevations.
- C. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.
- D. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.
- E. Apply surface sealer at rate recommended by manufacturer.
- F. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 PROTECTION

- A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION

SECTION 04 01 10
MASONRY CLEANING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes cleaning the following:
1. Unit masonry surfaces.

1.2 DEFINITIONS

- A. Very Low-Pressure Spray: Under 100 psi (690 kPa).
B. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).
C. Medium-Pressure Spray: 400 to 800 psi (2750 to 5510 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).
D. High-Pressure Spray: 800 to 1200 psi (5510 to 8250 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
1. Review methods and procedures related to cleaning masonry including, but not limited to, the following:
 - a. Verify masonry-cleaning equipment and facilities needed to make progress and avoid delays.
 - b. Materials, material application, and sequencing.
 - c. Cleaning program.

1.4 SEQUENCING AND SCHEDULING

- A. Work Sequence: Perform masonry-cleaning work in the following sequence:
1. Remove plant growth.
 2. Inspect for open mortar joints. Where repairs are required, delay further cleaning work until after repairs are completed, cured, and dried to prevent the intrusion of water and other cleaning materials into the wall.
 3. Remove paint.
 4. Clean masonry surfaces.
 5. Where water repellents are to be used on or near masonry, delay application of these chemicals until after cleaning.
- B. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in masonry units according to masonry repair Sections. Patch holes in mortar joints according to masonry repointing Sections.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include material descriptions and application instructions.
 2. Include test data substantiating that products comply with requirements.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For chemical-cleaner manufacturer.
B. Preconstruction Test Reports: For cleaning materials and methods.
C. Cleaning program.

1.7 QUALITY ASSURANCE

- A. Chemical-Cleaner Manufacturer Qualifications: A firm regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection, preconstruction product testing, and on-site assistance.
- B. Cleaning Program: Prepare a written cleaning program that describes cleaning process in detail, including materials, methods, and equipment to be used; protection of surrounding materials; and control of runoff during operations. Include provisions for supervising worker performance and preventing damage.
 - 1. If materials and methods other than those indicated are proposed for any phase of cleaning work, add a written description of such materials and methods, including evidence of successful use on comparable projects and demonstrations to show their effectiveness for this Project.
- C. Mockups: Prepare mockups of cleaning on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Cleaning: Contact Independent Representative Firm, MW Escue Company, to assist with cleaning test panels before purchasing material for project.
 - a. Clean an area as indicated for each type of masonry and surface condition.
 - b. Test cleaners and methods on samples of adjacent materials for possible adverse reactions. Do not test cleaners and methods known to have deleterious effect.
 - c. Allow a waiting period of not less than seven days after completion of sample cleaning to permit a study of sample panels for negative reactions.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage one or more chemical-cleaner manufacturers to perform preconstruction testing on masonry surfaces.
 - 1. Use test areas as indicated and representative of proposed materials and existing construction.
 - 2. Propose changes to materials and methods to suit Project.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit masonry-cleaning work to be performed according to product manufacturers' written instructions and specified requirements.
- B. Clean masonry surfaces only when air temperature is 40 deg F (4 deg C) and above and is predicted to remain so for at least seven days after completion of cleaning.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. PROSOCO, Inc.
 - a. Contact for Independent Representative Firm:
MW Escue Company.
Lance Escue – 901-277-907 ; lance@mwescue.com
Meredith Escue – 901-277-7580 ; meredith@mwescue.com

2.2 CLEANING MATERIALS

- A. Water: Potable.
- B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).
- C. Chemical Cleaner: Manufacturer's standard system that does not contain hydrofluoric acid.
 - 1. Acceptable Product: PROSOCO, Inc.; Enviro Klean SafRestorer.
- D. Acidic Cleaner for Mortar: Manufacturer's standard system for new masonry surfaces that are subject to vanadium, manganese and other metallic stains.
 - 1. Acceptable Product: PROSOCO, Inc.; Sure Klean Vana Trol.

2.3 ACCESSORY MATERIALS

- A. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, glazed masonry, and polished stone surfaces from damaging effects of acidic and alkaline masonry cleaners.

2.4 CHEMICAL CLEANING SOLUTIONS

- A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended in writing by chemical-cleaner manufacturer.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent paint removers and chemical cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.
 - 1. Cover adjacent surfaces with materials that are proven to resist paint removers and chemical cleaners used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant. Apply masking agents according to manufacturer's written instructions. Do not apply liquid strippable masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
 - 2. Do not apply chemical solutions during winds of enough force to spread them to unprotected surfaces.
 - 3. Neutralize alkaline and acid wastes before disposal.
 - 4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.
- B. Remove gutters and downspouts and associated hardware adjacent to immediate work area and store during masonry cleaning. Reinstall when masonry cleaning is complete.
 - 1. Provide temporary rain drainage during work to direct water away from building.

3.2 CLEANING MASONRY, GENERAL

- A. Cleaning Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 20 feet (6 m) away by Architect.
- B. Proceed with cleaning in an orderly manner; work from bottom to top of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.
- C. Use only those cleaning methods indicated for each masonry material and location.
 - 1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.
 - 2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage surfaces, including joints.
 - a. Equip units with pressure gages.
 - b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
 - c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
 - d. For high-pressure water-spray application, use fan-shaped spray that disperses water at an angle of at least 40 degrees.
 - e. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.
- D. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces. Keep wall wet below area being cleaned to prevent streaking from runoff.

- E. Perform additional general cleaning, paint and stain removal, and spot cleaning of small areas that are noticeably different when viewed according to the "Cleaning Appearance Standard" Paragraph, so that cleaned surfaces blend smoothly into surrounding areas.
 - F. Water Application Methods:
 - 1. Water-Soak Application: Soak masonry surfaces by applying water continuously and uniformly to limited area for time indicated. Apply water at low pressures and low volumes in multiple fine sprays using perforated hoses or multiple spray nozzles. Erect a protective enclosure constructed of polyethylene sheeting to cover area being sprayed.
 - 2. Water-Spray Applications: Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from masonry surface and apply water in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.
 - G. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces according to chemical-cleaner manufacturer's written instructions; use brush application. Do not allow chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.
 - H. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.
 - 1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.
 - I. After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.
- 3.3 PRELIMINARY CLEANING
- A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing remaining growth to dry as long as possible before removal. Remove loose soil and plant debris from open joints to whatever depth they occur.
 - B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, calking, asphalt, and tar.
 - 1. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.
 - C. Ensure masonry surfaces are prepared to receive painting. Refer to Section 09 91 13 "Exterior Painting" for additional surface preparation requirements.
- 3.4 CLEANING MASONRY
- A. Cold-Water Wash: Use cold water applied by high-pressure spray.
 - B. Hot-Water Wash: Use hot water applied by high-pressure spray.
 - C. Nonacidic Liquid Chemical Cleaning:
 - 1. Wet surface with fresh water applied by low-pressure spray, as recommended by manufacturer.
 - 2. Apply cleaner to surface by brush.
 - 3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
 - 4. Rinse with clean water applied by pressure spray, in pressure level as recommended by manufacturer, to remove chemicals and soil.
 - 5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.
 - D. Acidic Chemical Cleaning:
 - 1. Wet surface with cold water applied by low-pressure spray.
 - 2. Apply cleaner to surface by brush or low-pressure spray.
 - 3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
 - 4. Rinse with cold water applied by high-pressure spray to remove chemicals and soil. Rinse until all foaming, if any, stops and suds disappear.
 - 5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage chemical-cleaner manufacturer's factory-authorized service representatives for consultation and Project-site inspection, to perform preconstruction product testing, and provide on-site assistance when requested by Architect. Have paint-remover manufacturer's and chemical-cleaner manufacturer's factory-authorized service representatives visit Project site not less than once to observing progress and quality of the work.

3.6 FINAL CLEANING

- A. Clean adjacent nonmasonry surfaces of spillage and debris. Use detergent and soft brushes or cloths.
- B. Remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.
- C. Remove masking materials, leaving no residues that could trap dirt.

END OF SECTION

SECTION 04 20 00

UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units.
 - 2. Decorative concrete masonry units.
 - 3. Clay face brick.
 - 4. Mortar and grout.
 - 5. Steel reinforcing bars.
 - 6. Masonry-joint reinforcement.
 - 7. Ties and anchors.
 - 8. Embedded flashing.
 - 9. Miscellaneous masonry accessories.
- B. Products Installed but not Furnished under This Section:
 - 1. Steel lintels in unit masonry.
 - 2. Steel shelf angles for supporting unit masonry.
 - 3. Cavity wall insulation.

1.2 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination."

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - a. Show locations of control joints including additional proposed locations that may not be indicated on the Drawings.
 - 2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.
 - 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Initial Selection:
 - 1. Colored mortar.
- D. Samples for Verification: For each type and color of the following:
 - 1. Decorative CMUs.
 - 2. Clay face brick, in the form of straps of five or more bricks.
 - 3. Special brick shapes.
 - 4. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project.
 - 5. Weep holes and cavity vents.
 - 6. Accessories embedded in masonry.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of the following:
 - 1. Masonry units.
 - a. Include data on material properties.

- b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
 - c. For exposed brick, include test report for efflorescence according to ASTM C 67.
 2. Integral water repellent used in CMUs.
 3. Cementitious materials. Include name of manufacturer, brand name, and type.
 4. Mortar admixtures.
 5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 6. Grout mixes. Include description of type and proportions of ingredients.
 7. Reinforcing bars.
 8. Joint reinforcement.
 9. Anchors, ties, and metal accessories.
- B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.

1.6 QUALITY ASSURANCE

- A. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 01 40 00 "Quality Requirements" for mockups.
 1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 48 inches (1200 mm) long by 36 inches (900 mm) high by full thickness.
 2. Build sample panels facing south.
 3. Where masonry is to match existing, build panels adjacent and parallel to existing surface.
 4. Clean one-half of exposed faces of panels with masonry cleaner indicated.
 5. Protect approved sample panels from the elements with weather-resistant membrane.
 6. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
 - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless Architect specifically approves such deviations in writing.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 1. Build mockups as shown on Drawings, including face and backup wythes, fenestrations, flashing, and accessories. Comply with Section 01 43 39 "Mockups."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls, and hold cover securely in place.

2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe, and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 2. Protect sills, ledges, and projections from mortar droppings.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.
- C. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance-ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.
 1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.3 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 2. Provide square-edged units for outside corners unless otherwise indicated.
 3. Provide bullnose units at all exposed interior outside corners, including corners of door and window openings, of finished CMU walls and bullnosed blocks with solid top at CMU windowsills not indicated to receive other sill material on top of the CMU sill.
- B. CMUs: ASTM C90.
 1. Density Classification: Lightweight.

2. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
- C. Decorative CMUs: ASTM C90.
1. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph.
 2. Pattern and Texture: As scheduled.
 3. Colors:
 - a. Basis-of-Design Product: Featherlite; Lubbock Block Plant, Terrazzo.
 4. Special Aggregate: Provide units made with aggregate matching aggregate in Architect's sample.
- 2.4 MASONRY LINTELS
- A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.
- 2.5 BRICK
- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
 2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
 3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
 4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Clay Face Brick: Facing brick complying with ASTM C216.
1. Grade: SW.
 2. Type: FBS.
 3. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested according to ASTM C67.
 4. Efflorescence: Provide brick that has been tested according to ASTM C67 and is rated "not effloresced."
 5. Application: Use where brick is exposed unless otherwise indicated.
 6. Where shown to "match existing," provide face brick matching color range, texture, and size of existing adjacent brickwork.
 7. Size and Texture: As indicated on Drawings.
 8. Color:
 - a. Basis-of-Design: Endicott; Graphite.
- 2.6 MORTAR AND GROUT MATERIALS
- A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C114.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Masonry Cement: ASTM C 91/C 91M.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cemex S.A.B. de C.V.
 - b. Essroc.
 - c. Holcim (US) Inc.
 - d. Lafarge North America Inc.
 - e. Lehigh Hanson; Heidelberg Cement Group.

- E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.
 - 1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:
 - a. Davis Colors; True Tone Mortar Colors.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
 - d. Solomon Colors, Inc; Solomon Colors Mortar Colors.
 - F. Colored Cement Products: Packaged blend made from portland cement and hydrated lime or masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.
 - 1. Colored Portland Cement-Lime Mix:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Essroc.
 - 2) Holcim (US) Inc.
 - 3) Lafarge North America Inc.
 - 4) Lehigh Hanson; Heidelberg Cement Group.
 - 2. Colored Masonry Cement:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Cemex S.A.B. de C.V.
 - 2) Essroc.
 - 3) Holcim (US) Inc.
 - 4) Lafarge North America Inc.
 - 5) Lehigh Hanson; Heidelberg Cement Group.
 - 3. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
 - 4. Pigments shall not exceed 10 percent of portland cement by weight.
 - 5. Pigments shall not exceed 5 percent of masonry cement by weight.
 - G. Aggregate for Mortar: ASTM C144.
 - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 - 2. For joints less than 1/4-inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18 mm) sieve.
 - H. Aggregate for Grout: ASTM C404.
 - I. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
 - 1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:
 - a. BASF Aktiengesellschaft; MasterSet FP 20.
 - b. Euclid Chemical Company (The); an RPM International company; ACCELGUARD 80.
 - c. GCP Applied Technologies Inc., MORSET.
 - J. Water: Potable.
- 2.7 REINFORCEMENT
- A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60 (Grade 420).
 - B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77 mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Dur-O-Wal; a Hohmann & Barnard company.
 - b. Heckmann Building Products, Inc.
 - c. Hohmann & Barnard, Inc.

- d. Lock Rite.
 - e. Wire-Bond.
- C. Vertical Reinforcement: Unless noted otherwise on Structural Drawings, the minimum vertical reinforcement at concrete masonry unit wall shall be #4 bars at 32 inches o.c. with #4 by 48-inch dowels at 32 inches o.c. aligned with grouted cells.
- D. Masonry-Joint Reinforcement, General: ASTM A951/A951M.
- 1. Interior Walls: Hot-dip galvanized carbon steel.
 - 2. Exterior Walls: Stainless steel, Type 304.
 - 3. Wire Size for Side Rods: 0.187-inch (4.76 mm) diameter.
 - 4. Wire Size for Cross Rods: 0.148-inch (3.77 mm) diameter.
 - 5. Wire Size for Veneer Ties: 0.187-inch (4.76 mm) diameter.
 - 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
 - 7. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.
- E. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder or truss type with single pair of side rods, unless otherwise noted in Structural Drawings or specifications.
- F. Masonry-Joint Reinforcement for Multiwythe Masonry:
- 1. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe, unless otherwise noted in Structural Drawings or specifications, and with separate adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches (32 mm). Size ties to extend at least halfway through facing wythe but with at least 5/8-inch (16-mm) cover on outside face.
 - 2. Products to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Dur-O-Wall; Truss Design DA3700 Dur-O-Eye.
 - b. Wire-Bond; Series 900 Level Hook and Eye Truss.
- 2.8 TIES AND ANCHORS
- A. General: Ties and anchors shall extend at least 1-1/2 inches (38 mm) into veneer but with at least a 5/8-inch (16 mm) cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
- 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.
 - 2. Stainless-Steel Wire: ASTM A580/A580M, Type 304.
 - 3. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
 - 4. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Corrugated-Metal Ties: Not allowed.
- D. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches (100 mm) wide.
- 1. Where wythes do not align or are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches (32 mm).
 - 2. Wire: Fabricate from 3/16-inch- (4.76 mm-) diameter, hot-dip galvanized steel wire.
- E. Partition Top Anchors: 0.105-inch- (2.66 mm-) thick metal plate with a 3/8-inch- (9.5 mm-) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- F. Adjustable Masonry-Veneer Anchors:
- 1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf (445-N) load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch (1.5 mm).
 - 2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.105-inch- (2.66 mm-) thick steel sheet, galvanized after fabrication.
 - 3. Fabricate wire ties from 0.187-inch- (4.76 mm-) diameter, hot-dip galvanized-steel wire unless otherwise indicated.

4. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a gasketed sheet metal anchor section, 1-1/4 inches (32 mm) wide by 6 inches (152 mm) long, with screw holes top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation or sheathing; and raised rib-stiffened strap, 5/8 inch (16 mm) wide by 6 inches (152 mm) long, stamped into center to provide a slot between strap and base for inserting wire tie. Self-adhering, modified bituminous gasket fits behind anchor plate and extends beyond pronged legs. Where continuous insulation is shown, provide anchor portion with tabs to prevent crushing of insulation when installed.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Hohmann & Barnard, Inc.
 - 2) Wire-Bond.
5. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 (4.83 mm) diameter by length required to penetrate steel stud flange with not less than three exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours according to ASTM B117.

2.9 EMBEDDED FLASHING MATERIALS

- A. Flexible Flashing: Use the following unless otherwise indicated:
 1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch (1.02 mm).
 - a. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Carlisle Coatings & Waterproofing Inc.; CCW-705-TWF Thru-Wall Flashing.
 - 2) GCP Applied Technologies Inc.; Perm-A-Barrier Wall Flashing.
 - 3) Polyguard Products, Inc.; Polyguard 400.
 - b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
- B. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.
- C. Termination Bars: Provide stainless steel termination bars in cavity walls where copper flashing will be installed with termination bars to concrete block backup and with waterproof sealant to protect top side of terminations refer to Division 07 section on "Joint Sealants."
 1. Do not use termination bars at face of sheathing unless specifically detailed otherwise in the Drawings. Through-wall flashings at stud construction shall extend through and turn up behind exterior sheathing and CI insulation. Air barrier system materials (per Division 07 Air Barrier Sections) shall lap over and down the face of the through-wall flashings.
 2. Termination Bars for Flexible Flashing: #304 Stainless steel sheet 0.090 inch by 3/4 inches minimum with a 3/16-inch minimum sealant flange at top, 8 inch o.c. pre-punched bolt holes minimum.
 3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products
 4. that may be incorporated into the Work include, but are not limited to, the following:
 - a. OMG Roofing Products
 - b. Hohmann & Barnard, Inc. (T1 with Foam-Tite option)
 - c. Wire-Bond.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).
- D. Weep/Cavity Vent Products: Use the following unless otherwise indicated:

1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe, in color selected from manufacturer's standard.
 - a. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Heckmann Building Products, Inc.; No. 85 Cell Vent.
 - 2) Hohmann & Barnard, Inc.; QV Quadro-Vent.
 - 3) Wire-Bond; #3601 Cell Vent
 - 4) Mortar Net Solutions; CellVent.
 - b. Colors: As selected by Architect, to minimize appearance for each color of mortar or exposed masonry condition.
 - E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
 1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:
 - a. Heckmann Building Products, Inc.; #84 WallDefender.
 - b. Hohmann & Barnard, Inc.; Mortar Trap.
 - c. Mortar Net Solutions; MortarNet.
 - d. Wire-Bond; Cavity Net DT (3611D).
 2. Configuration: Provide one of the following:
 - a. Strips, full depth of cavity and 10 inches (250 mm) high, with dovetail-shaped notches 7 inches (175 mm) deep that prevent clogging with mortar droppings.
- 2.11 MASONRY CLEANERS
- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Diedrich Technologies, Inc., a Hohmann & Barnard company.
 - b. EaCo Chem, Inc.
 - c. PROSOCO, Inc.
- 2.12 MORTAR AND GROUT MIXES
- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 1. Do not use calcium chloride in mortar or grout.
 1. Use portland cement-lime or masonry cement mortar unless otherwise indicated.
 2. For exterior masonry, use portland cement-lime or masonry cement mortar.
 3. For reinforced masonry, use portland cement-lime or masonry cement mortar.
 4. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
 - B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
 - C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.
 1. For masonry below grade or in contact with earth, use Type S.
 2. For reinforced masonry, use Type S.
 3. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
 4. For interior nonload-bearing partitions, Type O may be used instead of Type N.
 - D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
 1. Pigments shall not exceed 10 percent of portland cement by weight.
 2. Pigments shall not exceed 5 percent of masonry cement by weight.

3. Mix to match Architect's sample.
4. Application: Use pigmented mortar for exposed mortar joints with the following units:
 - a. Decorative CMUs.
 - b. Clay face brick.
- E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
 1. Mix to match Architect's sample.
 2. Application: Use colored-aggregate mortar for exposed mortar joints with the following units:
 - a. Decorative CMUs.
- F. Grout for Unit Masonry: Comply with ASTM C476.
 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
 2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
 3. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C143/C143M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 2. Verify that foundations are within tolerances specified.
 3. Verify that reinforcing dowels are properly placed.
 4. Verify that substrates are free of substances that impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 COORDINATION

- A. Contractor is responsible to coordinate between trades prior to concrete slab pours to avoid conflicts with CMU wall construction, including, but not limited to, the following:
 1. Positions, sizes, and other requirements for locating all reinforcing coming up through slab. Unless otherwise noted in Structural Drawings, post-installation with epoxy anchors is not an equivalent method of installation. Any request to substitute post-installed anchors in masonry construction should be pre-approved by Contractor via RFI to the Structural Engineer of record, and the Structural Engineer may reject requests for such substitution.
 2. Coordinate all conduits and pipes as shown on MEP Drawings for concealed installation.
 3. Reinforced / grouted cells will not be in conflict with electrical conduits, plumbing pipes, or other items built into CMU cells. This includes the quantity, sizes, and locations to comply with all notes, specific location details, and typical details, as indicated in the Structural Drawings.
 - a. A large number of conduits in a line could cause non-compliance with Structural requirements, either for the CMU wall, or in the concrete slab. In areas where many conduits are required for electrical items, request clarification from Architect and Structural Engineer as to allowable routings of conduits to avoid adverse impact on the structural system.

3.3 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested according to ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.

3.4 TOLERANCES

- A. Dimensions and Locations of Elements:
 - 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
 - 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
 - 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.
- B. Lines and Levels:
 - 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.
 - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12 mm) maximum.
 - 3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
 - 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12 mm) maximum.
 - 5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
 - 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12 mm) maximum.
 - 7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.
- C. Joints:
 - 1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
 - 2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
 - 3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
 - 4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).
 - 5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.

3.5 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in bond pattern indicated on Drawings; do not use units with less-than-nominal 4-inch (100 mm) horizontal face dimensions at corners or jambs.

- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches (100 mm). Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items. Install pipes and conduit as shown on MEP Drawings and conceal within masonry cells at all locations. Alert Architect to conflicts before installation.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 - 1. Install compressible filler in joint between top of partition and underside of structure above.
 - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors 48 inches (1200 mm) o.c. unless otherwise indicated.
 - 3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
 - 4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 07 84 43 "Joint Firestopping."

3.6 MORTAR BEDDING AND JOINTING

- A. Lay CMUs as follows:
 - 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
 - 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
 - 3. Bed webs in mortar in grouted masonry, including starting course on footings.
 - 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
 - 5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
- E. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.7 ANCHORED MASONRY VENEERS

- A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:
 - 1. Fasten screw-attached anchors through sheathing to wall framing with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
 - 2. Embed tie sections in masonry joints.
 - 3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
 - 4. Space anchors as indicated, with not less than one anchor for each 2 sq. ft. (0.2 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 8 inches (203 mm), around perimeter.
- B. Provide not less than 2 inches (50 mm) of airspace between back of masonry veneer and face of insulation.

1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.8 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
 1. Space reinforcement not more than 16 inches (406 mm) o.c.
 2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
 3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.9 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry as follows:
 1. Install preformed control-joint gaskets designed to fit standard sash block.
- C. Form expansion joints in brick as follows:
 1. Build in compressible joint fillers where indicated.
- D. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 92 00 "Joint Sealants," but not less than 3/8 inch (10 mm).
 1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.10 LINTELS

- A. Install steel lintels where indicated.
- B. Provide masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.
- C. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.11 FLASHING, WEEP HOLES, AND CAVITY VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 2. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches (200 mm); with upper edge tucked under water-resistive barrier, lapping at least 4 inches (100 mm). Fasten upper edge of flexible flashing to sheathing through termination bar.
 3. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
 4. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- E. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.
 - 1. Use specified weep/cavity vent products to form weep holes.
 - 2. Space weep holes 24 inches (600 mm) o.c. unless otherwise indicated.
- F. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.
- G. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form cavity vents.
 - 1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.12 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 60 inches (1520 mm).

3.13 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors for structural masonry to perform tests and inspections and prepare reports. All other tests and inspections will be performed by Contractor. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.
 - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.
- E. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C67 for compressive strength.
- F. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.
- G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.
- H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.

3.14 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
 - 6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
 - 7. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.15 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

SECTION 05 12 00
STRUCTURAL STEEL

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Steel columns
 2. Steel beams
 3. Fusion welded anchors
 4. Miscellaneous angles and plates
 5. Manufactured Bearing Assemblies
 6. Bolts
 7. Steel assemblies to be embedded in concrete
 8. Laboratory testing and inspection
 9. Shop painting
 10. Supplementary parts and members necessary to complete and erect structural steel frame

1.2 REFERENCE STANDARDS (Latest Edition)

- A. American Institute of Steel Construction, AISC:
1. AISC Manual of Steel Construction.
 2. Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
 3. Code of Standard Practice for Steel Buildings and Bridges.
 4. Specification for Structural Joints Using ASTM A325 or A490 Bolts.
- B. American Society for Testing and Materials:
1. ASTM A36, Standard Specification for Structural Steel.
 2. ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 3. ASTM A108, Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.
 4. ASTM A123, Standard Specification for Zinc (Hot- Galvanizing) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, bars and strip.
 5. ASTM A143, Recommended Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
 6. ASTM A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 7. ASTM A193, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
 8. ASTM A307, Standard Specification for Carbon Steel Externally Threaded Standard Fasteners.
 9. ASTM A325, Standard Specification for High-Strength Bolts for Structural Steel Joints.
 10. ASTM A500, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 11. ASTM A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 12. ASTM A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality.
 13. ASTM A786, Standard Specification for Hot-Rolled Carbon, Low Alloy, High Strength Low Alloy, and Alloy Steel Floor Plates
 14. ASTM A992, Standard Specification for Steel for Structural Shapes for Use in Building Framing.
 15. ASTM F1554, Standard Specification for Anchor Bolts
 16. ASTM B117, Standard Salt Spray (Fog) Testing.
 17. ASTM D522, Standard Test for Elongation of Attached Organic Coatings with Conical Mandrel Apparatus.
- C. American Welding Society:
1. AWS D1.1, Structural Welding Code - Steel.
 2. AWS D1.3, Structural Welding Code - Sheet Steel.
- D. Industrial Fasteners Institute:
1. Handbook on Bolt, Nut and Rivet Standards.
- E. American National Standards Institute:

1. ANSI B18.2, Fasteners.
 2. ANSI B27.2, Plain Washers.
- F. The Society for Protective Coatings, SSPC:
1. SSPC Painting Manual, Volume 1, Good Painting Practice.
 2. SSPC Painting Manual, Volume 2, Systems and Specifications.

1.3 SUBMITTALS

- A. Shop Drawings: Submit detailed shop and installation drawings showing shop and erection details including member sizes, grades of materials, details of fabrication and erection, and end connections.
1. Do not begin fabrication of materials prior to review of shop drawings.
 2. Review of shop drawings is for member sizes, spacings, detail, and general compliance with Contract Documents only.
 3. Material quantities, lengths, fit, verification of job conditions and coordination with other trades are responsibility of Contractor.
 4. Calculations: Submit calculations for connections as required, signed and sealed by a Professional Engineer experienced in such design and registered in the State of the Project.
 5. Reproductions of Contract Drawings shall not be used for shop drawings.
- B. Erection Procedure: Submit descriptive data illustrating general procedure for erection of structural steel including sequence of work, proposed schedule and details of temporary staying and bracing.
- C. Submit Mill Certifications showing compliance of materials with ASTM and AISC Specifications.
- D. Submit Mill Certifications (Manufacturer's Inspection Certificates) for bolts, nuts and washers.
- E. Submit manufacturer's data sheets or certified test results indicating compliance with requirements for manufactured components.

1.4 QUALIFICATIONS

- A. Arc-Welding: Welding procedures and techniques, welders and tackers shall be qualified in accordance with AWS D1.1.
1. Welders to be employed on Work shall maintain current AWS certification throughout duration of Project.
 2. If requested by Architect, submit identifying stenciled test coupons made by operator whose workmanship is subject to question, and if reasonable doubt of proficiency exists, welder shall be re-qualified and certified by independent testing laboratory at no additional expense to Owner.
 3. Work suspected of deficient quality may be subject to removal of coupons from any location on any joint for testing. Remove sections of welds found defective and properly rewelded before proceeding with work.
- B. Steel Fabricator: not less than 5 years of experience in fabrication of structural steel.
- C. Steel Erector: not less than 5 years of experience in erection of structural steel.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Coordinate delivery of anchor bolts and other anchorage assemblies to be embedded in concrete or masonry construction. Provide setting drawings, instructions and templates required for proper placement of anchor bolts and embeds.
- B. Sequence shipments of fabricated steel to expedite erection and minimize field handling of material.
- C. Store structural steel above ground on skids or platforms, and protect from corrosion. Store packaged materials in unbroken containers.
- D. Do not bend or damage materials during shipment, handling and erection.
- E. Take precautions in the removal of packaging or bundling devices to prevent damage to materials.
- F. Certification numbers for fasteners shall appear on product containers and shall correspond to identification numbers on mill test reports.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Structural Steel, normal grade: ASTM A36.
- B. High Strength Structural Steel: ASTM A572 - Grade 50.
- C. High Strength Structural Steel (W-Sections): ASTM A992 – Grade 50.
- D. Steel Pipes: ASTM A53 - Grade B (35,000 psi yield).
- E. Hollow Structural Sections (HSS) – Round or Rectangular: ASTM A500 - Grade B.
- F. Erection Bolts: ASTM A307, ANSI B18.2.1, and ANSI B18.2.2.

- G. High Strength Bolts: ASTM A325N, ANSI B18.2.1, ANSI B18.2.2.
 - 1. Manufacturer's symbol and grade markings shall appear on bolts and nuts.
- H. Anchor Bolts: ASTM F1554 Grade 36
- I. High Strength Anchor Bolts: ASTM F1554 Grade 105.
- J. Washers: ANSI B27.2 Type A.
- K. Welding Electrodes:
 - 1. Welding electrodes shall conform to AISC Specifications. Use E70 electrodes for ASTM A36 and ASTM A572 Grade 50 Steel.
 - 2. Coatings of low-hydrogen electrodes shall be thoroughly dry when used. Electrodes taken from hermetically sealed packages shall be used within 4 hours, or shall be dried in accordance with AWS D1.1 before use.
 - 3. Do not use electrodes of any type that have been wet.
- L. Coatings for structural steel
 - 1. Shop Primer:
 - a. Rust-inhibiting primer
 - b. Paint and methods of paint application shall comply with applicable air-quality and environmental regulations.
 - c. Paint shall be compatible with welding procedures and shall produce no significant difference in strength of weld material.
 - d. Paint shall meet or exceed requirements for abrasion - Fed. Test No. 141; elongation - ASTM D522; and salt spray - ASTM B117.
 - 2. Primer for Architecturally Exposed Structural Steel
 - a. Acceptable Products:
 - 1) Tnemec 115
 - 2) Valspar 13-R-29
 - 3) Carboline Phenoline 818
 - 4) Sherwin-Williams Kem Kromik Universal B50 Series
 - 3. Zinc-Coating: Where galvanizing steel is required, zinc coating shall conform to ASTM A123 and A143. Zinc coating for threaded products shall conform to ASTM A153. Do not galvanize ASTM A490 bolts.
 - 4. Cold Galvanizing: Galviline as manufactured by ZRC WORLDWIDE, Marshfield, MA (phone 800.831.3275; web site www.zrcworldwide.com), and used for repair only.
- M. Shear Studs
 - 1. Headed fusion welded shear connectors with proper ferrules and accessories especially designed to create composite deck action by mating of shear connectors, concrete deck, and supporting beam.
 - 2. Steel shall conform to ASTM A108 grades C1010-1020, minimum tensile strength of 60,000 psi.
 - 3. Studs shall be of uniform diameter, heads concentric and normal to shaft, and weld end chamfered and solid flux.

2.2 DESIGN OF CONNECTIONS

- A. Design connections to resist required forces, where not detailed on Drawings.
- B. Design connections for simple beams (except where end reactions are otherwise scheduled) for 55 percent of total uniform load capacity shown in Maximum Total Uniform Load Tables, Part 3, of AISC Manual, for given beam, span and grade of steel specified.
- C. Note slip critical connection requirements clearly on shop drawings.
- D. Complete penetration butt weld moment connections to develop 100% of flexural capacity of member.
- E. detail bolted connections using bolts conforming to ASTM A325N, Bearing Type Connections with threads allowed in shear plane. Details shall be in accordance with AISC Specification for Structural Joints.
- F. Design welded truss connections for 1.15 times required forces.
- G. Diagonal Bracing: Where forces are indicated on the drawings, design connections for the indicated force. Where forces are not indicated, design connections for full strength of member in tension.
- H. Do not use welds in combination with bolts in the same face of any connection.

2.3 FABRICATION

- A. Fabricate materials in accordance with applicable AISC Specifications and Standards.
- B. Pre-assemble work as much as possible and deliver to site ready for erection. Mark and match-mark pieces where field assembly is required.
- C. Prior to fabrication; straighten materials, remove twists and bends and clean faying surfaces of scale and rust.

- D. Clean members to be painted with power tools in accordance with SSPC standards.
- E. Camber beams to per the following:
 - 1. Beams up to 50 ft in length – 0-inches to ½-inches above the required camber. No beam to have less camber than specified.
 - 2. Beams over 50 ft in length - 1/8th inch per 15 feet of beam length above the required camber. No beam to have less camber than specified.
 - 3. Camber by cold camber method only, no heat camber permitted without written permission.
 - 4. No beam shall be installed with negative camber.
 - 5. Mark beams indicating direction of fabricated or natural camber.
- F. Provide members of required sizes, weights, shapes and lengths. Do not splice members to achieve required lengths except where specifically allowed by the Architect. Do not alter member shapes or lengths or enlarge bolt holes in the field for proper fit; return materials to the fabrication shop for correction where required. Member splices allowed for the convenience of the fabricator or erector shall not result in additional cost to the Owner.
- G. Punch or drill holes for bolts. Hole sizes shall conform to AISC Specifications.
- H. Compression joints shall have both contact surfaces milled for precision fit. Other joints shall be cut or dressed straight and true, and prepared as required for welding. Components of assemblies and built-up members shall be pinned and rigidly maintained in accurate position during final assembly.

2.4 WELDED CONSTRUCTION

- A. Comply with AWS D1.1.
- B. Clean surfaces of loose scale, rust, paint, grease and dirt. Remove oil with benzine. Wire brush welds after depositing for visual inspection. Welds shall be smooth and uniform in cross section, shall be free of porosity and clinkers, and shall have required fusion and penetration into base metal.
- C. Secure members in proper position for welding.
- D. Take proper precautions to minimize residual stresses and distortions in members being welded.
- E. Preheat and interpass temperatures shall conform to Table 3.2, AWS D1.1.
- F. Prepare members to be butt-welded in accordance with AISC recommendations for pre-qualified welds, and provide required clearances and back-up bars. Remove back-up bars after completing welds.
- G. Lay fillet welds of required sizes in proper position and with gaps not exceeding AISC recommendations.
- H. Tack welding shall not affect quality of finished welds.

2.5 BOLTED CONSTRUCTION

- A. Provide holes at right angles to members of sizes recommended by AISC Specifications. Short-slotted holes shall not be used for primary frame connections (members connecting to columns), trusses and wind bracing unless specifically allowed by the Architect. Where used, short-slotted holes shall be oriented normal to the direction of load.
- B. Provide beveled washers for surfaces out of parallel more than 1:20.
- C. Provide bolts of sufficient length to extend entirely through nuts.
- D. Protect fasteners from dirt and moisture at job site. Only as many fasteners as are anticipated to be installed and tightened during a work shift shall be taken from protective storage. Fasteners not used shall be returned to protected storage at end of shift. Fasteners shall not be cleaned of lubricant that is present in as-delivered condition. Fasteners for slip critical connections which must be cleaned of accumulated rust or dirt resulting from job site conditions, shall be cleaned and relubricated prior to installation.
- E. Anchor bolts and erection bolts: tighten with a suitable wrench not less than 15 inches long. Tap bolt heads with a hammer while tightening.
- F. High Strength Bolts (typical, except as noted otherwise): install bolts in properly aligned holes, and tighten to snug tight condition. Snug tight condition is defined as the tightness that exists when all plies in a joint are in firm contact.
- G. Hand tighten and tack weld (nut-to-bolt shank) bolts required to be "finger-tight".
- H. Holes for anchor bolts in base plates may be oversized in accordance with AISC Specifications. Provide washers as indicated on Drawings.

2.6 COATINGS

- A. SHOP PAINTING
 - 1. Apply one coat of rust-inhibitive primer to surfaces of structural steel members except: surfaces required to be field welded, to be encased in concrete, to be spray fireproofed, and top flanges of beams with shear connectors to support metal deck.

2. Thoroughly clean surfaces to be painted of all loose mill scale, dirt, rust, and other foreign matter with steel scrapers, wire brushes, or sandblasting in accordance with SSPC SP-3. Use SSPC-SP6 for Architecturally Exposed Steel (AESS). Remove oil and grease with solvents.
 3. Mix paint in accordance with manufacturer's recommendations, continuously stir during application, and do not add thinner after initial mixing.
 4. Apply paint in accordance with manufacturer's recommendations, thoroughly work over surfaces and into corners. Minimum dry thickness of coating shall be 2 mils.
 5. Repair damage to coating prior to delivery.
- B. GALVANIZING
1. Galvanize exposed steel members as noted on the drawings.
 2. Shelf angles supporting masonry or stone shall be galvanized.

2.7 PRODUCTS

- A. FUSION WELDED ANCHORS
1. Comply with AWS D1.1, Section 7.
 2. Clean surfaces to be welded of rust, oil, grease, paint and dirt. Remove mill scale by scraping or sandblasting.
 3. Weld headed studs with appropriate equipment properly adjusted for climactic conditions.
 4. Remove ceramic ferrules after welding.

2.8 SOURCE QUALITY CONTROL

- A. Testing of Shear Studs:
1. When temperature is below 32 degrees F, one stud in each 100 shall be tested.
 2. Minimum of 2 shear studs shall be tested at start of each production period in order to determine proper generator, control unit and stud welder setting. Studs shall be capable of being bent 45 degrees from vertical without weld failure. If, after welding, visual inspection reveals that sound weld or full 360 degree fillet has not been obtained for a particular stud, stud shall be struck with hammer and bent 15 degrees off perpendicular toward nearest end of beam. Studs failing this test shall be replaced.
- B. Pre-Erection Testing of High Strength Bolts
1. Test at least three bolt, nut and washer assemblies from each lot of bolts supplied to job site.
 2. Test assemblies in a tension measuring device at site to verify that assemblies can develop tension listed in Table 4 of AISC Specification for Structural Joints.
 3. Bolt tension shall be developed by tightening of nut.
- C. Inspection of Structural Steel:
1. Provide access to materials in fabrication and full cooperation to testing laboratory.
 2. Following testing services shall be performed:
 - a. Inspect fabrications in shop.
 - b. Check temporary bracing of steel frame.
 - c. Check location and condition of anchor bolts.
 - d. Check plumbness and tolerance of steel frame.
 - e. Qualification of welders and welding techniques.
 - f. Visually inspect bolts.
 - g. Visually inspect all field and shop welds.
 - h. Complete-penetration welds.
 - 1) Ultrasonic or X-ray testing per AWS Standards.
 - 2) Testing shall be performed on 100% of shop and field complete-penetration welds.
 - i. Re-inspect corrective measures required at expense of Contractor.
- D. Remove and replace Connections found to be faulty at no additional cost to the contract.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify condition and position of anchor bolts and embeds in concrete prior to commencing erection.
- B. Correct misaligned or missing components required for connections to steel framework before commencing erection.
- C. Measure camber of steel beams prior to erection and report deviations from required camber before placing concrete slabs. Do not place concrete on beams that have inadequate or negative camber.

3.2 SPECIAL REQUIREMENTS FOR ARCHITECTURALLY EXPOSED STRUCTURAL STEEL (AESS)

- A. Exposed steel finish and quality standard identified on the documents are defined based on AISC 303-16 including AESS1, AESS2, AESS3, AND AESS4. See the drawings for specific members requiring meeting one of these standards and see AISC 303-16 for additional information.
- B. AESS is defined as steel that is exposed to view in the final construction.
- C. Section 10 of the AISC Code of Standard Practice shall apply to all steel identified as AESS.
- D. Tube-to-tube and pipe-to-pipe connections shall be full welded connections with no exposed bolts, fasteners, clips, or plates. Erection clips and bolts may be used but shall be removed and ground smooth following final erection.
- E. For exposed welds in AESS, all plug, slot, V, groove, bevel, flare V and flare bevel welds shall be ground smooth. All fillet welds shall be smooth and uniform, visually acceptable to the Architect.
- F. When exposed fillet welds are not required to be continuous, spaces between intermittent welds shall be filled with metal filler or weld to provide a continuous uniform appearance.
 - 1. Welds on exterior AESS and within six feet of any floor shall be continuous. Metal filler is not permitted in these locations.
- G. Edges of exposed plates shall be sawn or sheared to provide a uniform edge. Thermal cutting to be used only with acceptance of the Architect if uniform edges can be maintained.
- H. Exposed fasteners may be used only as indicated on Drawings or required for field connections. Exposed fasteners are not permitted for shop connections unless specifically approved by Architect. When exposed fasteners are permitted, the connections shall be uniform and consistent, with the connections of adjacent beams matching in size and arrangement to provide a consistent, uniform appearance. When exposed fasteners are permitted, galvanized bolts shall be used.
- I. Within seven days following erection, field touch up all AESS. Field touch up paint shall be the same as shop primer, applied by spraying on exposed surfaces only after proper preparation including grinding, smoothing and cleaning.
- J. AESS that is mishandled or stored in such a way that the steel and/or primer has been damaged will be subject to rejection upon review of the Architect.

3.3 ERECTION AND FIELD ASSEMBLY

- A. Erect structural steel in accordance with AISC Specifications. Work shall be plumb, square, true to line, level and in proper position and orientation.
- B. Provide temporary bracing and guys to maintain stability of framework during erection for stresses and loads due to erection equipment and its operation, weight of structure, wind, and temporary loads imposed during erection. Check and adjust bracing frequently during progress of erection and assembly. Maintain temporary bracing until all components of the structure required for lateral stability are in place and final connections made.
- C. Do not stack materials on partially completed framework, or in a manner to cause damage or overloading of the structure.
- D. Tolerances shall be in accordance with AISC Code of Standard Practice and as follows:
 - 1. Displacement of columns adjacent to elevator shafts not to exceed 1 inch at any point.
 - 2. Individual members plumb or level to within 1:750.
 - 3. Vertical dimensions: 1/4 inch per story, exclusive of elastic shortening of columns.
 - 4. Floor framing members: +/- 1/4 inch from column splice next above.
 - 5. Horizontal dimensions: +/- 1:2000 for overall length or width.
- E. Field Assembly:
 - 1. Assemble steel framework accurately to lines and elevations indicated and within specified tolerances. Align and adjust members forming parts of a completed frame before fastening.
 - 2. Erect structural steel in proper sequence with work of other trades.
 - 3. Tie anchor bolts securely in position before concrete is placed.
 - 4. Thoroughly clean bearing surfaces and surfaces to be in permanent contact before assembly.
 - 5. Adjust bolt holes requiring enlargement only by reaming, not by drifting or burning.
 - 6. Erection bolts may be tightened and left in place, except in architecturally exposed work. Fill holes left from removed bolts by plug welding. Grind welds smooth where architecturally exposed.
 - 7. Straighten and correct members damaged during handling, or replace without additional cost to the Owner.
 - 8. Where shoring of beams and girders is required, provide positive support at midpoint of spans under 25 feet and at third points of spans over 25 feet. Locate temporary supports directly above beams at the supporting floor, or transfer load to beams with load spreaders. Re-shore where construction loading exceeds live load capacity of supporting floor.

F. Field Connections:

1. After frame is aligned and plumb, make final welded and bolted connections in accordance with AISC Specifications.
2. Properly sequence welding to prevent distortion, and misalignment of the framework.
3. Maintain temporary bracing of the structure until connections are complete and other required components of the structure (e.g. floor slabs and metal roof decks) are in place.

3.4 ADJUSTING

- A. Touch-up field welds, abrasions and scarred areas of structural steel with same paint used for shop coating after erection of frame and final connections are completed.

3.5 FIELD PAINTING

- A. Refer to Section 09 90 00 for field painting of exposed steel.

END OF SECTION

SECTION 05 12 13

ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Architecturally exposed structural steel (AESS).
 - 2. Section 05 12 00 "Structural Steel Framing" requirements that also apply to AESS.
- B. Related Requirements:
 - 1. Section 05 50 00 "Metal Fabrications" for miscellaneous steel fabrications not defined as structural steel.
 - 2. Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting" for surface preparation and priming requirements.

1.2 DEFINITIONS

- A. AESS: Architecturally exposed structural steel.
- B. Category AESS 3: Structural steel that is categorized by ANSI/AISC 303, Section 10, as AESS 3 and is designated as AESS 3 or Category AESS 3 in the Contract Documents.
- C. SEAC/RMSCA Guide Specification: SEAC/RMSCA's "Sample Specification, Section 05 12 13: Architecturally Exposed Structural Steel."

1.3 COORDINATION

- A. Coordinate surface preparation requirements for shop-primed items.
- B. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data:
 - 1. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 2. Corrosion-resisting (weathering steel), tension-control, high-strength, bolt-nut-washer assemblies.
 - 3. Filler.
 - 4. Primer.
 - 5. Galvanized-steel primer.
 - 6. Etching cleaner.
 - 7. Galvanized repair paint.
- B. Shop Drawings: Show fabrication of AESS components. Shop Drawings for structural steel may be used for AESS.
 - 1. Identify AESS category for each steel member and connection, including transitions between AESS categories and between AESS and non-AESS.
 - 2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 3. Include embedment Drawings.
 - 4. Indicate orientation of mill marks and HSS seams.
 - 5. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain. Indicate grinding, finish, and profile of welds.
 - 6. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections. Indicate orientation and location of bolt heads.
 - 7. Indicate exposed surfaces and edges and surface preparation being used.
 - 8. Indicate special tolerances and erection requirements.
 - 9. Indicate weep holes for HSS and vent holes for galvanized HSS.
 - 10. Indicate surface preparation, primer, and coating requirements, including systems specified in other Sections.

- C. Samples: Submit Samples to set quality standards for AESS.
 - 1. Two steel plates, 3/8 by 8 by 4 inches (9.5 by 200 by 100 mm), with long edges joined by a groove weld and with weld ground smooth.
 - 2. Steel plate, 3/8 by 8 by 8 inches (9.5 by 200 by 200 mm), with one end of a short length of rectangular steel tube, 4 by 6 by 3/8 inches (100 by 150 by 9.5 mm), welded to plate with a continuous fillet weld and with weld ground smooth and blended.
 - 3. Round steel tube or pipe, minimum 8 inches (200 mm) in diameter, with end of another round steel tube or pipe, approximately 4 inches (100 mm) in diameter, welded to its side at a 45-degree angle with a continuous fillet weld and with weld ground smooth and blended.
- 1.6 INFORMATIONAL SUBMITTALS
 - A. Qualification Data: For fabricator.
 - B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- 1.7 QUALITY ASSURANCE
 - A. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P2 or SSPC-QP 3.
 - B. Mockups: Build mockups of AESS to set quality standards for fabrication and installation.
 - 1. Build mockup of typical portion of AESS as shown on Drawings.
 - 2. Coordinate painting requirements with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- 1.8 DELIVERY, STORAGE, AND HANDLING
 - A. Use special care in handling AESS to prevent twisting, warping, nicking, and other damage during fabrication, delivery, and erection. Store materials to permit easy access for inspection and identification. Keep AESS members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect AESS members and packaged materials from corrosion and deterioration.
 - 1. Do not store AESS materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- 1.9 FIELD CONDITIONS
 - A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

PART 2 - PRODUCTS

- 2.1 PERFORMANCE REQUIREMENTS
 - A. Comply with requirements of ANSI/AISC 303, Sections 1 through 9 and as modified in Section 10, "Architecturally Exposed Structural Steel."
- 2.2 BOLTS, CONNECTORS, AND ANCHORS
 - A. Tension-Control, High-Strength, Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, round-head assemblies consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, (ASTMA563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - 1. Finish: Plain.
- 2.3 FILLER
 - A. Polyester filler intended for use in repairing dents in automobile bodies.
- 2.4 PRIMER
 - A. Steel Primer:
 - 1. Comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
 - 2. SSPC-Paint 23, latex primer.
 - 3. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

- B. Galvanized-Steel Primer: MPI#26.
 - 1. Etching Cleaner: MPI#25, for galvanized steel.
 - 2. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.5 FABRICATION

- A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.
 - 1. Use special care handling and fabricating AESS before and after shop painting to minimize damage to shop finish.
- B. Category AESS 3:
 - 1. Comply with overall profile dimensions of AWS D1.1/D1.1M for welded built-up members. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
 - 2. Prepare surfaces according to Part 2 "Shop Priming" Article and SSPC-SP 6 (WAB)/NACE WAB-3.
 - 3. Grind sheared, punched, and flame-cut edges to remove burrs and provide smooth surfaces and eased edges.
 - 4. Make intermittent welds appear continuous, using filler or additional welding.
 - 5. Seal weld open ends of hollow structural sections with 3/8-inch (9.5-mm) closure plates.
 - 6. Limit butt and plug weld projections to 1/16 inch (1.6 mm).
 - 7. Install bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
 - 8. Remove weld spatter, slivers, and similar surface discontinuities.
 - 9. Remove blemishes and surface irregularities resulting from temporary braces or fixtures by filling or grinding, before cleaning, treating, and shop priming.
 - 10. Grind tack welds smooth unless incorporated into final welds.
 - 11. Remove backing and runoff tabs, and grind welds smooth.
 - 12. Limit as-fabricated straightness tolerance to one-half that permitted for structural-steel materials in ANSI/AISC 303.
 - 13. Limit as-fabricated curved structural steel tolerance to that permitted for structural-steel materials in ANSI/AISC 303.
 - 14. Limit as-fabricated straightness tolerance of welded built-up members to one-half that permitted by AWS D1.1/D1.1M.
 - 15. Conceal fabrication and erection markings from view in the completed structure.
 - 16. Make welds uniform and smooth.
 - 17. Cut out mill marks from mill material or hide these markings from view in the completed structure. Where neither method is possible, remove mill marks by grinding and filling surfaces as approved by Architect.
 - 18. Grind butt and plug welds smooth or fill, removing weld splatter exposed to view.
 - 19. Orient HSS seams as indicated or away from view.
 - 20. Align and match abutting member cross sections.
 - 21. At visible open joints of copes, miters, and cuts, maintain uniform clear gaps of 1/8 inch (3.2 mm). At closed joints, maintain uniform contact within 1/16 inch (1.6 mm).
 - 22. Fabricate with exposed surfaces smooth, square, and of surface quality approved by Architect.
- C. Erection marks, painted marks, and other marks are permitted on galvanized- steel surfaces of completed structure.
- D. Cleaning Corrosion-Resisting (Weathering) AESS: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 6 (WAB)/NACE WAB-3.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.7 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A123/A123M.
 - 1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.

2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
3. Galvanize AESS lintels attached to structural-steel frame and located in exterior walls.

2.8 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 2. Surfaces to be field welded.
 3. Surfaces to be high-strength bolted with slip-critical connections.
 4. Corrosion-resisting (weathering) steel surfaces.
 5. Galvanized surfaces unless indicated to be painted.
- B. Surface Preparation: Clean nongalvanized surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 1. SSPC-SP 6 (WAB)/NACE WAB-3.
- C. Preparing Galvanized Steel for Shop Priming: After galvanizing, thoroughly clean steel of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner or according to SSPC-SP 16.
- D. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 1. Stripe paint corners, crevices, bolts, welds, and eased edges.
 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments, showing dimensions, locations, angles, and elevations.
- B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep AESS secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

- A. Take special care during erection to avoid marking or distorting the AESS and to minimize damage to shop painting. Set AESS accurately in locations and to elevations indicated and according to ANSI/AISC 303 and ANSI/AISC 360.
 1. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Take care to avoid any blemishes, holes, or unsightly surfaces resulting from the use or removal of temporary elements.
 2. Grind tack welds smooth.
 3. Remove backing and runoff tabs, and grind welds smooth.
 4. Orient bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
 5. Conceal fabrication and erection markings from view in the completed structure.
- B. In addition to ANSI/AISC 303, Section 10 requirements, comply with the following.
 1. Erection of Category AESS 3:
 - a. Erect AESS to the standard frame tolerances specified in ANSI/AISC 303 for non-AESS.
 - b. Comply with AWS D1.1/D1.1M. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
 - c. Remove weld spatter, slivers, and similar surface discontinuities.
 - d. Grind off butt and plug weld projections larger than 1/16 inch (1.6 mm).
 - e. Continuous welds shall be of uniform size and profile.

- f. Ream holes that must be enlarged. Use of drift pins or burning is not permitted. Replace misaligned connection plates where holes cannot be aligned with acceptable appearance.
 - g. Splice members only where indicated on Drawings.
 - h. No torch cutting or field fabrication is permitted.
 - i. Weld profiles, quality, and finish shall be as approved by Architect.
 - j. Make joint welds, including tack welds, appear continuous by filling intermittent welds.
- 3.4 FIELD CONNECTIONS
 - A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
 - B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
- 3.5 FIELD QUALITY CONTROL
 - A. Testing Agency: Owner will engage a qualified testing agency to inspect AESS as specified in Section 05 12 00 "Structural Steel Framing." The testing agency is not responsible for enforcing requirements relating to aesthetic effect.
 - B. Architect will observe AESS in place to determine acceptability relating to aesthetic effect.
- 3.6 PROTECTION
 - A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and touchup galvanizing to comply with ASTM A780/A780M.
 - B. Touchup Painting:
 - 1. Cleaning and touchup painting are specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

TABLE 10.1
AESS Category Matrix

Category		AESS C	AESS 4	AESS 3	AESS 2	AESS 1	SSS
Id	Characteristics	Custom Elements	Showcase Elements	Feature Elements in close view	Feature Elements not in close view	Basic Elements	Standard Structural Steel
1.1	Surface preparation to SSPC-SP 6		•	•	•	•	
1.2	Sharp edges ground smooth		•	•	•	•	
1.3	Continuous weld appearance		•	•	•	•	
1.4	Standard structural bolts		•	•	•	•	
1.5	Weld spatters removed		•	•	•	•	
2.1	Visual samples		•	•	optional		
2.2	One-half standard fabrication tolerances		•	•	•		
2.3	Fabrication marks not apparent		•	•	•		
2.4	Welds uniform and smooth		•	•	•		
3.1	Mill marks removed		•	•			
3.2	Butt and plug welds ground smooth and filled		•	•			
3.3	HSS weld seam oriented for reduced visibility		•	•			
3.4	Cross sectional abutting surface aligned		•	•			
3.5	Joint gap tolerances minimized		•	•			
3.6	All welded connections		optional	optional			
4.1	HSS seam not apparent		•				
4.2	Welds contoured and blended		•				
4.3	Surfaces filed and sanded		•				
4.4	Weld show-through minimized		•				

User Note:

- 1.1 Prior to blast cleaning, grease and oil are removed by solvent cleaning to meet SSPC-SP1.
 - 1.2 Rough surfaces are deburred and ground smooth. Sharp edges resulting from flame cutting, grinding and especially shearing are softened.
 - 1.3 Intermittent welds are made continuous, either with additional welding, caulking or body filler. For corrosive environments, all joints are seal welded. Seams of hollow structural sections are acceptable as produced.
 - 1.4 All bolt heads in connections are on the same side, as specified, and consistent from one connection to another.
 - 1.5 Weld spatter, slivers, surface discontinuities are removed. Weld projection up to 1/16 in. (2 mm) is acceptable for butt and plug welded joints.
 - 2.1 Visual samples are either a 3-D rendering, a physical sample, a first-off inspection, a scaled mock-up or a full-scale mock-up, as specified in the *contract documents*.
 - 2.2 These tolerances are one-half of those for standard structural steel as specified in this Code.
 - 2.3 Members markings during the fabrication and erection processes are not visible.
 - 3.1 All mill marks are not visible in the finished product.
 - 3.2 Caulking or body filler is acceptable.
 - 3.3 Seams are oriented away from view or as indicated in the *contract documents*.
 - 3.4 The matching of abutting cross sections is required.
 - 3.5 This characteristic is similar to 2.2 above. A clear distance between abutting members of 1/8 in. (3 mm) is required.
 - 3.6 Hidden bolts may be considered.
 - 4.1 HSS seams are treated so they are not apparent.
 - 4.2 The steel surface imperfections are filled and sanded.
 - 4.3 Weld show-through on the back side of a welded element can be minimized by hand grinding the back side surface. The degree of weld-through is a function of weld size and material.
- C. Additional characteristics may be added for custom elements.

END OF SECTION

SECTION 05 21 00

STEEL JOISTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pre-engineered steel joists
 - 2. Bridging
 - 3. Ceiling extensions
 - 4. Bearing plates
 - 5. Side wall anchors
 - 6. Extended ends

1.2 REFERENCES

- A. Steel Joist Institute, SJI:
 - 1. Standard Specifications for Open Web Steel Joists, K-Series; and Standard Load Table, Open Web Steel Joists, K-Series.
 - 2. Standard Specifications for Longspan Steel Joists LH Series; and Standard Load Table, Longspan Steel Joists, LH Series.
 - 3. Recommended Code of Standard Practice for Steel Joists and Joist Girders.
- B. American Society for Testing and Materials:
 - 1. ASTM A36, Standard Specification for Structural Steel.
 - 2. ASTM A307, Standard Specification for Carbon Steel Externally Threaded Standard Fasteners.
- C. American Welding Society:
 - 1. AWS A5.5, Specification for Steel, Low-Alloy, Covered Arc Welding Electrodes.
 - 2. AWS D1.1, Structural Welding Code - Steel.

1.3 SUBMITTALS

- A. Shop Drawings: Submit shop and erection drawings to include member marks, number, type, location, and spacing of members; details of bridging, extended ends and attachment at supports.
 - 1. Reproduction of Contract Drawings shall not be used for drawings.
- B. Design: Indicate on shop drawings where special designs have been provided, including a detailed, written description of magnitudes and locations of loads for each special design loading condition.
- C. Submit Certified mill test reports showing compliance with requirements of ASTM and SJI Specifications.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Member of Steel Joist Institute
 - 2. Fabrications, handling, erection and connections of steel joists shall be in accordance with latest editions of SJI Specifications.
- B. Welding Operator Qualifications:
 - 1. Certified within 6 months previous

1.5 DELIVERY, STORAGE AND HANDLING

- A. Mark pieces for identification during erection.
- B. Deliver to site in proper sequence for erection.
- C. Store materials above ground; prevent corrosion, warpage and twisting.
- D. Do not bend or damage members during handling.
- E. Take precautions breaking bundles to prevent damage to materials and injury to workmen.

1.6 DESIGN

- A. Joists shall be designed by the fabricator in accordance with the specifications of the Steel Joist Institute.
- B. Where loads are shown or specified, members shall be designed for the specific loading conditions required.

- C. Where loadings are not shown, members shall be designed for the maximum allowable load indicated in the standard load tables published by the Steel Joist Institute for the member designation and spans required.
- D. Fabricator shall determine and include in the work any and all special bridging or temporary bracing required for proper erection or final assembly of the work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel bridging, bearing plates and wall anchors: comply with ASTM A36.
- B. Bolts: comply with ASTM A307.
- C. Welding Electrodes: comply with AWS A5.5, E70 or submerged arc Grade SAW-2.
- D. Steel Joists: comply with SJI Specifications.
 - 1. Provide double angle bottom chords.
 - 2. Provide extended ends where required.
- E. Paint: rust-inhibiting primer; comply with SJI Specifications; paint and methods of paint application shall comply with applicable air-quality and environmental regulations.

2.2 FABRICATION

- A. Design and fabricate joists in accordance with SJI Specifications.
- B. Accessories: Provide required sag rods, bridging, extended bottom chords and top chords, side wall anchors, wall connectors, headers, and ceiling extensions.
- C. Shop Paint: After fabrication, clean joists, bridging, and anchors of rust, mill scale, dirt and other foreign material. Remove grease and oil with solvents. Apply one coat of paint, minimum thickness of 1 mil.
- D. Extended Ends: Design to cantilever from the main span of the joist, provide load capacity at least equal to that of joist.
- E. Provide horizontal and X-bridging as required, minimum bridging requirements in accordance with SJI Specifications.

2.3 SOURCE QUALITY CONTROL

- A. Laboratory Testing and Inspection
 - 1. Visually inspect shop welds.

PART 3 - EXECUTION

3.1 ERECTION

- A. Replace joists damaged by bending or warping during handling and erection.
- B. Bridging shall comply with SJI Specifications and with details on Drawings.
- C. Minimum bearing and anchorage shall comply with SJI Specifications and Drawings as related to particular type of support.
- D. Provide erection bolts for joists located on column centerlines.
- E. Set joists to lines, levels, and spacing as indicated. Provide bearing plates as indicated or required to carry out structural requirements. Execute general handling and erection in accordance with SJI Specifications.
- F. Permanently fasten joists to supports and install bridging and anchorage before any construction loads, other than workmen, are placed on joists.
- G. Perform welding in accordance with AWS D1.1.
- H. Properly store and protect electrodes to prevent deterioration or damage by moisture and climate.
- I. After erection, touch up field connections and abraded places of shop paint with same kind of paint as shop coat.
- J. Do not weld bottom chords of joists to supports until full dead load of roof is applied. Brace joists and supporting structure for safety and stability until permanent bracing structures are in place.
- K. Do not use bridging to support conduit, piping, duct work, or other equipment.
- L. Do not attach hangers supporting loads in excess of 100 pounds directly to joist chords. See details on Structural Drawings for methods of supporting loads in excess of 100 pounds on joists.

3.2 ADJUSTING

- A. Touch-up abrasions and welds with shop paint.
- B. Correct or replace damaged materials at no additional cost to the Owner.

3.3 FIELD QUALITY CONTROL

- A. Laboratory Testing and Inspection
 - 1. Inspect condition of materials after erection.
 - 2. Inspect connections to supporting structure.

END OF SECTION

SECTION 05 31 00

METAL ROOF DECK

PART 1 - GENERAL

1.1 General

- A. Section Includes:
 - 1. Metal Roof Deck
 - 2. Sheet Metal Accessories

1.2 REFERENCES (Latest Edition Available)

- A. Steel Deck Institute (SDI), Specifications and Commentary for Steel Roof Deck.
- B. American Iron and Steel Institute (AISI), Specification for the Design of Cold-Formed Steel Structural Members.
- C. American Welding Society:
 - 1. AWS A5.1, Specification for Steel, Carbon, Covered Arc Welding Electrodes.
 - 2. AWS D1.3, Structural Welding Code - Sheet Steel.
- D. American Society for Testing and Materials:
 - 1. ASTM A90, Standard Tests for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
 - 2. ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 3. ASTM A924, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
 - 4. ASTM A1008, Standard Specification for Steel Sheet, Cold-Rolled Sheet, Carbon, Structural.
 - 5. ASTM B117, Standard Salt Spray (Fog) Test.
 - 6. ASTM D714, Evaluating Degree of Blistering of Paints.
 - 7. ASTM D1654, Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
- E. Underwriters Laboratories, Inc.:
 - 1. Bulletin of Research No. 52, Development of Apparatus and Test Method for Determining Wind Uplift Resistance of Roof Assemblies.
 - 2. Standard UL580, Tests for Wind Uplift Resistance of Roof Assemblies.

1.3 SUBMITTALS

- A. Shop Drawings: Submit shop drawings for review prior to fabrication or installation of materials.
 - 1. Indicate erection layouts, details, steel deck dimensions and section properties, and installation instructions. Show supporting framing, lengths and markings of deck to correspond with sequence and procedure to be followed in installing and fastening deck. Show methods of fastening deck and installing accessories. Show locations, types and sequence of welded connections for deck units.
 - 2. Indicated pattern for deck venting.
 - 3. Indicate welds using standard AWS welding symbols. Show size and number of holes to be cut in deck.
 - 4. Indicate allowable diaphragm shear capacity corresponding to pattern and type of connections provided.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications
 - 1. Member Steel Deck Institute.
 - 2. Minimum 5 years of experience.
- B. Erector Qualifications
 - 1. Minimum 5 years of experience.
 - 2. Welders certified within previous 6 months.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver deck in bundles and store on pallets above the ground, protect from corrosion and damage. Rusted, crimped or bent deck shall not be installed in the work.
- B. Do not store materials on installed deck before connecting to supporting structure.
- C. Do not overload deck during construction by workmen or storage of materials.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel Grades:
 - 1. ASTM A653, Grade A for galvanized deck.
- B. Miscellaneous steel plates at vents, sump pans, and closures: 20 gage material.
- C. Welding Rods: AWS A5.1, E70
- D. Weld Washers: 14 gage, with 3/8ths diameter hole at center.
- E. Vented Deck: modifications to deck for venting shall be factory punched with upward protruding vent tabs. Field modifications for venting is not allowed.
- F. Galvanizing:
 - 1. Wiped zinc coating, 0.2 to 0.5 ounces per square foot, complying with ASTM A924.
 - 2. Comply with ASTM A90 and A239 for weight and uniformity.

2.2 MANUFACTURED UNITS

- A. Metal deck units shall comply with the Specifications of the Steel Deck Institute.
- B. Design units for required spans and conditions of continuity, generally for 3 continuous spans, except as required by layout.
- C. Stresses under construction loads, gravity loads and wind loading shall not exceed recommendations of the Steel Deck Institute.

2.3 FABRICATION

- A. Fabricate in lengths as long as practical and piece-mark bundles for identification during erection.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Do not lay deck units in place until supporting structure is secured in place and final connections are complete.
- B. Layout deck units in accordance with shop drawings, do not stretch or bend units.
- C. Overlap ends a minimum of 2 inches. Interlock side laps as shown on shop drawings.
- D. Connections:
 - 1. As noted on the structural drawings.
- E. Weld metal fillers and closure pieces in place.

3.2 FIELD QUALITY CONTROL

- A. Laboratory Testing and Inspection:
 - 1. Inspect condition of deck units for damage and corrosion.
 - 2. Inspect connections of deck to structure and at side laps.

3.3 ADJUSTING

- A. Touch-up scarred areas on both sides of deck including welds, rust spots and abrasions by wire-brushing and painting with shop paint.
- B. Repair blow-holes at welds with 18 gage plates welded in place. Replace entire sections of deck where holes cannot be satisfactorily repaired.

3.4 HANGERS FOR MISCELLANEOUS EQUIPMENT

- A. Do not attach hangers for ceilings, ductwork, or piping directly to metal roof deck.

END OF SECTION

SECTION 05 31 13

COMPOSITE METAL FLOOR DECK AND FIELD WELDED SHEAR STUDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Composite metal floor deck
 - 2. Shear studs

1.2 REFERENCES

- A. American Institute of Steel Construction:
 - 1. AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
- B. American Society for Testing and Materials:
 - 1. ASTM A108, Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.
 - 2. ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 3. ASTM A924, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
- C. American Welding Society:
 - 1. AWS A2.4, Standard Symbols for Welding, Brazing and Nondestructive Examination.
 - 2. AWS D1.1, Structural Welding Code, Steel.
 - 3. AWS D9.1, Specification for Welding of Sheet Metal.
- D. Steel Deck Institute:
 - 1. SDI Specifications for Composite Steel Floor Deck.
- E. Underwriters Laboratories Building Materials Directory.

1.3 SUBMITTALS

- A. Product Data: submit manufacturer's data indicating product compliance for the following:
 - 1. Composite Metal Floor Deck
 - a. Submit certification that decking meets requirements for working platform and form for concrete placement.
 - b. Submit certification that slab and deck system meets requirements for superimposed load capacity.
 - 2. Shear Studs
- B. Shop Drawings: submit shop and installation drawings for review, including:
 - 1. Composite Metal Form Deck drawings
 - a. Metal deck erection layouts, details, dimensions, and installation instructions. Indicate where shoring of deck is required for concrete placement.
 - b. Show framing, locations, lengths, and markings of deck to correspond with sequence and procedure to be followed in installing and fastening steel deck.
 - c. Show methods of fastening deck and installing accessories.
 - d. Show locations, types, and sequence of welded connections for deck units, using standard AWS weld symbols.
 - e. Show size and number of holes to be cut in deck.
 - 2. Shear studs: show sizes, locations, and layout of shear studs to be field welded to top flanges of steel beams.

1.4 QUALITY ASSURANCE

- A. Welding:
 - 1. Use welding procedures and techniques, welders, and tackers that are qualified in accordance with AWS D1.1.
 - 2. Maintain current AWS certification throughout duration of Project for welders employed on Work.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deck:
 - 1. Deliver, store, handle and install steel deck and accessories so as not to damage or deform.

2. Stack deck, stored at site before erection, on platforms or pallets and cover with tarpaulins or other suitable covering to provide weathertight enclosure and to afford proper air circulation.
 3. Do not use deck for storage or as a working platform until sheets have been securely fastened in position. Do not damage or overload deck during construction period.
 4. Do not use damaged deck. Replace damaged deck with new material at no additional cost to Owner.
 5. Wirebrush and re-coat rusted areas on deck within 24 hours of detection.
- B. Shear Studs:
1. Store in dry condition, above ground.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Shear Studs:
1. Provide shear stud connectors with proper ferrules and accessories especially designed to create composite deck action by mating of shear connectors, concrete deck and supporting beam, and capable of providing shear forces shown on Drawings when welded through deck used on Project.
 2. Comply with ASTM A108, Grades C1010-1020, with minimum tensile strength of 60,000 psi.
 3. Diameter: uniform, sizes shown on drawings.
 4. Head: concentric with and normal to shaft.
 5. Weld Ends: chamfered and solid flux.
 6. Height: at least 1-1/2 inches above top of deck after installation, with at least 1/2 inch clear concrete cover above top of stud.
- B. Cold Galvanizing Compound: Galviline by ZRC Worldwide, Marshfield, MA. Tel: (800) 831-3275 (www.zrcworldwide.com).

2.2 MANUFACTURED UNITS

- A. Composite Metal Deck
1. Sheet metal for deck: ASTM A653, Grade A.
 2. Coating on deck and accessories: ASTM A924, G60.
 3. Provide deck having integral locking lugs or embossments that provide mechanical lock between deck and concrete slab. Minimum lug depth: 0.005 inches.
 4. Deck units:
 - a. Capable of supporting weight of wet concrete, plus 20 psf uniform live load or 150 pound concentrated load per foot of deck width without intermediate shoring on all span conditions, and without exceeding SDI Specifications limits on deck stress and deflection.
 - b. Classified by U.L. Building Materials Directory.
 - c. Each unit or bundle labeled and marked in accordance with U.L. requirements, indicating manufacturer, testing, and inspection.
 5. Deck ribs: spaced no more than 12 inches on center, and designed to provide efficiency factor of 1.0 for development of headed shear studs in concrete in accordance with AISC Specifications.

2.3 ACCESSORIES

- A. Sheet metal closures and fillers: ASTM A653.
- B. Ceiling hanger inserts: compatible with deck used.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Do not begin laying of deck units until supporting members are secured in place and their end connections completed.
- B. Provide shoring where indicated on shop drawings. Shoring must be supported on adjacent beams if the beams are not shored to construction below.
- C. Clean rust, oil, grease, paint, and debris away from areas to which anchors are to be welded. Remove mill scale by grinding or by sandblasting.

3.2 DECK INSTALLATION

- A. Lay and align units as follows:

1. Maintain required number of units shown on shop drawings.
 2. Prevent stretching or contracting of sidelaps.
 3. Abut, do not lap, ends of units.
 4. Align flutes in deck at butt joints.
 5. Do not use deck units that are bent or kinked or otherwise damaged such as to prevent proper interlocking and connection of edges to adjacent units.
- B. Openings in deck:
1. Deck erector: cut framed openings indicated on Drawings.
 2. Holes 12 inches in diameter or less may be cut by trades requiring holes.
 3. Where openings greater than 12 inches in diameter not shown on Drawings are required, notify Architect. Do not proceed to cut deck until Architect accepts proposed openings.
- C. Weld deck to supporting steel using 5/8" diameter puddle welds or headed shear studs at not more than 12 inches on center.
- D. Coordinate welding sequence and procedure with placing of units.
- E. Fasten side laps and connect perimeter edges to supports at spacing not to exceed three feet.
1. Fasten side laps using welds, screws or button punching as indicated on approved shop drawings.
- F. Weld metal fillers and closure pieces in place.
- G. Replace defective deck connections before concrete slab is placed.
- H. Install inserts to support ceiling hangers. Provide minimum of one ceiling insert for every 4 square feet of ceiling.

3.3 SHEAR STUD INSTALLATION

- A. Automatically end weld shear studs in accordance with AWS D1.1, Section 7.
- B. Remove ceramic ferrules from anchors after welding.
- C. Do not weld studs when temperature is below zero degrees F.
- D. Do not weld studs when surface is wet with rain or snow.

3.4 FIELD QUALITY CONTROL

- A. Deck: Inspect deck at welded connections. Reject connections where deck is not intact after welding and where blow holes occurred.
- B. Shear Studs:
 1. Weld at least 2 shear studs at start of each work period to determine proper generator, control unit, and stud welder settings. Bend studs 45 degrees from vertical by striking with hammer. Inspect weld. Do not include these 2 studs in required total number of studs on Project.
 2. Visually inspect welds at shear studs. Test studs which do not appear to have full sound 360 degree fillet weld at base. Test by bending 15 degrees from vertical toward nearest end of beam by striking with hammer. Replace studs which fail this test.
 3. When temperature is below 32 degrees F, test one stud in each 100 studs after weld cools. If stud fails in weld, test 2 additional studs. Do not resume welding unless 2 additional studs pass test.

3.5 ADJUSTING

- A. Field Touch Up of Deck: After erection, use cold galvanizing compound to touch up both sides of deck at welds, weld scars, bruises, and rust spots.

END OF SECTION

SECTION 05 40 00

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Exterior non-load-bearing wall framing.
 - 2. Interior non-load-bearing wall framing.
 - 3. Soffit framing.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
- B. Meet with Owner, Architect, testing and inspecting agency representative, metal framing Installer, Metal Framing Engineer, exterior sheathing Installer, and installers whose work interfaces with or affects cold-formed metal framing.
- C. Review methods and procedures related to cold-formed metal framing installation, including those contained in metal framing engineer's delegated design submittal.
- D. Review design loads imposed on building structure.
 - 1. Review and clearly identify locations of interior and corner wind load zones of building façade.
 - 2. Review design wind speeds, and resulting positive and negative loads imposed on metal framing and exterior sheathing at interior zones and corner zones of building façade.
 - 3. Review securement of system components required to withstand design wind loads, including the following:
 - a. Attachment of bottom track to floor structure, and type and spacing of fasteners.
 - b. Attachment of top track to overhead structure, and type and spacing of fasteners.
 - c. Attachment of studs to top and bottom tracks.
 - d. Attachment of clips to overhead structure.
 - e. Attachment of studs to clips.
 - f. Review required minimum edge clearance from edge of slab, and size, spacing, and required penetration of fasteners.
- E. Review size and location of exterior wall framing mockup.
- F. Review requirements and understanding of Field Quality Control article.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Provide shop drawings prepared by cold-formed metal framing manufacturer or other delegated design engineer.
 - 2. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 - 3. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
 - 4. Indicate exterior sheathing screw fastener spacing to be utilized at interior zones and corner zones of building façade, as required to ensure sheathing installation will withstand negative wind pressures imposed by design wind speeds.
- C. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.
- D. Delegated-Design Submittal: For cold-formed steel framing.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.

- B. Welding certificates.
- C. Product Certificates: For each type of code-compliance certification for studs and tracks.
- D. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.
 - 1. Steel sheet.
 - 2. Expansion anchors.
 - 3. Power-actuated anchors.
 - 4. Mechanical fasteners.
 - 5. Vertical deflection clips.
 - 6. Horizontal drift deflection clips.
 - 7. Miscellaneous structural clips and accessories.
- E. Research Reports:
 - 1. For nonstandard cold-formed steel framing power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
 - 2. For sill sealer gasket/termite barrier, showing compliance with ICC-ES AC380.
- F. Field Quality Control:
 - 1. Photographic documentation of approved exterior wall framing mockup, in digital form. Include pan and close-up photos of the following:
 - a. Attachment of bottom track to floor structure.
 - b. Attachment of top track to overhead structure.
 - c. Attachment of studs to bottom track and top track/clips.
 - d. Attachment of vertical deflection clips to overhead structure.
 - e. Attachment of horizontal drift clips to overhead structure.
 - f. Attachment of studs to vertical deflection clips.
 - g. Attachment of studs to horizontal drift clips.
 - h. Attachment of sheathing to studs.
 - 2. Pre-Inspection Notification: Submit written report that work has been reviewed for compliance by Contractor, Installer, and Metal Framing Engineer, and is ready for inspection by Testing Agency.

1.5 QUALITY ASSURANCE

- A. Engineering Responsibility: Engage a qualified Texas licensed professional engineer to prepare design calculations, Shop Drawings, and other structural data.
- B. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
- C. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment, indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
- E. Manufacturer Qualifications: Member in good standing of the Steel Framing Industry Association (SFIA) or be a part of a similar organization that provides verifiable code compliance program.
 - 1. Products to be certified under an independent third-party inspection program administered by an agency accredited by IAS to ICC-ES AC98 IAS Accreditation Criteria for Inspection Agencies.
- F. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified in accordance with the product-certification program of the Steel Framing Industry Association (SFIA) or be a part of a similar organization that provides verifiable code compliance program.
- G. Comply with AISI S100, and AISI S200 and ASTM C955, Section 8.
- H. Coordinate with insulation installer, if other than cold-formed metal framing installer, to pack stud packs headers and similar construction that will not be accessible after erection, with batt insulation. Should Contractor fail to coordinate installation of batt thermal insulation, Contractor shall be responsible to foam insulate all such cavities at no additional cost to Owner, prior to applying interior sheathing.

- I. Mock-Up: Build pre-construction mockup detailed on the Drawings to verify selections made under Submittals, to demonstrate typical construction and waterproofing details, and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockups as indicated on Drawings.
 - a. Show typical components, attachments to building structure, and methods of installation.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI's "Code of Standard Practice."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CEMCO.
 - 2. ClarkDietrich.
 - 3. MarinoWARE.
 - 4. SCAFCO Steel Stud Company.
 - 5. TSN.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design cold-formed steel framing including fasteners and connections to building structure.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: As indicated on Drawings.
 - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Non-Load-Bearing Framing behind Brick or Stone Masonry Veneer: Horizontal deflection of 1/600 of the wall height.
 - b. Exterior Non-Load-Bearing Framing behind Metal Panels: Horizontal deflection of 1/240 of the wall height.
 - c. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft. (239 Pa).
 - 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
 - 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of 1 inch (25 mm) unless noted otherwise.
 - 5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:
 - 1. Wall Studs: AISI S211.
 - 2. Lateral Design: AISI S213.
- D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

2.3 COLD-FORMED STEEL FRAMING MATERIALS

- A. Framing Members, General: Comply with AISI S200 and ASTM C955, Section 8 for conditions indicated.
- B. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
 - 1. Grade: As required by structural performance.
 - 2. Coating: G60 (Z180), A60 (ZF180), AZ50 (AZM150), or GF30 (ZGF90).
- C. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: As required by structural performance.
 - 2. Coating: G60 (Z180).

2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: As required by structural performance.
 - 2. Flange Width: As required by structural performance.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: As required by structural performance.
 - 2. Flange Width: 1-1/4 inches (32 mm).
 - 3. Where curved applications are indicated in Drawings, provide custom pre-curved tracks, or segmented track capable of producing a smooth arc to indicated radiuses.
- C. Vertical Deflection Clips: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ClarkDietrich.
 - b. MarinoWARE.
 - c. TSN.
- D. Slotted Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; punched with vertical slots in both legs. Studs should be positively attached to deep-leg track using vertical slots while allowing free vertical movement. Legs designed to support horizontal and lateral loads and transfer them to the primary structure, as follows:
 - 1. ClarkDietrich; BlazeFrame DSL Slotted Deflection Track or comparable product.
 - 2. Leg Dimension: 2-1/2 inches (63.5 mm) with 1-1/2-inch (38.1-mm) slot.
 - 3. Minimum Thickness: Match stud thickness.

2.5 INTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: As required by structural performance.
 - 2. Flange Width: As required by structural performance.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: As required by structural performance.
 - 2. Flange Width: As required by structural performance.
- C. Slotted Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; punched with vertical slots in both legs. Studs should be positively attached to deep-leg track using vertical slots while allowing free vertical movement. Legs designed to support horizontal and lateral loads and transfer them to the primary structure, as follows:
 - 1. ClarkDietrich; BlazeFrame DSL Slotted Deflection Track or comparable product.
 - 2. Leg Dimension: 2-1/2 inches (63.5 mm) with 1-1/2-inch (38.1-mm) slot.
 - 3. Minimum Thickness: Match stud thickness.
- D. Vertical Deflection Clips: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AllSteel & Gypsum Products, Inc.

- b. ClarkDietrich.
- c. MarinoWARE.
- d. SCAFCO Steel Stud Company.
- e. TSN.

- E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.6 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: As required by structural performance.
 - 2. Flange Width: As required by structural performance, minimum.

2.7 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 - 1. Supplementary framing.
 - 2. Bracing, bridging, and solid blocking.
 - 3. Web stiffeners.
 - 4. Anchor clips.
 - 5. End clips.
 - 6. Foundation clips.
 - 7. Gusset plates.
 - 8. Stud kickers and knee braces.
 - 9. Joist hangers and end closures.
 - 10. Hole-reinforcing plates.
 - 11. Backer plates.

2.8 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.
- B. Anchor Bolts: ASTM F1554, Grade 55, threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by mechanically deposition according to ASTM B695, Class 50.
- C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.
 - 1. Uses: Securing cold-formed steel framing to structure.
 - 2. Type: Torque-controlled expansion anchor or torque-controlled adhesive anchor.
 - 3. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).
- D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

2.9 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: MIL-P-21035B or SSPC-Paint 20.
- B. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
- C. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch (6 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

2.10 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
 - 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
- C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet (1:960) and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

- F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation, specified in Section 07 21 00 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 INSTALLATION OF EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: As indicated on Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install slotted deflection tracks and anchor to building structure.
 - 2. Connect vertical deflection clips to bypassing studs and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.
 - 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 - 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.
- G. Install C-shaped furring in exterior insulation plane where indicated and as required to support exterior finish materials. Install C or J shaped furring around perimeter of building openings as required to support edges of finish materials, and where required to provide for attachment of windows, and at other locations as indicated on Drawings.

3.5 INSTALLATION OF EXTERIOR FURRING

- A. Installation of furring at continuous installation:
 - 1. At window and door openings, provide C or J shaped perimeter furring or tracks where detailed in Drawings and where required for fastening window framing.
 - 2. At jambs and heads of openings in fire-rated cavity walls, install 16 gauge C or J shaped perimeter framing or tracks of solid profile without cut-outs, where required for flame spread prevention into cavity. Framing sized to fill space from face of sheathing to back side of loose lintel, masonry veneer, or other non-combustible finish.

3.6 INSTALLATION OF INTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: As indicated on Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install slotted deflection tracks and anchor to building structure.
 - E. Install horizontal bridging in wall studs, spaced vertically in rows indicated but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.
 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.
- 3.7 INSTALLATION TOLERANCES
- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
 1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
- 3.8 REPAIR
- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.
- 3.9 FIELD QUALITY CONTROL
- A. Testing: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
 - B. Field and shop welds will be subject to testing and inspecting.
 - C. Testing agency will report test results promptly and in writing to Contractor and Architect.
 - D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.
 - E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- 3.10 PROTECTION
- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Steel framing and supports for overhead doors.
 2. Steel framing and supports for countertops.
 3. Steel tube reinforcement for low partitions.
 4. Steel framing and supports for mechanical and electrical equipment.
 5. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 6. Elevator machine beams, hoist beams, and divider beams.
 7. Steel shapes for supporting elevator door sills.
 8. Slotted channel framing.
 9. Shelf angles.
 10. Metal ladders.
 11. Elevator pit sump covers.
 12. Miscellaneous steel trim.
 13. Metal bollards.
 14. Loose bearing and leveling plates for applications where they are not specified in other Sections.
 15. Embedded angles and plates.
- B. Products furnished, but not installed, under this Section include the following:
1. Loose steel lintels.
 2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
1. Nonslip aggregates and nonslip-aggregate surface finishes.
 2. Fasteners.
 3. Shop primers.
 4. Shrinkage-resisting grout.
 5. Slotted channel framing.
 6. Manufactured metal ladders.
 7. Metal bollards.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for all items listed in the summary above.
1. Include shop drawings and structural analysis data signed and sealed by the qualified professional engineer licensed to practice in the location of the project, demonstrating the design and connections will meet all indicated and code required loads.
- C. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Research Reports: For post-installed anchors.

1.5 QUALITY ASSURANCE

- 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design ladders.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- D. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
- E. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless steel fasteners for fastening stainless steel.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ASTM F568M, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
- C. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593 (ASTM F738M); with hex nuts, ASTM F594 (ASTM F836M); and, where indicated, flat washers; Alloy Group 2 (A4).
- D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

- F. Post-Installed Anchors: Torque-controlled expansion anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Division 09 Section(s) on Painting
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- D. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated and coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.
 - 1. Provide mitered and welded units at corners.
 - 2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Weld shelf angle to embed plate where indicated.
- D. Galvanize and prime shelf angles located in exterior walls.
- E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.8 METAL LADDERS

- A. General:
 - 1. Comply with ANSI A14.3, except for elevator pit ladders.
 - 2. For elevator pit ladders, comply with ASME A17.1/CSA B44.
 - 3. Provide complete fall arrest system on all ladders 24 feet and higher from landing to landing.
- B. Steel Ladders:
 - 1. Space siderails 16 inches (406 mm) apart unless otherwise indicated.
 - 2. Siderails: Continuous, 3/8-by-2-1/2-inch (9.5-by-64-mm) steel flat bars, with eased edges.
 - 3. Rungs: 3/4-inch- (19-mm-) diameter, steel bars.
 - 4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
 - 5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
 - 6. Provide nonslip surfaces on top of each rung by coating with abrasive material metallurgically bonded to rung.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) IKG; MEBAC.
 - 2) Ohio Gratings, Inc.; ALGRIP Traction Surface.
 - 3) SlipNOT Metal Safety Flooring; W.S. Molnar Company; SlipNOT.
 - 7. Source Limitations: Obtain nonslip surfaces from single source from single manufacturer.
 - 8. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) IKG.
 - 2) Ohio Gratings, Inc.
 - 3) Gratings Pacific.
 - 9. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.
 - 10. Prime exterior ladders, including brackets and fasteners, with zinc-rich primer.
- C. Fall-Arrest System: Meets requirements of ANSI Z359.16, OSHA 1910.40, and OSHA 1926.602.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Edge Fall Protection.
 - 2. Material: Galvanized steel.
 - 3. Cable: 3/8-inch 1 by 7 galvanized steel.
 - 4. Brackets: Manufacturer's standard.
 - 5. Weight Capacity: 620 lbs.
- D. Roof Transfer Ladders: Refer to Section 07 72 00 "Roof Accessories."

2.9 ELEVATOR PIT SUMP COVERS

- A. Fabricate from 3/16-inch (4.8-mm) rolled-steel floor plate with four 1-inch- (25-mm-) diameter holes for water drainage and for lifting.

- B. Provide steel angle supports unless otherwise indicated.

2.10 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize exterior miscellaneous steel trim.
- D. Prime exterior miscellaneous steel trim with zinc-rich primer.

2.11 METAL BOLLARDS

- A. Pipe Bollards: 6-inch diameter galvanized Schedule 40 steel pipe with concrete fill.
 - 1. Size: 7 feet in length, recessed 3 feet below-grade. 4 feet above grade, unless otherwise indicated in Drawings.
 - 2. Paint: Refer to Division 09 Painting Sections for requirements.
 - a. Colors: Safety yellow, or as selected by Architect.

2.12 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize bearing and leveling plates.
- C. Prime plates with zinc-rich primer.

2.13 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches (200 mm) unless otherwise indicated.

2.14 BRAKE METAL

- A. Material: Galvanized steel formed in press brake.
- B. Thickness: As indicated.
- C. Finish: Field Painted.
- D. Texture: Smooth.
- E. Profile: As indicated.

2.15 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.16 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with universal shop primer unless zinc-rich primer is indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 INSTALLATION OF METAL BOLLARDS

- A. Metal Pipe Bollards:
 - 1. Anchor bollards in concrete. Fill annular space around bollard solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8-inch toward bollard for positive drainage away from bollard base.
 - 2. Fill bollards solidly with concrete, mounding top surface to shed water.
 - 3. Paint bollards in color(s) as approved by Architect.

3.4 INSTALLATION OF BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.5 REPAIRS

- A. Touchup Painting:
 - 1. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 Painting Sections.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION

SECTION 05 51 13
METAL PAN STAIRS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Preassembled steel stairs with precast GFRC treads.

1.2 DEFINITIONS

- A. GFRC: Glass-fiber-reinforced concrete.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs.
 - 1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
 - 2. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width and are within fire-resistance-rated stair enclosure.
- D. Schedule installation of railings and guards so wall attachments are made only to completed walls.
 - 1. Do not support railings and guards temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For metal pan stairs and the following:
 - 1. Shop primer products.
 - 2. Precast GFRC treads.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
 - 3. Include plan at each level.
 - 4. Indicate profile and dimensions of precast GFRC treads.
- C. Samples for Verification: For each type and finish of precast GFRC tread.
- D. Delegated-Design Submittal: For stairs, precast GFRC treads, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification.
 1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
 2. Protect steel members and packaged materials from corrosion and deterioration.
 3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.
 - a. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design stairs, precast GFRC treads, including attachment to building construction.
- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
 2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
 3. Uniform and concentrated loads need not be assumed to act concurrently.
 4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.
 5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.

2.2 METALS

- A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Uncoated, Cold-Rolled Steel Sheet: ASTM A1008/A1008M, either commercial steel, Type B, or structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.
- D. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513, Type 5 (mandrel drawn).
- E. Perforated Metal: Stainless steel, Type 316L.
 1. Basis-of-Design Product: McNichols; Perforated Metal, Round, Stainless Steel, Type 316L, 16 Gauge, 3/16-inch Round on 3/8-inch Staggered Centers.
 2. Open Area: 23 percent, maximum.
 3. Finish: As selected by Architect from manufacturer's full range.
 4. Location: Main Staircase in Unit A; Spine.

2.3 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls.
 1. Select fasteners for type, grade, and class required.
- B. Fasteners for Anchoring Railings and Guards to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings and guards to other types of construction indicated and capable of withstanding design loads.
- C. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
- D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

- E. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
- 2.4 MISCELLANEOUS MATERIALS
- A. Welding Electrodes: Comply with AWS requirements.
 - B. Shop Primers: Provide primers that comply with Section 09 91 23 "Interior Painting."
- 2.5 PRECAST GFRC TREADS
- A. As specified in Section 03 49 00 "Glass-Fiber-Reinforced Concrete."
- 2.6 FABRICATION, GENERAL
- A. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding unless otherwise indicated.
 - 2. Use connections that maintain structural value of joined pieces.
 - B. Assemble stairs in shop to greatest extent possible.
 - 1. Disassemble units only as necessary for shipping and handling limitations.
 - 2. Clearly mark units for reassembly and coordinated installation.
 - C. Cut, drill, and punch metals cleanly and accurately.
 - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
 - 2. Remove sharp or rough areas on exposed surfaces.
 - D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
 - E. Form exposed work with accurate angles and surfaces and straight edges.
 - F. Weld connections to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Weld exposed corners and seams continuously unless otherwise indicated.
 - 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish # 3 - Partially dressed weld with spatter removed.
 - G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
 - 1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
 - 2. Locate joints where least conspicuous.
 - 3. Fabricate joints that will be exposed to weather in a manner to exclude water.
 - 4. Provide weep holes where water may accumulate internally.
- 2.7 FABRICATION OF STEEL-FRAMED STAIRS
- A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Architectural exposed applications in common areas and Commercial for fire stairs Class, unless more stringent requirements are indicated.
 - B. Stair Framing:
 - 1. Fabricate stringers of steel plates or steel channels.
 - a. Stringer Size: As required to comply with "Performance Requirements" Article.
 - b. Provide closures for exposed ends of channel and rectangular tube stringers.
 - c. Finish: Shop primed.
 - 2. Construct platforms of steel plate or channel headers and miscellaneous framing members as required to comply with "Performance Requirements" Article.

- a. Provide closures for exposed ends of channel and rectangular tube framing.
 - b. Finish: Shop primed.
 3. Weld stringers to headers; weld framing members to stringers and headers.
 4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below.
 - a. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.
 5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch (1.7 mm).
 1. Fabricate treads and landing subplatforms of exterior stairs so finished walking surfaces slope to drain.
 2. Steel Sheet: Uncoated, cold -rolled steel sheet.
 3. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
 4. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
 5. Shape metal pans to include nosing integral with riser.
 6. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.
 - a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

2.8 FINISHES

- A. Finish metal stairs after assembly.
- B. Preparation for Shop Priming: Prepare uncoated, ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF METAL PAN STAIRS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.
 1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
 1. Grouted Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates.
 - a. Clean bottom surface of plates.
 - b. Set plates for structural members on wedges, shims, or setting nuts.
 - c. Tighten anchor bolts after supported members have been positioned and plumbed.
 - d. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.

- e. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.
 - 1) Neatly finish exposed surfaces; protect grout and allow to cure.
 - 2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
 - D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
 - E. Fit exposed connections accurately together to form hairline joints.
 - 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
 - 2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
 - 3. Comply with requirements for welding in "Fabrication, General" Article.
 - F. Install precast GFRC treads according to manufacturer's written instructions.
- 3.3 REPAIR
- A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 23 "Interior Painting."

END OF SECTION

SECTION 05 52 13

PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel pipe and tube railings.
 - 2. Aluminum infill panels.
 - 3. Stainless-steel pipe and tube railings.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Railing brackets.
 - 3. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- E. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.
- F. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
 - 1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.
 - a. Basis-of-Design Product: Julius Blum & Company; Catalog 20, Product 275.

2.3 STEEL AND IRON

- A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 1. Provide galvanized finish for exterior installations and where indicated.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Perforated Metal: Cold-rolled steel sheet, ASTM A 1008/A 1008M, or hot-rolled steel sheet, ASTM A 1011/A 1011M, commercial steel Type B, 0.060 inch (1.52 mm) thick, with 3/8 inch holes 1/2 inch o.c. in staggered rows.

2.4 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Perforated Metal: Aluminum sheet with perforations as indicated on Drawings, manufacturer's standard thickness, within nominal 2-inch- (51-mm-) wide aluminum angle frame, ground smooth without visible seams.

2.5 STAINLESS STEEL

- A. Tubing: ASTM A 554, Grade MT 304.
- B. Pipe: ASTM A 312/A 312M, Grade TP 304.
- C. Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20.

2.6 FASTENERS

- A. General: Provide the following:
 - 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.
 - 2. Hot-Dip Galvanized Railings for Exterior Applications: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
 - 3. Stainless-Steel Railings: Type 304 stainless-steel fasteners.
 - 4. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
 - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
 - 2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
 - 3. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.7 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 - 1. For stainless-steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- G. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - 1. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.8 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
 - D. Form work true to line and level with accurate angles and surfaces.
 - E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.
 - F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
 - G. Connections: Fabricate railings with welded connections unless otherwise indicated.
 - H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
 - I. Form Changes in Direction as Follows:
 - 1. As detailed.
 - 2. By bending.
 - J. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
 - K. Close exposed ends of railing members with prefabricated end fittings.
 - L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
 - M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
 - N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
 - O. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.
 - P. Perforated-Metal Infill Panels, Where Indicated: Fabricate infill panels from perforated metal made from aluminum.
 - 1. Frame panels with C-shaped channels made from stainless steel sheet, not less than 0.043 inch (1.1 mm) thick.
 - 2. Perforations and Pattern: As indicated on Drawings.
 - Q. Perforated-Metal Infill Panels, Where Indicated: Fabricate infill panels from perforated metal made from steel.
 - 1. Edge panels with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than 0.043 inch (1.1 mm) thick.
 - 2. Perforations and Pattern: As indicated on Drawings.
- 2.9 STEEL AND IRON FINISHES
- A. Galvanized Railings:
 - 1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
 - 2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
 - 3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
 - 4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, galvanize anchors to be embedded in exterior concrete or masonry.
- E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 1. Railings Indicated to Receive Primers Specified in Section 09 91 13 "Exterior Painting: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 2. Other Railings: SSPC-SP 3, "Power Tool Cleaning."
- F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
 1. Shop prime uncoated railings with primers specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

2.10 ALUMINUM FINISHES

- A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 1. Color and Gloss: Semi-Gloss, PC-41 White.

2.11 STAINLESS-STEEL FINISHES

- A. Remove tool and die marks and stretch lines, or blend into finish.
- B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- C. Stainless Steel Tubing Finishes:
 1. Baked-Enamel or Powder-Coat Finish: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.
 2. Directional Satin Finish: No. 6.
- D. Stainless Steel Sheet and Plate Finishes:
 1. Directional Satin Finish: No. 6.
- E. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.
- 3.3 RAILING CONNECTIONS
- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- 3.4 ANCHORING POSTS
- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Cover anchorage joint with flange of same metal as post, attached to post with set screws.
- C. Leave anchorage joint exposed with anchoring material flush with adjacent surface.
- D. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
1. For stainless-steel pipe railings, weld flanges to post and bolt to supporting surfaces.
 2. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.
- 3.5 ATTACHING RAILINGS
- A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.
- C. Attach railings to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets and railing end flanges to building construction as follows:
1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 2. For hollow masonry anchorage, use toggle bolts.
 3. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
- 3.6 ADJUSTING AND CLEANING
- A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

3.7 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION

SECTION 05 70 00

DECORATIVE METAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sunscreen.

1.2 COORDINATION

- A. Coordinate installation of anchorages for decorative metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including finishing materials.
- B. Shop Drawings: Show fabrication and installation details for decorative metal.
 - 1. Include plans, elevations, component details, and attachment details.
 - 2. Indicate materials and profiles of each decorative metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.
- C. Patterns, Models, or Plaster Castings: Made from proposed patterns for each design of custom casting required.
- D. Samples for Initial Selection: For products involving selection of color, texture, or design including mechanical finishes.
- E. Samples for Verification: For each type of exposed finish.
 - 1. Sections of linear shapes.
 - 2. Full-size Samples of castings and forgings.
 - a. For custom castings, submit finished Samples showing ability to reproduce detail, cast-metal color, and quality of finish.
 - 3. Samples of welded joints showing quality of workmanship.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing decorative metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Installer Qualifications: Fabricator of products.
- C. Powder-Coating Applicator Qualifications: A firm experienced in successfully applying powder coatings of type indicated and employing competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

- E. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store decorative metal in a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.
- B. Deliver and store cast-metal products in wooden crates surrounded by enough packing material to ensure that products are not cracked or otherwise damaged.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Use materials with smooth, flat surfaces unless otherwise indicated. Use materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

2.2 SUNSCREEN

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. KCS.
- B. Basis-of-Design Product: KCS; EFS 1000.
- C. Design: As indicated on Drawings.
- D. Finish and Color: As selected by Architect from manufacturer's full range.
- E. Mounting: As indicated on Drawings.

2.3 ALUMINUM

- A. Fabricate products from alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.
- B. Bars and Shapes: ASTM B 221 (ASTM B 221M), Alloy 6063-T5/T52.
- C. Round Tubing: ASTM B 429/B 429M, Alloy 6063-T6.
- D. Tubing: ASTM B 210 (ASTM B 210M), Alloy 6063-T832.
- E. Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 5005-H32.
- F. Forgings: ASTM B 247 (ASTM B 247M), Alloy 6061-T6.
- G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

2.4 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
 - 1. Aluminum Items: Type 304 stainless-steel fasteners.
 - 2. Dissimilar Metals: Type 304 stainless-steel fasteners.
- B. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.
- C. Provide concealed fasteners for interconnecting components and for attaching decorative metal items to other work unless exposed fasteners are unavoidable.
 - 1. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.

- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
 - 1. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 - 1. For aluminum, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2.6 FABRICATION, GENERAL

- A. Assemble items in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- B. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.
- D. Form simple and compound curves in bars, pipe, tubing, and extruded shapes by bending members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces.
- E. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- F. Mill joints to a tight, hairline fit. Cope or miter corner joints. Fabricate connections that will be exposed to weather in a manner to exclude water.
- G. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- H. Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Cut, reinforce, drill, and tap as needed to receive finish hardware, screws, and similar items unless otherwise indicated.
- I. Comply with AWS for recommended practices in shop welding. Weld behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded joints of flux, and dress exposed and contact surfaces.
- J. Provide castings that are sound and free of warp, cracks, blowholes, or other defects that impair strength or appearance. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks.

2.7 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.8 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative metal.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install sunscreen in accordance with manufacturer's written instructions and recommendations.
- B. Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.
- C. Perform cutting, drilling, and fitting required to install decorative metal. Set products accurately in location, alignment, and elevation, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.
- D. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.
- E. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- F. Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.
 - 1. Retain protective coverings intact; remove coverings simultaneously from similarly finished items to preclude nonuniform oxidation and discoloration.
- G. Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal arc welding and requirements for welding and for finishing welded connections in "Fabrication, General" Article. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
- H. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 - 1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.3 CLEANING AND PROTECTION

- A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- C. Protect finishes of decorative metal from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering at time of Substantial Completion.
- D. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

SECTION 06 10 53

MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rooftop equipment bases and support curbs.
 - 2. Wood blocking and nailers.
 - 3. Wood furring.
 - 4. Plywood backing panels.
 - 5. Utility shelving.
 - 6. Tool pegboard.
 - 7. Slatboard wall panel.

1.2 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 - 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
 - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
 - 1. Preservative-treated wood.
 - 2. Fire-retardant-treated wood.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory-mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
 - 3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC2.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.
 - 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 - 4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
 - 5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Treatment shall not promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
 - 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 - 4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664, and design value adjustment factors shall be calculated according to ASTM D6841.
- C. Fire-Retardant Fiberboard: Medium-density fiberboard (MDF) panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture.
- D. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.
- E. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.
- F. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.
- G. Application: Treat all miscellaneous carpentry unless otherwise indicated.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Rooftop equipment bases and support curbs.
 - 4. Furring.
 - 5. Utility shelving and casework.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

1. Mixed southern pine or southern pine; SPIB.
 2. Spruce-pine-fir; NLGA.
 3. Western woods; WCLIB or WWPA.
 4. Northern species; NLGA.
 5. Eastern softwoods; NeLMA.
- C. Provide Furniture Grade or Baltic Birch Plywood for casework indicated in multipurpose CTE shop space.
- D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.
- 2.5 PLYWOOD BACKING PANELS
- A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.
- 2.6 SLATBOARD WALL PANELS
- A. Slatboard wall panels: Medium density fiberboard core with grooves, melamine finish.
1. Basis-of-Design Product: Creative Core Solutions; LPL Medium Gray Slatwall Panel.
 - a. Color: Gray.
 - b. Groove Spacing: 3 inches (76 mm) on center.
- 2.7 FASTENERS
- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Screws for Fastening to Metal Framing: ASTM C1002 or ASTM C954, length as recommended by screw manufacturer for material being fastened.
- D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 or ICC-ES AC193 as appropriate for the substrate.
1. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2 (ASTM F738M and ASTM F836M, Grade A1 or A4).
- 2.8 MISCELLANEOUS MATERIALS
- A. Adhesives for Gluing Furring to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.
- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).
- 2.9 TOOL PEGBOARD
- A. Tool-Hanging Pegboard (in Shop Room):
1. Provide Masonite pegboard in shop room in size as indicated on Drawings.
 2. Install with plastic spacers and with galvanized fasteners and washers, of appropriate type for substrate indicated. Fasten through corner holes and at 2-feet on center around the perimeter.
 3. Finish: Unpainted.
 4. Hanging Accessories: Not in contract; provided and installed separately by Owner.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- D. Do not splice structural members between supports unless otherwise indicated.
- E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.
- F. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- G. Comply with AWWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.
- H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- I. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 - 2. ICC-ES evaluation report for fastener.
- J. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILER

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 INSTALLATION OF WOOD FURRING

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- (19-by-63-mm actual-) size furring horizontally and vertically at 24 inches (610 mm) o.c.
- C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- (19-by-38-mm actual-) size furring vertically at 16 inches (406 mm) o.c.

3.4 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

- B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

SECTION 06 16 00

SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wall sheathing.
 - 2. Parapet sheathing.
 - 3. Sheathing joint and penetration treatment.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
 - 3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5516.
 - 4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
 - 1. For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 WOOD PANEL PRODUCTS

- A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- B. Factory mark panels to indicate compliance with applicable standard.

2.3 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Use treatment that does not promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
 - 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
 - 4. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D5516 and design value adjustment factors shall be calculated according to ASTM D6305. Span ratings after treatment shall be not less than span ratings specified.
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat plywood indicated on Drawings.

2.5 WALL SHEATHING

- A. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corporation; GlasRoc.
 - b. Continental Building Products, LLC; Weather Defense.
 - c. Georgia-Pacific Building Products; DensGlass Sheathing.
 - d. National Gypsum Company; Gold Bond eXP Sheathing.
 - e. United States Gypsum Company; Securock.
 - 2. Type and Thickness: Regular, 1/2 inch (13 mm) thick unless Type X is required by building code or indicated on drawings.
 - 3. Size: 48 by 96 inches (1219 by 2438 mm) for vertical installation.

2.6 PARAPET SHEATHING

- A. Plywood Sheathing: DOC PS 1, Exterior, Structural I sheathing.
 - 1. Span Rating: Not less than 16/0.
 - 2. Nominal Thickness: Not less than 3/4-inch.

2.7 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- E. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
 - 1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C1002.
 - 2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C954.

2.8 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
 - 1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
 - 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
 - 3. ICC-ES evaluation report for fastener.
- D. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Sheathing:
 - a. Screw to cold-formed metal framing.
 - b. Space panels 1/8 inch (3 mm) apart at edges and ends.

3.3 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to cold-formed metal framing with screws.
 - 2. Install panels with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
 - 3. Install panels with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.
 - 1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.
 - 2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.
 - 1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.
 - 2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- E. Seal sheathing joints according to sheathing manufacturer's written instructions.
 - 1. Complete installation of sill sealer gaskets by adhering upward leg of tee-shaped gaskets to face of sheathing.
 - 2. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
 - 3. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION

SECTION 06 41 16

PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Plastic-laminate-clad architectural cabinets.
 - 2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.
 - 3. Polypropylene pegboards.

1.2 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.
- B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 08 71 00 "Door Hardware" to manufacturer of architectural cabinets; coordinate Shop Drawings and fabrication with hardware requirements.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Show large-scale details.
 - 3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.
- C. Samples for Verification: For the following:
 - 1. Plastic Laminates: 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish required.
 - a. Provide one sample applied to core material with specified edge material applied to one edge.
 - 2. Thermoset Decorative Panels: 8 by 10 inches (200 by 250 mm), for each color, pattern, and surface finish.
 - a. Provide edge banding on one edge.
 - 3. Corner Pieces:
 - a. Cabinet-front frame joints between stiles and rails and at exposed end pieces, 18 inches (450 mm) high by 18 inches (450 mm) wide by 6 inches (150 mm) deep.
 - b. Miter joints for standing trim.
 - 4. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Product Certificates: For each type of product.
 - 1. Composite wood products.
 - 2. High-pressure decorative laminate.
 - 3. Glass.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Manufacturer of products.

- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockups of typical architectural cabinets as shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during the remainder of the construction period.
- B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.
 - 1. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.
- B. Architectural Woodwork Standards Grade: Custom.
- C. Type of Construction: Frameless.
- D. Door and Drawer-Front Style: Flush overlay.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Formica Corporation.
 - b. Nevamar Company.
 - c. Wilsonart.
- F. Laminate Cladding for Exposed Surfaces:
 - 1. Horizontal Surfaces: Grade HGS.
 - 2. Postformed Surfaces: Grade HGP.
 - 3. Vertical Surfaces: Grade VGS.
 - 4. Edges: PVC edge banding, 0.04 inch (1 mm) thick, matching laminate in color, pattern, and finish.
 - 5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
- G. Materials for Semiexposed Surfaces:
 - 1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
 - a. Edges of Plastic-Laminate Shelves: PVC edge banding, 0.018 inch (0.45 mm) thick, matching laminate in color, pattern, and finish.
 - b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
 - 2. Drawer Sides and Backs: Solid-hardwood lumber.
 - 3. Drawer Bottoms: Hardwood plywood.

- H. Dust Panels: 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.
 - 2. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - a. As scheduled.

2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - 1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
 - 2. Particleboard: ANSI A208.1, Grade M-2.
 - 3. Softwood Plywood: DOC PS 1, medium-density overlay.
 - 4. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 08 71 00 "Door Hardware."
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, self-closing, stainless steel with a satin finish.
 - 1. 165°/170°- Blum Clip top 170 degrees of opening self-closing hinge 71T6540B OR Salice Series 200 165 degrees of opening self-closing hinge C2JFA99.
 - 2. 120° hinge- Blum Clip top 120 degrees of opening self-closing hinge 71T5590B OR Salice Series 200 120 degrees of opening self-closing hinge C2J9A99.
 - 3. 165-degree hinge typical, 120-degree hinge against wall locations.
 - 4. Provide two hinges at doors 42 inches high or less, three hinges for doors up to 60 inches high, and four hinges for doors over 60 inches high.
- C. Wire Pulls: Back mounted, solid metal, 4 inches (100 mm) long, 5/16 inch (8 mm) in diameter.
 - 1. Basis-of-Design Product: Stanley; 348235.
- D. Catches:
 - 1. Elbow Catch: Brass with latch held by coiled compression spring with 0.0598 inch (1.519 mm) (16 gage) plated steel catch plate.
 - a. Provide at the top of the fixed leaf of base cabinets with double doors that have locks and at the bottom of the fixed leaf of upper cabinets with double doors that have locks.
 - 2. Magnetic catches, BHMA A156.9, B03141.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) EPCO; #592.
 - 2) Hager; 1437.
 - 3) Stanley; SP-41/SP-45.
 - b. Provide at the top of all cabinet doors that do not have spring catches.
 - c. Provide at the approximate pull height, at underside of fixed shelf or on bulkhead if no shelf of each door of tall cabinets.
- E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
 - 1. Basis-of-Design Product: Knappe & Vogt; 346ANO.

- F. Adjustable Shelf Supports: Standard back-mounted system using surface mounted metal shelf standards and coordinated cantilevered shelf brackets, satin chrome finish, for nominal 1 inch spacing adjustments.
 - 1. Basis-of-Design Product: Knape & Vogt; 85/185 Heavy Duty Double Slotted.
- G. Shelf Rests: BHMA A156.9, B04013; metal.
- H. Drawer Slides: BHMA A156.9.
 - 1. Standard Drawer Slides:
 - a. Type: Full extension with overtravel.
 - b. Static Load Capacity: Heavy Duty grade.
 - c. Mounting: Side mounted.
 - d. Stops: Integral type.
 - e. Capacity: 200 lb base on an 18" slide length.
 - f. Steel Ball Bearing type.
 - g. Runners to have instant removal and stop to prevent inadvertent removal with positive closing action.
 - h. Manufacturers:
 - 1) Accuride International, Inc.
 - 2) Grass America Inc.
 - 3) Knape & Vogt Manufacturing Company.
 - 2. Flat File Drawer Slides:
 - a. Type: Full extension with overtravel.
 - b. Static Load Capacity: Heavy Duty grade.
 - c. Mounting: Side mounted.
 - d. Stops: Integral type.
 - e. Capacity: 200 lb base on an 18" slide length.
 - f. Mounting: Side, 1" maximum clearance.
 - g. Steel Ball Bearing type.
 - h. Runners to have instant removal and stop to prevent inadvertent removal with positive closing action.
 - i. Manufacturers:
 - 1) Accuride International, Inc.
 - 2) Grass America Inc.
 - 3) Knape & Vogt Manufacturing Company.
 - 3. Lateral File Drawer Slides:
 - a. Type: Full extension with overtravel.
 - b. Static Load Capacity: Heavy Duty grade.
 - c. Mounting: Side mounted.
 - d. Stops: Integral type.
 - e. Capacity: 200 lb base on an 18" slide length.
 - f. Mounting: Side, 1" maximum clearance.
 - g. Steel Ball Bearing type.
 - h. Runners to have instant removal and stop to prevent inadvertent removal with positive closing action.
 - i. Manufacturers:
 - 1) Accuride International, Inc.
 - 2) Grass America Inc.
 - 3) Knape & Vogt Manufacturing Company.
 - 4. File Hanger Rails:
 - a. Manufacturers:
 - 1) Kinetron Inc.; Product KHFB-500 with bar.
 - 2) Provide configuration options for both letter- and legal-sized files.
 - 3) Provide configuration options for both side-to-side and front-to-back orientations.
 - 5. For computer keyboard shelves, provide Grade 1.
 - a. Basis-of-Design Product: Knape & Vogt Manufacturing Company; Model SD-10-21 Keyboard and Mouse Tray.
- I. Door Locks: BHMA A156.11, E07121.
- J. Drawer Locks: BHMA A156.11, E07041.
 - 1. Cabinet Locks: Keyed cylinder master keyed, steel with satin finish.
 - a. Product: Match existing.

- b. All locks provided with two keys. All locks in a room, except teacher's cabinet, to be keyed alike, and each room to be keyed differently. Provide two master keys per room and provide two master keys for all units on project.
 - K. Door and Drawer Silencers: BHMA A156.16, L03011.
 - L. Grommets for Cable Passage: 3-inch (51-mm) OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
 - 1. Color: As selected by Architect from manufacturer's full range. Allow for different colors for different countertop finish.
 - M. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Satin Stainless Steel: BHMA 630.
 - N. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
- 2.4 MISCELLANEOUS MATERIALS
- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
 - B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
 - C. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
 - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.
- 2.5 TOOL PEGBOARD
- A. Tool-Hanging Pegboard (in Shop Room): ISO 19069-1:2015:
 - 1. Provide polypropylene pegboard in Shop Room as indicated on Drawings.
 - 2. Install with plastic spacers and with galvanized fasteners and washers, of appropriate type for substrate indicated. Fasten through corner holes and at 2-feet on center around the perimeter.
 - 3. Finish: White.
 - 4. Hanging Accessories: Not in contract; provided and installed separately by Owner.
- 2.6 FABRICATION
- A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.
 - B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify Architect seven days in advance of the dates and times architectural cabinet fabrication will be complete.
 - 2. Trial fit assemblies at manufacturer's shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
 - C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 - D. Install glass to comply with applicable requirements in Section 08 80 00 "Glazing" and in GANA's "Glazing Manual."
 - 1. For glass in frames, secure glass with removable stops.
 - 2. For exposed glass edges, polish and grind smooth.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

- A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm) using concealed shims.
 - 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 - 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c..

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION

SECTION 06 61 16

SOLID SURFACING FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

1. Solid surface fabrications, including window sills.

1.2 ACTION SUBMITTALS

- A. Product Data: For solid surfacing materials.
- B. Shop Drawings: Show materials, finishes, and edge profiles.
 1. Show locations and details of joints.
 2. Show direction of directional pattern, if any.
- C. Samples for Verification: For the following products:
 1. Solid surfacing material, 6 inches (150 mm) square.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For solid surface material to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate solid surfacing similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of solid surfacings.
- C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
 1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOLID SURFACE MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Affinity Surfaces; a brand of Domain Industries, Inc.
 - b. Avonite Surfaces.
 - c. Corian.
 - d. E. I. du Pont de Nemours and Company.
 - e. Formica Corporation.
 - f. LG Chemical, Ltd.
 - g. Meganite Inc.
 - h. Samsung Chemical USA, Inc.
 - i. Swan Corporation (The).
 - j. Transolid Div of Trumbull Industries.
 - k. Wilsonart.
 2. Type: Provide Standard type unless Special Purpose type is indicated.
 3. Colors and Patterns: As indicated on Drawings.
 4. Edge Profile: Micro-chamfer exposed top and bottom edges.
- B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 SOLID SURFACE INTERIOR WINDOWSILLS

- A. Solid Surface Material Thickness: 1/2-inch.
- B. Wood Underlayment Material (Where Required for Support by Surface Material): Plywood.
- C. Colors, Patterns, and Finishes: As indicated on Drawings.
- D. Fabricate sills in one piece where possible. Comply with solid surface material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
- E. Edge Profile: Micro-chamfer exposed top and bottom edges.
- F. Seal joints to adjacent construction in color(s) as selected by Architect.

2.3 SOLID SURFACING FABRICATION

- A. Fabricate solid surfacings according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
 - 1. Grade: Custom.
- B. Solid Surfacings: 1/2-inch- (12.7-mm-) thick, solid surface material.
- C. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
- D. Joints: Fabricate solid surfacings without joints.
- E. Edge Profile: Double thickness, with micro-chamfer exposed top and bottom edges.
- F. Cut holes for sinks, faucets, and accessories as required.

2.4 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
 - 1. Adhesives shall have a VOC content of 70 g/L or less.
- B. Sealant for Solid surfacings: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive solid surface material and conditions under which solid surfacings will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of solid surface.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install solid surfacings level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m), 1/4 inch (6 mm) maximum. Do not exceed 1/64-inch (0.4-mm) difference between planes of adjacent units.
- B. Fasten solid surfacings by screwing through corner blocks of base units into underside of solid surfacing. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match solid surfacing, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- D. Secure solid surfacings to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match solid surfacing, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- E. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

END OF SECTION

SECTION 06 64 00
PLASTIC PANELING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Provide and install glass-fiber-reinforced plastic wall panels and trim accessories as herein specified at mop sink walls and where indicated on Drawings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For plastic paneling, in manufacturer's standard sizes.

1.3 QUALITY ASSURANCE

- A. Testing Agency: Acceptable to authorities having jurisdiction.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

2.2 PLASTIC SHEET PANELING

- A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D 5319.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Composites, Inc..
 - b. Glasteel.
 - c. Marlite.
 - d. Newcourt, Inc.
 - e. Nudo Products, Inc.
 - f. Sequentia Products.
 - 2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E 84. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 3. Nominal Thickness: Not less than 0.09 inch (2.3 mm).
 - 4. Surface Finish: As selected by Architect from manufacturer's standard.
 - 5. Color: As selected by Architect from manufacturer's full range.

2.3 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
 - 1. Color: Match panels.
- B. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.
- C. Adhesive: As recommended by plastic paneling manufacturer.
- D. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.
- B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- C. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.
- D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- E. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.
 - 1. Mark plumb lines on substrate at trim accessory locations for accurate installation.
 - 2. Locate trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

3.3 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels in a full spread of adhesive.
- C. Install trim accessories with adhesive.
- D. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.
- E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION

SECTION 07 01 53
ROOF MODIFICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes the following:
 - 1. Modifications to existing roofing system in preparation for tie-in with new adjacent compatible roofing system.
 - 2. Patching of existing roofing system where existing openings are no longer required.
 - 3. Cutting in of new penetrations through existing roof system, and flashing with new materials into existing roofing system.
 - 4. Temporary roofing membrane.
 - 5. Protection of existing roofing system that is not to be modified or disturbed.

1.2 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

1.3 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.
- B. Existing Membrane Roofing System: Roofing membrane, surfacing, and components and accessories between deck and roofing membrane.
- C. Substrate Board: Rigid board or panel products placed over the roof deck that serve as thermal barriers, provide a smooth substrate, or serve as a component of a fire-resistance-rated roofing system.
- D. Roof Re-Cover Preparation: Existing roofing membrane that is to remain and be prepared for reuse.
- E. Partial Roof Tear-Off: Removal of a portion of existing membrane roofing system from deck or removal of selected components and accessories from existing membrane roofing system.
- F. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and reinstalled.
- G. Existing to Remain: Existing items of construction that are not indicated to be removed.

1.4 SYSTEM DESCRIPTION

- A. Designated Roof Areas: Remove existing ballast (if any), perimeter flashings, base flashings, counter flashings, vent stack flashings, roofing membrane, insulation, and other system components as required for roofing work.
- B. Remove or relocate designated roof mounted mechanical and electrical equipment as required for roofing work.
- C. Provide products required by manufacturers to be fully compatible with each other and with indicated substrates, or provide separation materials as required to eliminate contact between incompatible materials.
- D. Provide new roof membrane, insulation, and flashing to accommodate roof mounted equipment removal or relocation, penetrations, and new building addition.
- E. Performance Requirements: Prevent water infiltration through roof membrane penetrations or modifications resulting from work described in Contract Documents.
- F. Industry Standards: Conform to NRCA - Roofing and Waterproofing Manual, except where more stringent requirements are indicated.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product specified.
 - 1. Include list of materials and data sheets describing physical characteristics and performance criteria for materials proposed for use as well as applicable standards met by each product.

2. Temporary Roofing: Include Product Data and description of temporary roofing system. If temporary roof will remain in place, submit surface preparation requirements needed to receive permanent roof, and submit a letter from roofing membrane manufacturer stating acceptance of the temporary membrane, and that its inclusion will not adversely affect the roofing system's resistance to fire and wind.
 - B. Shop Drawings: Submit details for this specific project indicating construction at penetrations, terminations, flashings, drains, and tie-in to existing roof.
- 1.6 INFORMATIONAL SUBMITTALS
- A. Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including exterior and interior finish surfaces, that might be misconstrued as having been damaged by roofing modification operations. Submit before Work begins.
 - B. Certifications specified in Quality Assurance article.
 - C. Qualification Data: For Installer, including certificate that Installer is approved by warrantor of existing roofing system.
 - D. Manufacturer's Installation Instructions: Submit manufacturer's printed installation instructions for each product.
- 1.7 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For roofing system to include in the maintenance manuals specified in Division 01.
 - B. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roof installation.
 - C. Warranty: Submit specified warranty in accordance with Division 01.
- 1.8 QUALITY ASSURANCE
- A. Applicator Qualifications: Approved by manufacturer for making modifications and repairs to existing warranted roofing prior to execution of this Contract.
 1. Minimum of 5 years documented experience in roofing repairs of this type of roof.
 2. Include list of completed projects having similar scope of work identified by name, location, date, reference name, and phone number.
 - B. Materials Removal Firm: Company specializing in performing the work of this Section with minimum 5 years documented experience.
 - C. Certifications:
 1. Submit manufacturer's certification stating materials ordered and supplied are compatible with existing roofing system and will not void existing warranty.
 2. Submit manufacturer's project registration form indicating that manufacturer has reviewed Project and will issue or extend existing warranty to cover repairs warranty upon successful completion of installation.
 3. Submit manufacturer's approval of applicator.
 4. Certify materials shipped to Project site meet roof manufacturer's published performance standards and requirements of this Specification.
 5. State that membrane manufacturer approves of insulation type and method of installation.
 - D. Regulatory Requirements: Comply with governing EPA notification regulations before beginning membrane roofing removal. Comply with hauling and disposal regulations of authorities having jurisdiction.
- 1.9 PROJECT CONDITIONS
- A. Owner will occupy portions of building immediately below roofing modification area. Conduct roof modifications so Owner's operations will not be disrupted. Provide Owner with not less than 2 weeks notice of activities that may affect Owner's operations.
 1. Coordinate work activities daily with Owner so Owner can place protective dust or water leakage covers over sensitive equipment or furnishings, shut down HVAC and fire-alarm or -detection equipment if needed, and evacuate occupants from below the work area if desired.
 2. Before working over structurally impaired areas of deck, notify Owner to evacuate occupants from below the affected area. Verify that occupants below the work area have been evacuated prior to proceeding with work over the impaired deck area.

- B. Protect building where roofing is scheduled to be modified, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from modification operations.
- C. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
- D. Owner assumes no responsibility for condition of areas to be modified.
 - 1. Conditions existing at time of inspection for bidding will be maintained by Owner as far as practical.
- E. Handle and store roofing materials and place equipment in a manner to avoid significant or permanent damage to deck or structural supporting members.
- F. Weather Limitations: Proceed with roofing modification work only when existing and forecasted weather conditions permit Work to proceed without water entering into existing roofing system or building.
 - 1. Emergency Equipment: Maintain on-site equipment necessary to apply emergency temporary edge seal in the event of sudden storms or inclement weather.
 - 2. Maintain continuous temporary protection prior to and during installation of new roofing system.
- G. Hazardous Materials: It is not expected that hazardous materials such as asbestos-containing materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work. Existing roof will be left no less watertight than before removal.
 - 2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

1.10 SEQUENCING AND SCHEDULING

- A. Schedule work to coincide with commencement of installation of new roofing system.
- B. Remove only existing roofing materials that can be replaced with new materials the same day.
- C. Coordinate the work with other affected mechanical and electrical work associated with roof penetrations.

1.11 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during roof modification work, by methods and with materials so as not to void existing roofing system warranty. Notify warrantor before proceeding.
 - 1. Notify warrantor of existing roofing system on completion of roofing modifications, and obtain documentation verifying that existing roofing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.
- B. If roofing system manufacturer's warranty is no longer in effect on the existing roof system, upon completion of Work and prior to final payment, furnish written warranty signed by installer and Contractor stating that for 2 year period from date of Substantial Completion of Building repairs and maintenance will be made to maintain roofing and flashings in watertight condition.

PART 2 - PRODUCTS

2.1 INFILL AND PATCHING MATERIALS

- A. Use infill and patching materials, including sheet and adhesive materials, flashings, roof surfacing, fasteners, adhesives, and accessories, matching existing membrane roofing system materials, unless otherwise indicated.

2.2 TEMPORARY ROOFING MATERIALS

- A. Selection of materials and design of temporary roofing is responsibility of Contractor. Select only materials that are compatible with existing roofing system. For pipe penetrations, use flashing materials and techniques as recommended by NRCA, utilizing portals mounted to curbs.

2.3 RECOVER BOARDS

- A. Recover Board: ASTM C 1177, glass-mat, water-resistant gypsum substrate; 1/4 inch thick.
- B. Fasteners: Factory-coated steel fasteners, listed in FMG's "Approval Guide," designed for fastening recover boards to deck.

2.4 AUXILIARY MATERIALS

- A. General: Auxiliary preparation materials recommended by roofing system manufacturer for intended use and compatible with components of existing membrane roofing system
- B. Insulation: Type used in original roof construction in thickness necessary to achieve satisfactory repair of membrane with no ponded water.
- C. Wood Blocking and Nailers: As specified in Division 06.
- D. Metal Flashing Sheet: Metal flashing sheet is specified in Division 07 Section "Sheet Metal Flashing and Trim."
- E. Mechanical Fasteners and Disks: Appropriate for purpose intended and approved by UL or FM; length required for thickness of materials, fluoropolymer finish complete with disks; manufacturer as required by membrane manufacturer.
- F. Ballast (if required): Type required to match existing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions under which roofing modifications will be performed with Installer present for compliance with requirements.
- B. Verify that roof openings and penetrations are in place and set and braced and that roof drains are properly clamped into position.
- C. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at roof penetrations and terminations and match the thicknesses of insulation required.
- D. Do not proceed with installation until unsatisfactory conditions have been corrected.
- E. Do not apply roofing materials to damp, frozen, dirty, dusty or other surface conditions which are unacceptable to manufacturer or applicator.

3.2 PREPARATION

- A. Clean substrate of dust, debris, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prepare roof surfaces as recommended by manufacturer of original installation.
- C. Protect existing membrane roofing system that is indicated not to be modified.
 - 1. Loosely lay 1 inch minimum thick, molded expanded polystyrene (MEPS) insulation over the roofing membrane in areas indicated. Loosely lay 15/32-inch plywood or OSB panels over MEPS. Extend MEPS past edges of plywood or OSB panels a minimum of 1 inch.
 - 2. Limit traffic and material storage to areas of existing roofing membrane that have been protected.
 - 3. Maintain temporary protection and leave in place until replacement roofing has been completed.
- D. Coordinate with Owner to shut down air intake equipment in the vicinity of the Work. Cover air intake louvers before proceeding with roof modification work that could affect indoor air quality or activate smoke detectors in the ductwork.
- E. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.
- F. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday. Prevent debris from entering or blocking roof drains and conductors. Use roof-drain plugs specifically designed for this purpose. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.
 - 1. If roof drains will be temporarily blocked or unserviceable due to roofing system removal or partial installation of new membrane roofing system, provide alternative drainage method to remove water and eliminate ponding. Do not permit water to enter into or under existing membrane roofing system components that are to remain.
- G. Verify that rooftop utilities and service piping have been shut off before commencing Work.

3.3 PROTECTION

- A. Protect existing building surfaces against damage from roofing installation.

- B. Provide temporary seals to prevent water from entering completed sections of the roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.4 PARTIAL ROOF REMOVAL

- A. Partial Roof Tear-Off: Where indicated, remove existing roofing membrane and other membrane roofing system components down to the deck and as required to allow for proper patching of existing roof, and tie-in to new roofing system.
 - 1. Remove cover boards, roof insulation, and substrate boards.
 - 2. Bitumen and felts that are firmly bonded to concrete decks are permitted to remain if felts are dry. Remove unadhered bitumen and felts and wet felts.
 - 3. Remove excess asphalt from steel deck. A maximum of 15 lb/100 sq. ft. of asphalt is permitted to remain on steel decks.
 - 4. Remove fasteners from deck or cut fasteners off slightly above deck surface.

3.5 DECK PREPARATION

- A. Inspect deck after partial tear-off of membrane roofing system.
- B. Precast Concrete Decks:
 - 1. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.
 - 2. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263 or by pouring 1 pint of hot roofing asphalt on deck at start of each day's work and at start of each roof area or plane. Do not proceed with roofing work if moisture condenses under the plastic sheet or if asphalt test sample foams or can be easily and cleanly stripped after cooling.
 - 3. Do not proceed with installation until after the minimum concrete curing period, and moisture and pH levels are within the acceptable range as recommended by roofing system manufacturer.
- C. If deck surface is not suitable for receiving new roofing, or if structural integrity of deck is suspect, immediately notify Architect. Do not proceed with installation until directed by Architect.

3.6 INFILL MATERIALS INSTALLATION

- A. Immediately after removal of selected portions of existing membrane roofing system, and inspection and repair, if needed, of deck, fill in the tear-off areas to match existing membrane roofing system construction.
 - 1. Install new roofing membrane patch over roof infill area. If new roofing membrane is installed the same day tear-off is made, roofing membrane patch is not required.

3.7 FLASHING AND REPAIR WORK

- A. General: Perform work in accordance with instructions and recommendations of manufacturer of original installation materials.
- B. Remove loose aggregate from aggregate-surfaced, built-up bituminous roofing with a power broom.
- C. Clean substrate of contaminants such as dirt, debris, oil, and grease that can affect adhesion of roof patching materials.
- D. Cut holes for penetrations neatly and in accordance with Division 01 Section "Cutting and Patching."
- E. Where continuity of existing fastener pattern has been interrupted by cutting and patching work, provide additional uplift securement for existing roofing system with new screws and plates applied to each roof zone to comply with same wind uplift requirements as specified for new roofing work.
- F. Lay base flashing and seal down to membrane and penetration.
- G. Strip in flashing with multiple layers of felt and bitumen on built up systems and with one layer of sheet material on single ply systems.
- H. Counterflash as required.
- I. Make watertight.
- J. Do not damage metal counterflashings that are to remain. Replace metal counterflashings damaged during removal with counterflashings of same metal, weight or thickness, and finish.

3.8 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
 - 1. Notify Architect and Owner 48 hours in advance of the date and time of inspection.
- B. Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.

3.9 DISPOSAL

- A. Collect and place demolished materials in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
 - 1. Storage or sale of demolished items or materials on-site will not be permitted.
- B. Transport demolished materials off Owner's property and legally dispose of them.

END OF SECTION

SECTION 07 13 52

MODIFIED BITUMINOUS SHEET WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Plaza Deck Waterproofing Membrane Application
- B. Flashing Application
- C. Incorporation of Sheet Metal Flashing Components and Accessories into the Plaza Deck Waterproofing System

1.2 RELATED SECTIONS

- A. Section 06 10 53 - Miscellaneous Rough Carpentry
- B. Section 07 62 00 - Sheet Metal Flashing and Trim

1.3 REFERENCES

- A. ASTM American Society for Testing and Materials - Philadelphia, PA
- B. FM Factory Mutual Engineering Research Corp. - Norwood, MA
- C. NRCA National Roofing Contractors Association - Rosemont, IL
- D. OSHA Occupational Safety and Health Administration - Washington, DC
- E. SMACNA Sheet Metal and Air Conditioning Contractors National Association - Chantilly, VA
- F. UL Underwriters Laboratories - Northbrook, IL

1.4 SYSTEM DESCRIPTION

- A. Two ply SBS modified bitumen waterproofing system with compatible/specified flexible flashing materials overlaid with concrete topping slab.
- B. Performance Requirements: Waterproofing System shall prevent water migration from entering the building through the waterproofing membrane or flashing.

1.5 SUBMITTALS

- A. Product Data: Submit product data on all materials used in construction of specified waterproofing system including, but not limited to, modified base and cap plies, flashing base and cap plies, flashing fasteners, bituminous materials, insulation, drainage mat, filter fabric, pavers, and other related accessories.
- B. Shop Drawings: Indicated dimensions, layout, spans, joint construction details, methods of anchorage, method and sequence of installation.
- C. Manufacturer's Installation Instructions: Include installation sequence, special instructions, and Material Safety Data Sheets.
- D. Manufacturer's Certificate: Certificate stating products meet or exceed all specified requirements.
- E. Contract Closeout Submittals:
 - 1. Project Record Documents
 - 2. Contractors Five-Year Labor and Material Warranty
 - 3. Manufacturer's Twenty Year No-Dollar-Limit Labor and Material Warranty.

1.6 QUALITY CONTROL

- A. Work of this Section shall conform to NRCA Roofing and Waterproofing Manual and Manufacturer's instructions.
- B. Qualifications for Work of this Section:

1. Manufacturer specializing in the manufacture of products in this Section with a minimum five years documented experience of those products being used.
 2. Applicator specializing in applying the Work and Products of this Section with a minimum of five years documented experience and approved by the Manufacturer to install the necessary waterproofing system and flashings so as to qualify and provide the specified 20 year NDL type warranty.
- C. Pre-installation Conference:
1. Convene a waterproofing pre-installation conference two weeks prior to commencing work of this Section, under provisions of applicable Section.
 2. Require attendance of parties directly affecting Work of this Section.
 3. Review conditions of demolition, if applicable, installation, installation procedures and coordination with related Work.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to the site and store/protect on site under provisions of applicable Section.
 - B. Deliver products in manufacturer's original containers, dry, undamaged, with seal and labels in tact.
 - C. Store products in weather protected environment clear of ground moisture.
 - D. Stand and store roll goods on end.
 - E. Do not store more materials on the deck than can be installed within two days.
 - F. Maximum allowable loading for storage purposes is 20 pounds per square foot.
- 1.8 PROJECT CONDITIONS
- A. Do not apply waterproofing during inclement weather.
 - B. Do not apply waterproofing system to damp or frozen deck or substrate.
 - C. Observe wind chill and other cold weather conditions for proper bituminous application temperatures.
 - E. Torch Safety: Crew members handling torches shall be trained by an Authorized Certified Roofing Torch Applicator (CERTA) Trainer, be certified according to CERTA torch safety guidelines as published by the National Roofing Contractor's Association (NRCA), and follow torch safety practices as required by the Contractor's insurance carrier. Designate one person on each crew to perform a daily fire watch. The designated crew member shall watch for fires or smoldering materials on all areas during roof construction activity, and for the minimum period required by CERTA guidelines after roofing material application has been suspended for the day.
- 1.9 SEQUENCING AND SCHEDULING
- A. Coordinate work under provisions of applicable Section.
 - B. Coordinate work with other trades and work to ensure sufficient materials and man-power are available to completely install and make water-tight all waterproofing installed on a daily basis.
 - C. Coordinate installation of associated metal flashing and roof related items as Work of this Section proceeds.
- 1.10 WARRANTY
- A. Provide five year warranty from installer covering damage to building resulting from failure to resist penetration of water and replacement of defective materials and labor.
 - B. Manufacturer's Warranty: Provide a twenty (20) year No-Dollar-Limit System Warranty from roof materials manufacturer covering full replacement of all materials and labor with no penal sum.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Waterproofing System:
 1. Siplast
 2. Tremco
- B. Fasteners:

1. OMG, Inc.
2. Construction Fasteners, Inc.
3. Powers Fasteners (Rawl)
4. Hilti
5. Simplex

- C. Substitutions: Provide all applicable data for proposed substitution no less than ten days prior to bid due date for review and addendum purposes.

2.2 MATERIALS

A. Sheet Materials:

1. SBS Modified Bitumen Base Ply (Field Membrane): Asphalt elastomer sheet with polyester and/or glass reinforcing, equal to:
 - a. Siplast – Paradiene 20 TG
2. SBS Modified Bitumen Waterproofing Cap Ply (Cap Sheet): Polyester and/or glass mat reinforced, equal to:
 - a. Siplast - Teranap
3. Modified Bitumen Flashing System, equal to:
 - a. Siplast – Teranap with Paradiene 20 SA backer
4. Provide components equal to Tremco TREMproof 6100

B. Bituminous Materials

1. Asphalt Primer: ASTM D41
2. Plastic Cement: ASTM D4586, Type I, asbestos free.
3. Flashing Cement: MBR type only, compatible for use with SBS modified bitumen roof system.

C. Accessories

1. Mechanical Fasteners for Flexible Flashing:
 - a. Masonry: Special heat treated, stress relieved, 1-1/4"; Masonry Nail manufactured by Simplex Nails, Inc.
 - b. Wood Blocking: High Carbon, zinc coated steel; annular threaded 1-inch shank nails; with minimum 1-inch x 30 gage metal disk; Roofing Nail, manufactured by Simplex Nails, Inc.
2. Membrane Protection Course: As approved by Waterproofing Membrane Manufacturer.
3. Substitutions: Under Provisions of applicable Section.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify that deck is supported and secured.
- C. Verify the deck is clean and smooth, free of depressions, waves, or other projections, properly sloped to drains or eaves.
- D. Verify that deck surfaces are dry and free of snow or ice.
- E. Verify that deck openings, curbs, pipes, sleeves, ducts, and vents through the deck are solidly set and wood nailing strips are in place.
- F. Beginning of installation means installer accepts existing surfaces.

3.2 PREPARATION

- A. Protect all building surfaces against damage from waterproofing work.
- B. Prevent debris and bitumen from drains, downspouts, underside of deck or other openings.
- C. Clean surfaces of deck and maintain free from all deleterious material during waterproofing operations. Prime surface of deck per Manufacturer's requirements.
- D. Verify flatness and tight joints of decking.

3.3 MEMBRANE APPLICATION

- A. Torch apply one ply of modified bitumen base ply to primed concrete deck, shingle fashion, working from low point or drain areas to high areas or peaks. Base ply side and end laps to be three inches minimum.

Cut dog ear angles at end laps overlapping selvage edges. Apply top pressure to top seal T-laps immediately following sheet applications with a clean trowel. Stagger end laps three feet minimum.

- B. Torch apply one ply of modified bitumen cap ply to base ply in accordance with manufacturer's instructions. Cap ply side and end laps to be four inches minimum. Cut dog ear angles at end laps overlapping selvage edges. Prepare the surface area of the finish ply end lap by burning off the protective surface film using torch. Apply top pressure to top seal T-laps immediately following sheet applications with a clean trowel. Stagger end laps three feet minimum.
- D. Apply plies smooth, free of air pockets, wrinkles, fishmouths, lap joints or tears. Do not lay felts in a buck water fashion.
- E. Membrane plies to butt up to vertical surfaces. Torch additional ply of sheet products as dictated to act as base flashing over waterproofing membrane. Secure to nailing strips or substrates with proper fasteners spaced not more than 4 inches on center.
- F. Install water cut-offs at end of day's operations. Seal open edges of field membrane including tops of field membrane and around penetrations with plastic cement or additional pieces of field membrane. Completely remove all cut-offs before resuming roofing operations.
- G. Mop and seal additional plies as dictated by Manufacturer to and around all deck penetrations.
- H. Prohibit foot and cart traffic over newly applied membrane products.

3.4 FLASHINGS AND ACCESSORIES

- A. Apply flexible base flashings to seal membrane to vertical elements. Install backer ply as dictated by material manufacturer. Base flashing sheets to be cut from the end of the roll and torch applied vertically with selvage edge. Secure to nailing strips or proper substrate at four inches on center.
- B. Coordinate installation of related flashings so that all vertical surfaces or areas so requiring flashing are not left for more than 5 days of exposure.
- C. All temporary flashings and applications of bituminous cement used for temporary seal shall be completely removed prior to application of modified bitumen base flashing products.
- D. Sealant: Apply a smooth continuous bead of the specified sealant at the exposed finish ply edge transition to metal flashings incorporated into the waterproofing system.
- E. Membrane Protection Layer: Place the specified polyethylene slip sheet unadhered directly over all areas of the newly applied membrane, extending to walls, curbs, and other related junctures.

3.5 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of applicable Section.
 - 1. Waterproofing membrane system must be inspected by the manufacturer's representative prior to installation of the overburden/protection system. The manufacturer's representative will compile required punch list items indicating any deficiencies in the roof membrane and flashing membrane system that shall be corrected before the installation will be accepted.
 - 2. Water Test: Prior to the application of the overburden plug drainage devices and flood the waterproofing surface with water a minimum of 1 to 2 inches deep. Leave the water for a minimum of 24 hours to ensure the system is leak free.

NOTE: PRECAUTIONS MUST BE TAKEN TO DETERMINE IF THE STRUCTURE CAN HOLD THE WEIGHT OF THE WATER FOR THE DURATION OF THE TEST.

- B. Upon substantial completion, Owner may have Work examined, using applicable methods, to establish conditions of completed Project.
- C. Correct identified defects or irregularities. Cut out and repair membrane defects before end of each day or as dictated by Owner's Representative.

3.6 MANUFACTURER'S FIELD SERVICES

- A. Request site attendance of waterproofing materials manufacturer during installation of the Work.

3.7 CLEANING

- A. Remove bituminous markings from finished areas and surfaces.

- B. In areas where finished surfaces are soiled by asphalt or any other source caused by Work of this Section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.
- C. Repair or replace defaced or disfigured finishes caused by Work of this Section.

3.8 PROTECTION

- A. Protect finished Work under applicable Section. Where traffic must continue over finished or existing roof membrane, protect surfaces with a cushion layer of insulation of at least 2" thick and one layer of 3/4" or greater plywood - all ballasted for site and personnel protection.

END OF SECTION

SECTION 07 14 00

ELEVATOR PIT WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following applications for use at elevator pits:
 - 1. HDPE sheet waterproofing below elevator pit slab-on-grade.
 - 2. Cold fluid applied waterproofing at elevator pit walls.
 - 3. Molded-sheet drainage panels.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
 - 2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
- B. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, expansion joints, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, waterstops and other termination conditions.

1.3 INFORMATIONAL SUBMITTALS

- A. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
- B. Submit evidence that Installer's existing company has minimum of 5 years continuous experience in application of specified materials. Submit list of at least five completed projects of similar scope and size, including:
 - 1. Project name.
 - 2. Owner's name.
 - 3. Owner's Representative name, address, and telephone number.
 - 4. Description of work.
 - 5. Self-adhering sheet materials used.
 - 6. Project supervisor.
 - 7. Total cost of waterproofing work and total cost of project.
 - 8. Completion date
- C. Sample Warranties: Copies of waterproofing manufacturer's warranty, Installer's warranty, and General Contractor's warranty, all stating obligations, remedies, limitations, and exclusions. Submitted with Bid.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that is approved or licensed by waterproofing manufacturer for installation of waterproofing required for this Project.
- B. Source Limitations: Obtain waterproofing materials and molded-sheet drainage panels through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver liquid materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by waterproofing manufacturer.
- C. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- D. Store rolls according to manufacturer's written instructions.
- E. Protect stored materials from direct sunlight.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
- B. Do not apply waterproofing in snow, rain, fog, or mist.
- C. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.7 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
 - 1. Warranty Period: 5 years from date of Substantial Completion.
- B. Installer's Warranty:
 - 1. Written warranty signed by Installer and Contractor, including
 - a. Repair or replace waterproofing or sheet flashings that do not comply with requirements; that do not remain watertight; that fail in adhesion, cohesion, or general durability; or that deteriorate in manner not clearly specified by submitted waterproofing manufacturer's data as inherent quality of material for application indicated.
 - b. Removal and reinstallation of protection board and drainage panels Warranty includes replacing materials as necessary.
 - c. Repair or replacement, to satisfaction of Owner, of other work or items which may have been displaced or damaged as consequence of defective work.
 - d. Make immediate emergency repairs within 48 hours of notice of leakage.
 - e. Warranty does not include removal or reinstallation of plantings, soil overburden, or backfill in planters; or concrete or asphalt toppings.
 - f. Warranty Period: 5 years after Substantial Completion date.
- C. Contractor Warranty:
 - 1. Written warranty signed by Contractor, including
 - a. Removal and reinstallation of plantings, soil overburden, and backfill in planters; and concrete and asphalt toppings. Provide new materials to replace materials that are not suitable for reuse, in opinion of Architect.
 - b. Repair or replacement, to satisfaction of Owner, other work or items which may have been displaced or damaged as consequence of defective work.
 - c. Make immediate emergency repairs within 48 hours of notice of leakage.
 - d. Warranty Period: 5 years after Substantial Completion date.

PART 2 - PRODUCTS

2.1 ELEVATOR PIT SHEET WATERPROOFING

- A. Location: Positive side, horizontal slab application.
- B. Products: Subject to compliance with requirements, provide one of the following:
 - 1. GCP Applied Technologies Inc.; Preprufe 300R Plus.
 - 2. Polyguard Products, Inc.; Underseal Underslab Membrane.
 - 3. W.R. Meadows, Inc.; PRECON.
- C. HDPE Sheet Waterproofing:
 - 1. Physical Properties: As follows, measured per standard test methods referenced:
 - a. Tensile Strength, Film: 4000 psi minimum; ASTM D 412.
 - b. Low-Temperature Flexibility: Pass at minus 10 deg F; ASTM D 1970.
 - c. Peel Adhesion to Concrete: 5 lbf/in.; ASTM D 903, modified.
 - d. Lap Adhesion: 2.5 lbf/in.; ASTM D 1876, modified.
 - e. Hydrostatic-Head Resistance: 231 ft.; ASTM D 5385, modified.
 - f. Vapor Permeance: 0.01 perms; ASTM E 96, Water Method.
 - g. Water Absorption: 0.5 percent; ASTM D 570.

2.2 ELEVATOR PIT FLUID APPLIED WATERPROOFING

- A. Location: Positive side, vertical wall application.
- B. Two component, synthetic rubber, cold vulcanized, fluid applied waterproofing membrane: Comply with ASTM C 836 and with manufacturer's written physical requirements.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. GCP Applied Technologies Inc.; Procor 75 Spray Grade with Procor Composite Membrane.
 - b. Polyguard Products, Inc.; Commercial Stretch.
 - c. W.R. Meadows, Inc.; MEL-ROL LM (ALL-SEASON).

2.3 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Penetration and Terminations:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. GCP Applied Technologies Inc; Preprufe CJ Tape and Bithuthene Liquid Membrane.
 - b. Polyguard Products, Inc.; Detail Sealant PW.
 - c. W.R. Meadows, Inc.; MEL-PRIME.

2.4 MOLDED-SHEET DRAINAGE PANELS

- A. Non-woven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 100 sieve laminated to 1 side with a polymeric film bonded to the other side of a 3-dimensional, non-biodegradable, molded-plastic-sheet drainage core, with a vertical flow rate of at least 15 gpm per ft.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - d. GCP Applied Technologies Inc; Hydroduct 220.
 - e. Polyguard Products, Inc.; Polyflow 10P.
 - f. W.R. Meadows, Inc.; Mel-Drain 5035-B.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
 - 1. Do not proceed with installation until after the minimum concrete curing period recommended by waterproofing manufacturer.
 - 2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - 3. Notify Architect in writing of anticipated problems using waterproofing over substrate.
 - 4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- C. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- D. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
- E. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions.

3.3 SHEET WATERPROOFING APPLICATION

- A. Install sheet waterproofing according to manufacturer's written instruction.
- B. Horizontal Applications: Install sheet with face against substrate. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by membrane manufacturer. Overlap and seal seams, and stagger and tape end laps to ensure watertight installation.
- C. Corners: Seal lapped terminations and cut edges of sheet waterproofing at inside and outside corners with detail tape.
- D. Seal penetrations through sheet waterproofing to provide watertight seal with detail tape patches or wraps and a liquid-membrane troweling.
- E. Install sheet-waterproofing and auxiliary materials to produce a continuous watertight tie into adjacent waterproofing.
- F. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Tape perimeter of damaged or nonconforming area extending 6 inches (150 mm) beyond repaired areas in all directions. Apply a patch of sheet waterproofing and firmly secure with detail tape.

3.4 PREPARATION AT TERMINATIONS AND PENETRATIONS

- A. Prepare vertical and horizontal surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, and sleeves according to ASTM C 898 and ASTM C 1471 and manufacturer's written instructions.
- B. Prime substrate unless otherwise instructed by waterproofing manufacturer.
- C. On vertical surfaces, apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.
 - 1. Provide sealant cants around penetrations and at inside corners of deck-to-wall butt joints when recommended by waterproofing manufacturer.

3.5 JOINT AND CRACK TREATMENT AT FLUID APPLIED SYSTEMS

- A. Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 898 and ASTM C 1471 and waterproofing manufacturer's written instructions. Remove dust and dirt from joints and cracks, complying with ASTM D 4258, before coating surfaces.
 - 1. Comply with ASTM C 1193 for joint-sealant installation.
 - 2. Apply bond breaker between sealant and preparation strip.
 - 3. Prime substrate and apply a single thickness of preparation strip extending a minimum of 3 inches (75 mm) along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.
 - 4. Rout and fill joints and cracks in substrate. Before filling, remove dust and dirt according to ASTM D 4258.
- B. Install sheet flashing and bond to deck and wall substrates where indicated or required according to waterproofing manufacturer's written instructions. Extend sheet flashings onto perpendicular surfaces and other work penetrating substrate according to ASTM C 898.

3.6 FLUID APPLIED WATERPROOFING APPLICATION

- A. Apply waterproofing according to ASTM C 898 and ASTM C 1471 and manufacturer's written instructions.
- B. Start installing waterproofing in presence of manufacturer's technical representative.
- C. Apply primer (pre-treatment) over prepared substrate per manufacturer's recommendations.
- D. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.
 - 1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases, with dry film thickness of 60 mils. Apply waterproofing to prepared wall terminations and vertical surfaces.
 - 2. Verify wet film thickness of waterproofing every 100 sq. ft.

3.7 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Lap edges and ends of geotextile to maintain continuity. Protect installed panels during subsequent construction.

3.8 PROTECTION AND CLEANING

- A. Protect waterproofing from damage and wear during remainder of construction period.
- B. Protect installed from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 07 14 16

COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Below-grade waterproofing membrane.
 - 2. Accessory waterproofing system materials.
 - 3. Protection course.
 - 4. Molded-sheet drainage panels.

1.2 DEFINITIONS

- A. Compatible: Material that will not adversely affect adjacent materials, is chemically compatible with adjacent materials, and where required for bond, achieves adhesive compatibility with adjacent materials.
- B. Chemical Compatibility: Material that will not break down, deteriorate, degrade, or prematurely fail when in contact with another material. Material that will not cause chemical breakdown, deterioration, degradation, staining, or premature failure of another material.
- C. Adhesive Compatibility: Material that will develop bond strength or provide a suitable surface for another material to develop bond strength complying with requirements when in contact with another material.

1.3 COORDINATION

- A. Coordinate Work under this Section with adjacent concrete foundation work, including fill, other waterproofing systems.
- B. Coordinate requirements for concrete formwork to provide suitable substrate for waterproofing and to minimize penetrations in waterproofing.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review waterproofing requirements, including, but not limited to, the following:
 - a. Surface preparation specified in other Sections.
 - b. Minimum concrete curing period.
 - c. Forecasted weather conditions.
 - d. Special details and sheet flashings.
 - e. Repairs.
 - f. Field quality control.
 - 2. Coordinate meeting to ensure a representative from the Architect, Manufacturer, and Subcontractor are all in attendance.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
 - 2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
- B. Shop Drawings:
 - 1. Indicate locations and extent of waterproofing.
 - 2. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, expansion-joint conditions, tie-ins with adjoining waterproofing, and other termination conditions.
- C. Samples: For the following materials:
 - 1. Cured sample of waterproofing membrane on suitable rigid substrate, 8 by 8 inches (200 by 200 mm).
 - 2. Flashing sheet, 8 by 8 inches (200 by 200 mm).
 - 3. Drainage panel, 4 by 4 inches (100 by 100 mm).

1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample warranties.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.
- B. On site field representative from Manufacturer shall be on site at the time of installation to verify whether products are installed according to Manufacturer's requirements and comply with warranty.

1.8 MOCKUPS

- A. Build mockups to verify selections made under Sample submittals and to set quality standards for installation.
 - 1. Build mockup for each typical waterproofing installation, including accessories to demonstrate surface preparation, crack and joint treatments, inside and outside corner treatments, and protection.
 - a. Size: 100 sq. ft. (9.3 sq. m) in area.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer. Protect stored materials in accordance with manufacturer's written instructions.
- B. Remove and replace materials that cannot be applied within their stated shelf life.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer.
 - 1. Do not apply waterproofing to frozen, damp, or wet substrates, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.
 - 2. Do not apply waterproofing when snow, rain, fog, or mist are present, or when such weather conditions are imminent during application and curing period.
- B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.11 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or remove and replace waterproofing that fails to remain watertight within specified warranty period.
 - 1. Warranty includes leak remediation, including repair, removal, and replacement of protection course drainage panels.
 - 2. Warranty Period: 20 years from date of Substantial Completion.
- B. Installer's Special Warranty: Submit warranty signed by Installer, covering the Work of this Section, for warranty period of two years from date of Substantial Completion.
 - 1. Warranty includes leak remediation, including repair, removal, and replacement of protection course drainage panels.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Waterproofing System: Obtain waterproofing materials, protection course and molded-sheet drainage panels from manufacturer approved by waterproofing membrane manufacturer.

2.2 WATERPROOFING MEMBRANE

- A. Cold Fluid-Applied Waterproofing: ASTM C836/C836M; Polymer-enhanced, single component, fluid-applied, asphalt emulsion, below-grade waterproofing membrane.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Tremco, Inc.
 - 2. Basis-of-Design Product: Tremco, Inc.; TREMproof 260.
 - 3. Performance Characteristics:
 - a. VOC Content: No more than 72 g/L.
 - b. Hardness, ASTM D 2240: 50 minimum; Pass.
 - c. Low Temperature Crack Bridging, ASTM C836; Modified ASTM C1305: Pass.
 - d. Adhesion-in-Peel after Water Immersion, ASTM C836; ASTM C794: Exceeds.
 - e. Elongation, ASTM D412: 800 percent.
 - f. Peel adhesion, ASTM D903: Passes.
 - g. Low-Temp Flexibility, ASTM C836: Pass.
 - h. Water resistance, ASTM C836, AATC-127: Pass.
 - i. Water Vapor Permeance E96 Dry Cup: 0.028 US Perms.
 - j. Water Vapor Permeance E96 Wet Cup: 0.032 US Perms.
 - k. Stability (80 deg F/26.7 deg C): 6 months, Minimum 1 year.
 - l. Solids 64 percent, Density 8.1 lb/gal.
 - 4. Substitutions: Any substitutions must be pre-approved by Architect.

2.3 ACCESSORY WATERPROOFING SYSTEM MATERIALS

- A. General: Accessory materials as recommended in writing by waterproofing manufacturer for intended use and compatible with one another and with waterproofing.
- B. Primer: Liquid waterborne primer as recommended in writing for substrate by waterproofing manufacturer.
- C. Surface Conditioner: Liquid, waterborne surface conditioner as recommended in writing for substrate by waterproofing manufacturer.
- D. Sheet Flashing: Manufacturer's standard flashing sheet.
 - 1. Adhesive: Manufacturer's standard contact adhesive.
- E. Reinforcing Fabric: Manufacturer's standard fiberglass mesh or spun-bonded polyester fabric.
- F. Detailing Seam Tape: Manufacturer's standard detailing tape.
- G. Joint Sealant: Single-component polyurethane sealant, compatible with waterproofing; ASTM C920, Type S, Class 50 or greater; Grade NS for sloping and vertical applications; Use NT exposure; and as recommended in writing by waterproofing manufacturer for substrate and joint conditions.
 - 1. Basis-of-Design Product: Tremco, Inc.; Dymonic 100.
- H. Backer Rod: Closed-cell polyethylene foam.
- I. Waterstop: Composite waterstop containing expandable, granular bentonite with one edge layered with pressure sensitive adhesive.
 - 1. Basis-of-Design Product: Tremco, Inc.; Superstop.
 - 2. Substitutions: Any substitutions must be pre-approved by Architect.

2.4 PROTECTION COURSE

- A. Protection Course: Non-biodegradable polyester, 14 oz. protection mat.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Tremco, Inc.
 - 2. Basis-of-Design Product: Tremco, Inc.; Protection Mat.
 - a. Performance Characteristics:
 - 1) Thickness: 100 mils in accordance with ASTM D 1117.
 - 2) Grab Tensile: 300 x 260 lb, in accordance with ASTM D4532.
 - 3) Puncture: 100 lb, in accordance with ASTM D4833.
 - 4) Water Permeability: 0.56 cm/sec⁻¹, in accordance with ASTM D4491.
 - 3. Substitutions: Any substitutions must be pre-approved by Architect.

2.5 MOLDED-SHEET DRAINAGE PANELS

- A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panels with Polymeric Film: Composite subsurface drainage panel acceptable to waterproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21 mm) sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate through the core of 9 to 21 gpm per ft. (112 to 261 L/min. per m).
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Hydrotech, Inc.; Hydrodrain 400.
 - b. Master Builders Solutions;; MasterSeal 975.
 - c. Carlisle Coatings & Waterproofing Inc.; CCW MiraDRAIN 6200XL
 - d. Polyguard Products, Inc.; Polyflow 10-P.
 - e. Tremco, Inc.; TREMDrain 1000.
 2. Basis-of-Design Product: Tremco, Inc.; TREMDrain 1000.
 3. Basis-of-Design Product at Above-Grade Locations Only: Tremco, Inc.; TREMDrain S.
 4. Substitutions: Any substitutions must be pre-approved by Architect.
- B. Molded-Sheet Collector-Panel System with Polymeric Film: Composite subsurface collector-panel system by same manufacturer as primary molded-sheet drainage panels; consisting of a high-profile, studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven-geotextile facing with an apparent opening size not exceeding No. 40 (0.425 mm) sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate through the core of 9 to 17 gpm per ft. (112 to 211 L/min. per m) and a minimum horizontal, in-plane flow rate. Provide system with manufacturer's outlets, connectors, tapes, and other accessories to connect primary molded-sheet drainage panels with piped subdrainage system.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. GCP Applied Technologies Inc.
 - b. Insulation Solutions, Inc.
 - c. Polyguard Products, Inc.
 - d. Tremco, Inc.
 2. Basis-of-Design Manufacturer: Tremco, Inc.
 3. Substitutions: Any substitutions must be pre-approved by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
1. Verify that concrete has cured and aged for minimum time period as recommended in writing by waterproofing manufacturer.
 2. Verify that substrate is visibly dry and within the moisture limits as recommended in writing by waterproofing manufacturer. Test for capillary moisture by plastic sheet method in accordance with ASTM D4263.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean, prepare, and treat substrates in accordance with waterproofing manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.
- D. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.
1. Abrasive blast clean concrete surfaces uniformly to expose top surface of fine aggregate in accordance with ASTM D4259 with a self-contained, recirculating, blast-cleaning apparatus. Remove material to provide a sound surface free of laitance, glaze, efflorescence, curing

compounds, concrete hardeners, or form-release agents. Remove remaining loose material and clean surfaces in accordance with ASTM D4258.

- E. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, holes, and other voids.
- F. Coordinate with Owner for impact to air-intake equipment in the vicinity of the Work. Cover or filter air-intake louvers before proceeding with work that could affect indoor air quality or that could activate smoke detectors in the ductwork.

3.3 PREPARATION AT TERMINATIONS, PENETRATIONS, AND CORNERS

- A. Prepare surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, sleeves, and corners in accordance with waterproofing manufacturer's written instructions and to recommendations in ASTM C898/C898M.

3.4 TREATMENT OF JOINTS AND CRACKS

- A. Prepare, treat, rout, and fill joints and cracks in substrate in accordance with waterproofing manufacturer's written instructions and to recommendations in ASTM C898/C898M. Before coating surfaces, remove dust and dirt from joints and cracks in accordance with ASTM D4258.
 - 1. Comply with ASTM C1193 for joint-sealant installation.
 - 2. Apply bond breaker on sealant surface, beneath preparation strip.
 - 3. Prime substrate along each side of joint and apply a single thickness of preparation strip at least 6 inches (150 mm) wide along each side of joint. Apply waterproofing in two separate applications and embed a joint-reinforcing strip in first preparation coat.
- B. Install sheet flashing and bond to deck and wall substrates where required in accordance with waterproofing manufacturer's written instructions.
 - 1. Extend sheet flashings for 4 inches (100 mm) onto perpendicular surfaces and items penetrating substrate.

3.5 INSTALLATION OF WATERPROOFING

- A. General: Apply waterproofing in accordance with manufacturer's written instructions and to recommendations in ASTM C898/C898M.
- B. Start installing waterproofing in presence of manufacturer's technical representative.
- C. Apply primer over prepared substrate at manufacturer's recommended rate and allow it to dry.
- D. Unreinforced Waterproofing Membrane Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.
 - 1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases and pinholes, with a minimum dry film thickness as recommended by manufacturer.
 - 2. Apply waterproofing to prepared wall terminations and vertical surfaces.
 - 3. Verify manufacturer's recommended wet film thickness of waterproofing every 100 sq. ft. (9.3 sq. m).
- E. Cure waterproofing, taking care to prevent contamination and damage to membrane.

3.6 INSTALLATION OF PROTECTION COURSE

- A. Cover waterproofing with protection course with butted joints before membrane is subject to construction or vehicular traffic.
 - 1. For horizontal applications, install protection course loose laid over fully cured membrane.
 - 2. For vertical applications, set protection course in nominally cured membrane, which will act as an adhesive. If membrane cures before application of protection course, use adhesive.

3.7 INSTALLATION OF MOLDED-SHEET DRAINAGE PANELS

- A. Place and secure molded-sheet drainage panels in accordance with waterproofing manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections:
 - 1. Testing agency to verify thickness of waterproofing during application for each 600 sq. ft. (56 sq. m) of installed waterproofing or part thereof.

- B. Perform the following tests before overlying construction is placed:
 - 1. Flood Testing: Flood test each completed horizontal waterproofed area for leaks, in accordance with recommendations in ASTM D5957. Install temporary containment assemblies, plug, or dam drains, and flood with potable water.
 - a. Flood to an average depth of 2-1/2 inches (64 mm) with a minimum depth of 1 inch (25 mm) and not exceeding a depth of 4 inches (100 mm). Maintain 2 inches (50 mm) of clearance from top of base flashing.
 - b. Flood each area for 24 hours.
 - c. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing and flashing installations are watertight.
 - 1) Cost of retesting is the responsibility of Contractor.
 - d. Testing agency to prepare survey report indicating locations of initial leaks, if any, and final survey report.
 - C. Manufacturer's Field Service: Engage a site representative qualified by waterproofing system manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components and to furnish daily reports to Architect.
 - 1. Final Inspection: Arrange for waterproofing system manufacturer's technical personnel to inspect system installation on completion, in presence of Architect, and to prepare inspection report.
 - 2. Notify Architect and Owner 48 hours in advance of date and time of inspections.
 - 3. Repair or remove and replace components of waterproofing system where inspections indicate that they do not comply with specified requirements.
 - D. Additional Tests and Inspections:
 - 1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.
 - 2. Waterproofing system will be considered defective if it does not pass tests and inspections.
 - E. Prepare test and inspection reports.
- 3.9 PROTECTION AND CLEANING
- A. Protect waterproofing system from damage and wear during remainder of construction period.
 - B. Protect installed protection course from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where material is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
 - C. Correct deficiencies in or remove waterproofing system that does not comply with requirements, repair substrates, and repair or reinstall waterproofing system to a condition free of damage and deterioration at time of Substantial Completion and in accordance with warranty requirements.
 - D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION

SECTION 07 19 00

WATER REPELLENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes penetrating water-repellent treatments for the following vertical and horizontal surfaces:
 - 1. Concrete unit masonry.
 - 2. Clay brick masonry.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's printed statement of VOC content.
 - 2. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.
- B. Samples: For each type of water repellent and substrate indicated, 12 by 12 inches (300 by 300 mm) in size, with specified water-repellent treatment applied to half of each Sample.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of water repellent.

1.5 QUALITY ASSURANCE

- A. Mockups: Prepare mockups of each required water repellent on each type of substrate required to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Locate mockups as directed by Architect.
 - a. Size: 10 sq. ft. (9.3 sq. m) each.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 FIELD CONDITIONS

- A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
 - 1. Concrete surfaces and mortar have cured for not less than 28 days.
 - 2. Building has been closed in for not less than 30 days before treating wall assemblies.
 - 3. Ambient temperature is above 40 deg F (4.4 deg C) and below 100 deg F (37.8 deg C) and will remain so for 24 hours.
 - 4. Substrate is not frozen and substrate-surface temperature is above 40 deg F (4.4 deg C) and below 100 deg F (37.8 deg C).
 - 5. Rain or snow is not predicted within 24 hours.
 - 6. Not less than 24 hours have passed since surfaces were last wet.
 - 7. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agree(s) to repair or replace materials that fail to maintain water repellency specified in "Performance Requirements" Article within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Performance: Water repellents shall meet the following performance requirements as determined by preconstruction testing on manufacturer's standard substrates representing those indicated for this Project.
- B. Water Absorption: Minimum 80 percent reduction of water absorption after 24 hours for treated compared to untreated specimens when tested according to the following:
 - 1. Concrete Masonry Units: ASTM C 140.
 - 2. Clay Brick: ASTM C 67.
- C. Water-Vapor Transmission: Comply with one or both of the following:
 - 1. Maximum 10 percent reduction water-vapor transmission of treated compared to untreated specimens, according to ASTM E 96/E 96M.
 - 2. Minimum 80 percent water-vapor transmission of treated compared to untreated specimens, according to ASTM D 1653.
- D. Water Penetration and Leakage through Masonry: Minimum 90 percent reduction in leakage rate of treated compared to untreated specimens, according to ASTM E 514/E 514M.
- E. Durability: Maximum 5 percent loss of water-repellent performance after 2500 hours of weathering according to ASTM G 154 compared to water-repellent-treated specimens before weathering.

2.2 PENETRATING WATER REPELLENTS

- A. 202010Siloxane, Penetrating Water Repellent: Clear, containing 10 percent or more solids of oligomeric alkylalkoxysiloxanes; with alcohol, ethanol, mineral spirits, water, or other proprietary solvent carrier; and with 600 g/L or less of VOCs.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Conproco Corporation; Conpro Shield MX.
 - b. Specco Industries, Inc; Waterstopper S-20.
- B. Silane/Siloxane-Blend, Penetrating Water Repellent: Clear, silane and siloxane blend with 400 g/L or less of VOCs.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Master Builders Solutions; MasterProtect H 185.
 - b. Euclid Chemical Company (The); an RPM company; Baracade WB 244.
 - c. L&M Construction Chemicals, Inc; Aquapel.
 - d. Pecora Corporation; KlereSeal 920-W.
 - e. Tnemec Inc; Series 635 Dur A Pell 10.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.
 - 1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.
 - 2. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
 - 3. Verify that required repairs are complete, cured, and dry before applying water repellent.
- B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. New Construction and Repairs: Allow concrete and other cementitious materials to age before application of water repellent, according to repellent manufacturer's written instructions.
- B. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions and as follows:
 - 1. Concrete Unit Masonry: Remove oil, curing compounds, laitance, and other substances that inhibit penetration or performance of water repellents according to ASTM E 1857.
 - 2. Clay Brick Masonry: ASTM D 5703.
- C. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.
- D. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.
- E. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
 - 1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.3 APPLICATION

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.
- B. Apply coating of water repellent on surfaces to be treated using 15 psi- (103 kPa-) pressure spray with a fan-type spray nozzle to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.
- C. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.4 FIELD QUALITY CONTROL

- A. Testing of Water-Repellent Material:
 - 1. Engage the services of a qualified testing agency to sample water-repellent material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 - 2. Testing agency will perform tests for compliance of water-repellent material with product requirements.
- B. Coverage Test: In the presence of Architect, hose down a dry, repellent-treated surface to verify complete and uniform product application. A change in surface color will indicate incomplete application.
 - 1. Notify Architect seven days in advance of the dates and times when surfaces will be tested.
 - 2. Reapply water repellent until coverage test indicates complete coverage.

3.5 CLEANING

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.
- B. Comply with manufacturer's written cleaning instructions.

END OF SECTION

SECTION 07 19 01
GRAFFITI REPELLENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Water repellents of the following types:
 - 1. Graffiti repellents.

1.2 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Manufacturer's printed literature for each product.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Capable of providing field service representation during installation and who will approve the installer and application method.
- B. Installer Qualifications: Installer experienced in performing this type of work and who has specialized in work similar to the type required for this project.
- C. Mock-Up or Test Panels: Before full-scale application, test products to be used on a mock-up or test panels.
 - 1. Review manufacturer's product data sheets to determine suitability of each product for each surface.
 - 2. Apply products using manufacturer-approved application methods, determining actual requirements for surface preparation, coverage rate, number of coats, and application procedures.
 - 3. After 48 hours, review effectiveness of protection, compatibility with substrates, and ability to achieve desired results.
 - 4. Obtain approval by Architect and Owner of workmanship, color, and texture before proceeding with work.
 - 5. Mock-Up: Provide construction matching but separate from project construction.
 - 6. Location: As determined by Architect.
 - 7. Maintain mock-up during construction; remove at completion and dispose of legally.
 - 8. Test Panels: Inconspicuous sections of actual construction.
 - 9. Location and number as selected by Architect.
 - 10. Size; 4 feet by 4 feet (1220 by 1220 mm).
 - 11. Repair unacceptable work to the satisfaction of the Architect and Owner.
- D. Pre-Installation Meeting: Hold a meeting prior to starting application, to review project conditions, protection requirements, manufacturer's installation instructions, and manufacturer's warranty requirements. See Section 01300 for additional requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in time to avoid construction delays.
- B. Deliver and store products in manufacturer's original packaging with identification labels intact.
- C. Store products protected from weather and at temperature and humidity conditions recommended by manufacturer.

1.5 PROJECT CONDITIONS

- A. Do not apply products under conditions outside manufacturer's requirements, which include:
- B. Surfaces that are frozen; allow complete thawing prior to installation.
- C. Surface and air temperatures below 40 degrees F (4 degrees C).
- D. Surface and air temperatures above 95 degrees F (35 degrees C).
- E. When surface or air temperature is not expected to remain above 40 degrees F (4 degrees C) for at least 8 hours after application.
- F. Wind conditions that may blow water repellents onto surfaces not intended to be treated.
- G. Less than 24 hours after a rain.
- H. When rain is expected less than 6 hours after installation.

1.6 WARRANTY

- A. See Section 01780 for additional requirements.
- B. Provide manufacturer's standard warranty for not less than 5 year(s) commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Prosoco, Inc.
 - 2. Sherwin-Williams.
 - 3. Nanoslic.
- B. Obtain water repellent materials and surface preparation cleaners from a single manufacturer.

2.2 GRAFFITI REPELLENTS

- A. Basis-of-Design Product: Prosoco; Blok-Guard(r) and Graffiti Control; clear liquid silicone elastomer (active substance), with 9 percent active substance and the following characteristics:
 - 1. VOC Content:
 - 2. Specific Gravity: 0.775.
 - 3. Flash Point: 100 degrees F (8 degrees C).
 - 4. Weight: 6.63 lb/gal (0.795 kg/L).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrates are acceptable for product installation; do not begin until substrates meet manufacturer's requirements.
- B. Do not begin until mock-up/test panels have been approved by Architect.

3.2 PREPARATION

- A. Protect adjacent surfaces not to be treated prior to beginning application.
- B. Remove dirt, dust, oil, grease, and other contaminants that would interfere with penetration or performance of products; where cleaners are required, use products recommended by manufacturer; rinse thoroughly and allow to dry completely.
- C. Repair, patch and fill cracks, voids, defects, and damaged areas to satisfaction of Architect; allow repair materials to cure completely.
- D. Seal joints with sealant and allow to cure completely.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and recommendations, and container label instructions.
- B. Mix materials in strict accordance with manufacturer's instructions; do not dilute unless permitted by manufacturer.
- C. Prevent overspray, wind drift, and splash onto surfaces not to be treated.
- D. Provide the services of the manufacturer's authorized field representative to verify that installed products comply with manufacturer's requirements and with the standard established by the Architect-approved mock-up/test panels.

3.4 FIELD QUALITY CONTROL

- A. Cleaning and Protection
 - 1. At completion of work, remove protective coverings.
 - 2. If surfaces that should have been protected from damage by this work have been damaged, clean, repair or replace to the satisfaction of the Architect.
 - 3. Repair or replace damaged treated surfaces.
 - 4. Protect completed work from damage during construction.

END OF SECTION

SECTION 07 21 00
THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Extruded polystyrene foam-plastic board.
 2. Polyisocyanurate foam-plastic board.
 3. Glass-fiber blanket.
 4. Mineral-wool blanket.
 5. Mineral-wool board.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Extruded Polystyrene Board, Type X: ASTM C 578, Type X, 15-psi (104-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
1. Products: Subject to compliance with requirements, provide the following:
 - a. Dow Chemical Company (The); STYROFOAM Brand CAVITYMATE SC Insulation.

2.2 POLYISOCYANURATE FOAM-PLASTIC BOARD

- A. Polyisocyanurate Board, Glass-Fiber-Mat Faced: ASTM C 1289, glass-fiber-mat faced, Type II, Class 2.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Atlas Roofing Corporation; EnergyShield CGF Pro.
 - b. Firestone Building Products; Enverge CI Glass Faced.
 - c. Hunter Panels; Xci CG.
 - d. Rmax, Inc.; a Sika company; Durasheath.
 2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.3 GLASS-FIBER BLANKET

- A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corporation; NoiseReducer Sound Attenuation and Acoustical Ceiling Batts.
 - b. Knauf Insulation; EcoBatt Unfaced with ECOSE Technology.
 - c. Owens Corning; EcoTouch PINK Fiberglas Insulation (unfaced).
 2. Provide at 6-inch stud construction in exterior walls and between conditioned and unconditioned spaces, unless otherwise noted: Nominal 6-1/4-inch thick batt insulation with an R-value of 19.

3. Provide at 3-5/8-inch stud construction in exterior walls and between conditioned and unconditioned spaces, unless otherwise noted: Nominal 3-1/2-inch thick batt insulation with an R-value of 13.

2.4 MINERAL-WOOL BLANKETS

- A. Mineral-Wool Blanket, Unfaced: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Industrial Insulation Group, LLC a division of Johns Manville; TempControl Batts .
 - b. Roxul Inc.; COMFORTBATT.
 - c. Thermafiber, Inc.; an Owens Corning company; UltraBatt.
 2. Mineral Batt insulation is allowed at Contractor option as substitute for glass fiber batt insulation in all applications.

2.5 SEMI-RIGID MINERL-WOOL INSULATION BOARD

- A. Mineral-Wool Board, Types IA and IB, Unfaced: ASTM C 612, Types IA and IB; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics. Nominal density of 4 lb/cu. ft. (64 kg/cu. m).
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Industrial Insulation Group, LLC, a division of Johns Manville; JM Cladstone Water and Fire Block.
 - b. Thermafiber, Inc.; an Owens Corning company; Thermafiber RainBarrier HD.
- B. Mineral Board insulation is allowed at Contractor option as substitute for both Extruded Polystyrene Board and Polyisocyanurate Board.

2.6 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AGM Industries, Inc; Series T TACTOO Insul-Hangers.
 - b. Gemco; Spindle Type.
 2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
 3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- B. Adhesively Attached, Angle-Shaped, Spindle-Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
 1. Products: Subject to compliance with requirements, provide the following:
 - a. Gemco; 90-Degree Insulation Hangers.
 2. Angle: Formed from 0.030-inch- (0.762-mm-) thick, perforated, galvanized carbon-steel sheet with each leg 2 inches (50 mm) square.
 3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- C. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AGM Industries, Inc; RC150.
 - b. Gemco; Dome-Cap.
 2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
 - a. Crawl spaces.
 - b. Ceiling plenums.
 - c. Attic spaces.

- D. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of 1 inch (25 mm) between face of insulation and substrate to which anchor is attached.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Gemco; Clutch Clip.
- E. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AGM Industries, Inc; TACTOO Adhesive.
 - b. Gemco; Tuff Bond Hanger Adhesive.

2.7 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 - 1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
- B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.
- C. Insulation Tape: Provide insulation tape as recommended by manufacturer.
 - 1. Dimensions: Manufacturer's standard.
 - 2. Location: At joints, where indicated on Drawings.
- D. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.
- E. Hexagonal Wire Mesh:
 - 1. Hot dip galvanized.
 - 2. Wire Gage: 13 mm.
 - 3. Aperture: 2-1/2 inches.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.
- B. Clean joint substrate surfaces as recommended by manufacturer before installing tape.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.
- E. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

3.3 INSTALLATION OF CAVITY-WALL INSULATION

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
 - 1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 04 20 00 "Unit Masonry."

- B. Insulation Tape: Tape joints where indicated and ensure airtight installation of joints.

3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
 5. Install batt insulation without visible voids, gaps, or separations. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members. Cut and trim insulation neatly to fit spaces without laps, bulges, or folds. Use batts free of rips and tears.
 6. Coordinate with light gauge metal stud installer to pack batt insulation in light gauge metal construction as it is being constructed, that will be inaccessible to install batts when completed (headers, stud packs, etc). use mineral batts where insulation may get wet or be exposed to weather prior to closing the building envelope. Alternatively, Contractor may at his option elect to fill cavities with foam insulation after building envelope is closed.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

3.5 INSTALLATION OF CURTAIN-WALL INSULATION

- A. Install board insulation in curtain-wall construction according to curtain-wall manufacturer's written instructions.
 1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated on Drawings between insulation and glass.
 2. Install insulation to fit snugly without bowing.

3.6 INSTALLATION OF MINERAL FIBER SEMI-RIGID BOARD CONTINUOUS INSULATION

- A. Continuous insulation at exterior wall shall be adhered or attached in place per manufacturer's recommendations for the substrates and conditions indicated. Use of friction fit only between furring channels is not an acceptable installation.
 1. Mechanical fasteners installation shall be coordinated with air barrier manufacturer's requirements for fastener penetrations through the air barrier, as applicable.
- B. Fit courses of insulation with edges butted tightly in both directions. Press units firmly against substrates indicated.
- C. Press units firmly against sheathing, or other substrates. Stagger joints, Make insulation continuous. Fill all voids.
- D. Coordinate placement of insulation with location of masonry veneer anchors, metal Zee furring, and similar construction.
- E. Cut and fit insulation tight to protrusions or interruptions to insulation plane.

3.7 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07 21 19

FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Closed-cell spray polyurethane foam.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Evaluation Reports: For spray-applied polyurethane foam-plastic insulation, from ICC-ES.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM

- A. Closed-Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of 1.5 lb/cu. ft. (24 kg/cu. m) and minimum aged R-value at 1-inch (25.4-mm) thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F (43 K x sq. m/W at 24 deg C) with hydrofluoroolefin (HFO) blowing agent.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Corporation; SPF; WALLTITE LWP.
 - b. Carlisle SFI; SealTite PRO HFO.
 - c. Handi Foam; E84 Low Pressure Spray Foam.
 - d. Huntsman Building Solutions; HeatLock HFO Pro.
 - e. Johns Manville; a Berkshire Hathaway company; JM Corbond IV.
 - f. NCFI Polyurethanes; a division of Barnhardt Manufacturing Company; NCFI InsulBloc SmartSPF.
 - 2. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.2 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.
- B. Fire Resistant Coating: Provide manufacturer's recommended coating over SPF Insulation where not separated from interior spaces by 1/2-inch gypsum board and insulation's inherent fire resistance does not meet code requirements.
 - 1. Ignition Barrier: In Crawl Spaces and Concealed Soffit areas. Install Ignition Barrier meeting the requirements of Chapter 26 of the IBC for Attic and Crawl Spaces. Apply ignition barrier recommended and/or compatible with SPF Insulation Manufacturer. Follow criteria for SPF Insulation in Crawl Spaces contained in AC 377. Meet the requirements of NFPA 286, UL 1715 and UBC 26-3 [1]. Acceptable Ignition Barrier manufacturers are:
 - a. Elasticoat 1500 Ignition Barrier by BASF.
 - b. Aldocoat 800 Intumescent Coating by Aldo Products Company.
 - c. NoBurn Plus Intumescent Coating by No-Burn Inc.
 - d. Substitutions in accordance with Section 01 25 00.

2. Thermal Barrier: Install Thermal Barrier over SPF Insulation meeting the requirements of Chapter 26 of the IBC for exterior walls. Apply Thermal Barrier recommended by and/or compatible with SPF Insulation Manufacturer. Thermal Barrier Manufacturers are:
 - a. Monokot Z-3306 by GCP Applied Technologies Inc.
 - b. Ure-k by International Cellulose Corp.
 - c. Flame Seal TB by Specialty Products, Inc.
 - d. Substitutions in accordance with Section 01 25 00.
3. Qualifications and testing criteria for Ignition Barrier and Thermal Barrier products shall receive approval from Agency Having Jurisdiction (AHJ). The Contractor shall provide AHJ approval letters as a required submittal. Listed manufacturers above are subject to this required prior approval.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify that substrates are clean, dry, and free of substances that are harmful to insulation.
- B. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.2 INSTALLATION

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Spray insulation to envelop entire area to be insulated and fill voids.
- C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.
- D. Framed Construction: Install into cavities formed by framing members to achieve thickness indicated on Drawings.
- E. Cavity Walls: Install into cavities to thickness indicated on Drawings.
- F. Miscellaneous Voids: Apply according to manufacturer's written instructions.

3.3 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

END OF SECTION

SECTION 07 21 29

SPRAY-APPLIED INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Sprayed-on cellulose fiber insulation.
 - 2. Protective coating.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: Furnish manufacturer's complete color selection showing full range of colors and finish characteristics.
- C. Samples for Verification: Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.
 - 1. 12-inch by 12-inch sample in color selected.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for insulation products.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by SFRM manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its SFRM to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.
- B. Regulatory Requirements: Comply with all applicable requirements of the laws, codes, ordinances and regulations of Federal, State and Municipal authorities having jurisdiction. Obtain necessary approvals from all such authorities.
- C. Single Source Responsibility: Obtain materials from a single manufacturer for the complete system.

1.5 DELIVER, STORAGE, AND HANDLING

- A. Deliver products to Project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, and shelf life if applicable.
- B. Store materials inside, under cover, and aboveground; keep dry until ready for use. Remove from Project site and discard wet or deteriorated materials. Do not open packaging nor remove labels until time of installation.
- C. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

1.6 PROJECT CONDITIONS

- A. Ventilation: Ventilate building spaces during and after application of spray-applied insulation material. Use natural means or, where this is inadequate, forced-air circulation until insulation dries thoroughly.

1.7 COORDINATION

- A. Sequence and coordinate application of spray-applied insulation with other related work specified in other Sections to comply with the following requirements:
 - 1. Provide temporary enclosure as required to confine spraying operations and protect the environment.
 - 2. Provide temporary enclosures for applications to prevent deterioration of insulation due to exposure to weather and to unfavorable ambient conditions for humidity, temperature, and ventilation.

3. Avoid unnecessary exposure of insulation to abrasion and other damage likely to occur during construction operations subsequent to its application.
- B. Do not apply insulation to metal roof deck substrates until concrete topping, if any, has been completed. For metal roof decks without concrete topping, do not apply insulation to metal roof deck substrates until roofing has been completed; prohibit roof traffic during application and drying of insulation.
- C. Do not apply insulation to metal floor deck substrates until concrete topping has been completed.
- D. Do not begin applying insulation until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
- E. Defer installing ducts, piping, and other items that would interfere with applying insulation until application of insulation is completed.
- F. Do not install enclosing or concealing construction until after insulation has been applied, inspected, and corrections have been made to defective applications.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. Recycled Content: Provide products with an average recycled content so that post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 90 percent.

2.2 MATERIALS

- A. Sprayed-on Cellulose Fiber Insulation: ASTM E1042, Type II, chemically treated recycled natural fibers bound together with special adhesives.
 1. Thickness: 3 inches.
 2. R value: As indicated on Drawings.
 3. Color: As selected by Architect from manufacturer's full range.
 4. Bond Strength: ASTM E 736, 400 lbs / sq. ft.
 5. Surface Burning Characteristics: ASTM E 84.
 - a. Flame Spread: 5
 - b. Smoke Developed: 5
 6. Bond Deflection: ASTM E 759
 7. Basis-of-Design Product: International Cellulose Corporation; K-13 Spray-On System.
- B. Protective Coating: Water based vinyl acrylic emulsion with fibers.
 1. Color: As selected by Architect from manufacturer's full range.
 2. Surface Burning Characteristics: ASTM E84.
 - a. Flame Spread: 5
 - b. Smoke Developed: 5
 3. Basis-of-Design Product: International Cellulose Corporation; Protek-13 - Abrasion Resistant Sprayed Protective Coating.

2.3 ACCESSORY MATERIALS

- A. Primer: Type as recommended by spray-applied insulation manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
- B. A substrate is in satisfactory condition if it complies with the following:
 1. Substrates comply with requirements in the Section where the substrate and related materials and construction are specified.
 2. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, incompatible paints, or other foreign substances capable of impairing bond of insulation with substrates under conditions of normal use or exposure.
 3. Objects penetrating insulation, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.

4. Substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying material.
 - C. Verify that concrete work on steel deck has been completed, if applicable.
 - D. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.2 PREPARATION
- A. Coordinate installation of work to be installed under and penetrating insulation prior to application of insulation.
 - B. Protection: Cover other work subject to damage from fallout or overspray of fire-resistive materials during application. Provide masking, drop cloths or other covering for materials and surfaces which are not to receive insulation.
 - C. Clean substrates of substances that could impair bond of insulation, including dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, and incompatible primers, and paints.
 - D. Prime substrates where recommended in writing by SFRM manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive SFRM.
- 3.3 INSTALLATION
- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.
 - B. Coat substrates with bonding adhesive before applying insulation materials to achieve proper adhesion or as may be otherwise recommended by insulation manufacturer for material and application indicated.
 - C. Extend insulation in full thickness over entire area of each substrate to be insulated.
 - D. Install with insulation manufacturer-recommended equipment.
 - E. Install in thickness indicated as measured by ASTM E 605.
 - F. Apply protective coating to all exposed surfaces. Protective coating need not be applied to insulation surfaces concealed behind gypsum board.
- 3.4 CLEANING AND PROTECTION
- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
 - B. Coordinate application of insulation with other construction to minimize need to cut or remove completed applications. As installation of other construction proceeds, inspect insulation and patch any damaged or removed areas.
 - C. Protect the Work so it will not deteriorate or be damaged.

END OF SECTION

SECTION 07 27 26

FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Vapor-permeable, fluid-applied air barriers.

1.2 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site at least two weeks prior to start of any air barrier system or weatherization system installation. Attendees shall include Contractor, Architect, certified air barrier installer, installers of any other air barrier or weatherization systems, any other contractors responsible for any portion of the complete building Continuous Air Barrier system, air barrier manufacturer's designated field representative, and installers of other work that interfaces with the Continuous Air Barrier system.
 - 1. Review Contractor's responsibility for a complete Continuous Air Barrier system for the entire building.
 - 2. Review methods and procedures related to air and weather barrier system(s) installation, including manufacturer's written instructions.
 - 3. Review submittals and any questions regarding Architect's comments.
 - 4. Review and finalize construction, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 5. Review air and weather barrier system(s) interface with flashings, special details, and condition of other construction that affects weather barrier.
 - 6. Review details and requirements for sealing air barrier system around penetrations such as pipes, ducts, electrical boxes, structural elements penetrating exterior walls, etc.
 - 7. Review requirements for air barrier system(s) where cladding attachments, masonry ties, or other fasteners will penetrate air barrier system(s).
 - 8. Review materials and details for junctures between different air barrier or weatherization systems.
 - 9. Review details for complete building Continuous Air Barrier system, including at top of wall to bottom of deck and any other details that might not be part of any single air barrier or weatherization system's standard installation details.
 - 10. Review mockups (if mockups are already prepared), or requirements for mockups (if mockups are not yet prepared).
 - 11. Examine substrate conditions and finishes for compliance with requirements.
 - 12. Review construction sequencing and other requirements for work interfacing with air and weather barrier system(s).
 - 13. Review field testing requirements.
 - 14. Review temporary protection requirements for air and weather barriers during and after installation.
 - 15. Review proper procedures for repair of air and weather barrier systems.
 - 16. Review weather barrier manufacturer's Project registration and observation process.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.
- C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 - 1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.
- B. Mockups: Build mockups to set quality standards for materials and execution.
 - 1. Build integrated mockups of exterior wall assembly, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
 - a. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.
 - b. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
 - c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.
- C. Refer to current Product MSDS for proper storage and handling. Store and handle materials in compliance with manufacturer's recommendations, and within manufacturer's temperature limits.
- D. Deliver materials to job site in undamaged and original packaging indicating the name of manufacturer and product.
- E. Store roll materials on end in original packaging. Protect rolls from direct sunlight until ready for use.
- F. Keep solvent away from open flame or excessive heat.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.
 - 1. Protect substrates from environmental conditions that affect air-barrier performance.
 - 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction

material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa), when tested according to ASTM E 2357.

2.3 MEDIUM-BUILD AIR BARRIERS, VAPOR PERMEABLE

- A. Medium-Build, Vapor-Permeable Air Barrier: Synthetic polymer material with an installed dry film thickness, according to manufacturer's written instructions, of 17 to 30 mils (0.4 to 0.8 mm) over smooth, void-free substrates.
1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:
 - a. DuPont Building Innovations: E. I. du Pont de Nemours and Company; Tyvek Fluid Applied WB+.
 - b. GCP Applied Technologies Inc.; Perm-A-Barrier VPL 50 (VOC: 48 g/L)
 - c. Henry Company; Air-Bloc 17.
 - d. Hohmann & Barnard, Inc.; Enviro-Barrier VP (VOC: 0 g/L).
 2. Basis-of-Design Product: DuPont Building Innovations: E. I. du Pont de Nemours and Company; Tyvek Fluid Applied WB+.
 3. Physical and Performance Properties:
 - a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa)pressure difference; ASTM E 2178.
 - b. Vapor Permeance: Minimum 10 perms (580 ng/Pa x s x sq. m); ASTM E 96/E 96M, Water Method, Procedure B.
 - c. Ultimate Elongation: Minimum 250percent; ASTM D 412, Die C.
 - d. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa)when tested according to ASTM D 4541.
 - e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
 - f. UV Resistance: Can be exposed to sunlight for 180 days according to manufacturer's written instructions.

2.4 ACCESSORY MATERIALS

- A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.
- B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.
- C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187 inch (0.5 mm) thick, and Series 300 stainless-steel fasteners.
- D. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Dow Corning Corporation.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.
 - c. Pecora Corporation.
 - d. Tremco Incorporated.
- E. Joint Tape: Self-adhered fiberglass mesh tape as recommended by air barrier manufacturer.
- F. Flashing:
1. Vapor Permeable Elastomeric Flashing:
 - a. Basis-of-Design Products:
 - 1) DuPont Building Innovations: E. I. du Pont de Nemours and Company; Tyvek Fluid Applied Flashing and Joint Compound+, and/or:
 - 2) DuPont Building Innovations: E. I. du Pont de Nemours and Company; FlexWrap NF.

2. Sheet flashing with butyl adhesive layer, for use at transitions between wall material, building corners, and over gaps in sheathing up to 1 inch wide:
 - a. Basis-of-Design Product: DuPont Building Innovations: E. I. du Pont de Nemours and Company; StraightFlash.
- G. Joint Compound: Fluid-applied, vapor permeable, elastomeric flashing material; trowel applied.
 1. Basis-of-Design Product: DuPont Building Innovations: E. I. du Pont de Nemours and Company; Tyvek Fluid Applied Flashing and Joint Compound+.
- H. Sealant: Elastomeric; non-vapor permeable sealant; compatible with air barrier.
 1. Basis-of-Design Product: DuPont Building Innovations: E. I. du Pont de Nemours and Company; Sealant for Tyvek Fluid Applied Systems.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
 3. Verify that substrates are visibly dry and free of moisture.
 4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- E. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- F. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.
- G. Bridge isolation joints, expansion joints, and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.3 ACCESSORIES INSTALLATION

- A. Install accessory materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate.
 3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
 4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.

- B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
 - C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
 - D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
 - E. Flexible Flashing at Door, Window, Louver, and Similar Openings:
 - 1. Coordinate flashing with fluid-applied air barrier and window installation.
 - 2. Opening Flashing with Self-Adhered Membranes:
 - a. Prime substrates as recommended by self-adhered sheet membrane flashing manufacturer. Cut sheet membrane flashing a minimum of 12 inches longer than length of sill rough opening.
 - b. Cover horizontal sill by aligning sheet membrane edge with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 6 inches. Secure sheet membrane tightly into corners by working in along the sill before adhering up the jambs.
 - c. Fan sheet membrane at bottom corners onto face of wall. Firmly press in place.
 - d. Apply 9-inch wide strips of sheet membrane at jambs. Align sheet membrane with interior of jamb framing. Start sheet membrane at head of opening and lap sheet membrane at sill.
 - e. Install sheet membrane at opening head using same installation procedures used at sill. Overlap jamb flashing a minimum of 2 inches.
 - 3. After installation of perimeter cladding support / window attachment furring at continuous insulation layer, apply membrane flashing to seal the interior face of the composite framing to the first layer of air barrier flashing that wraps into the opening as described above. Lap a minimum of 2 inches over the previously installed jamb membrane, and with minimum of 2 inches lap at the head and sill. Where there is a sill pan flashing, lap membrane flashing to the sill pan at the sill.
 - 4. Seal any gaps at the perimeter between metal flashings and air barrier system using manufacturer's approved self-adhering or fluid-applied membrane flashing for each condition.
 - F. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate. Maintain 3 inches (75 mm) of full contact over firm bearing to perimeter frames, with not less than 1 inch (25 mm) of full contact.
 - 1. Transition Strip: Roll firmly to enhance adhesion.
 - G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
 - H. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
 - I. Seal top of through-wall flashings to air barrier with an additional 6-inch- (150-mm-) wide, transition strip.
 - J. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
 - K. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches (150 mm) beyond repaired areas in strip direction.
- 3.4 PRIMARY AIR-BARRIER MATERIAL INSTALLATION
- A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.
 - 1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
 - 2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
 - 3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.

- B. Medium-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply an increased thickness of air-barrier material in full contact around protrusions such as masonry ties.
 - 1. Vapor-Permeable, Medium-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, applied in one or more equal coats. Apply additional material as needed to achieve void- and pinhole-free surface, but do not exceed thickness on which required vapor permeability is based.
- C. Do not cover air barrier until it has been tested and inspected by testing agency.
- D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.5 FIELD QUALITY CONTROL

- A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements.
 - 1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
 - 2. Air-barrier dry film thickness.
 - 3. Continuous structural support of air-barrier system has been provided.
 - 4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
 - 5. Site conditions for application temperature and dryness of substrates have been maintained.
 - 6. Maximum exposure time of materials to UV deterioration has not been exceeded.
 - 7. Surfaces have been primed, if applicable.
 - 8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
 - 9. Strips and transition strips have been firmly adhered to substrate.
 - 10. Compatible materials have been used.
 - 11. Transitions at changes in direction and structural support at gaps have been provided.
 - 12. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
 - 13. All penetrations have been sealed.
- D. Air barriers will be considered defective if they do not pass tests and inspections.
 - 1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
 - 2. Remove and replace deficient air-barrier components for retesting as specified above.
- E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- F. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
 - 1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.
 - 2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.
- C. Remove masking materials after installation.

END OF SECTION

SECTION 07 42 13.13

FORMED METAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Concealed-fastener, lap-seam metal wall panels.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 7. Review temporary protection requirements for metal panel assembly during and after installation.
 8. Review of procedures for repair of metal panels damaged after installation.
 9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
1. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.
 2. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
 3. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).
- C. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below:
1. Metal Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockup of typical metal panel assembly as directed by Architect, including corner, supports, attachments, and accessories.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.6 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.7 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 1. Wind Loads: As indicated on Drawings.
 2. Other Design Loads: As indicated on Drawings.
 3. Deflection Limits: For wind loads, no greater than 1/240 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 283 at the following test-pressure difference:
 1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa).

- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

- A. General: Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Reveal-Joint, Concealed-Fastener Metal Wall Panels: Formed with vertical panel edges and a flat pan between panel edges; with narrow reveal joint between panels.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Aloca Architectural Products (USA).
 - b. ATAS International, Inc.
 - c. Berridge Manufacturing Company.
 - d. CENTRIA Architectural Systems.
 - e. MBCI; a division of NCI Group, Inc.
 - f. Morin - A Kingspan Group Company.
 - g. PAC-CLAD Petersen; a Carlisle Company.
 2. Basis-of-Design: PAC-CLAD Petersen; a Carlisle Company; Highline S1.
 3. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: 22 gauge.
 - b. Exterior Finish: Two-coat fluoropolymer.
 - c. Color: Bone White.
 4. Panel Coverage: 11.356 inches.
 5. Panel Height: 1-3/8 inches.
 6. Provide clips.

2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 - 1. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.

2.4 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:
 - 1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 - 1. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Shim or otherwise plumb substrates receiving metal panels.
 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 3. Install screw fasteners in predrilled holes.
 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 5. Install flashing and trim as metal panel work proceeds.
 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
 5. Flash and seal panels with weather closures at perimeter of all openings.
- E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- F. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect completed metal wall panel installation, including accessories.
- B. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.
- C. Prepare test and inspection reports.

3.5 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 42 13.23

METAL COMPOSITE MATERIAL WALL AND SOFFIT PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes metal composite material wall and soffit panels, rainscreen system.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, metal composite material panel Installer, metal composite material panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal composite material panels, including installers of doors, windows, and louvers.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to metal composite material panel installation, including manufacturer's written instructions.
 - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal composite material panels.
 - 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 - 7. Review temporary protection requirements for metal composite material panel assembly during and after installation.
 - 8. Review procedures for repair of panels damaged after installation.
 - 9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
 - 1. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.
 - 2. Include fabrication and installation layouts of metal composite material panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
 - 3. Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1-1/2 inches per 12 inches (1:10).
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
 - 1. Metal Composite Material Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other metal composite material panel accessories.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical metal composite material panel assembly as directed by Architect, including corner, supports, attachments, and accessories.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal composite material panels, and other manufactured items so as not to be damaged or deformed. Package metal composite material panels for protection during transportation and handling.
- B. Unload, store, and erect metal composite material panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal composite material panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal composite material panels to ensure dryness, with positive slope for drainage of water. Do not store metal composite material panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal composite material panels during installation.

1.6 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal composite material panels to be performed according to manufacturers' written instructions and warranty requirements.

1.7 COORDINATION

- A. Coordinate metal composite material panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal composite material panel systems that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal composite material panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: 20years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal composite material panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 330:
 1. Wind Loads: As indicated on Drawings.
 2. Other Design Loads: As indicated on Drawings.
 3. Deflection Limits: For wind loads, no greater than 1/240of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 283 at the following test-pressure difference:
 1. Test-Pressure Difference:6.24 lbf/sq. ft. (300 Pa).

- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- F. Fire Propagation Characteristics: Metal composite material wall and soffit panel system passes NFPA 285 testing.

2.2 METAL COMPOSITE MATERIAL WALL AND SOFFIT PANELS

- A. Metal Composite Material Wall and Soffit Panel Systems: Provide factory-formed and -assembled, metal composite material wall and soffit panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners, and accessories required for weathertight system.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ALPOLIC Materials; Mitsubishi Plastics Composites America.
 - b. 3A Composites; ALUCOBOND.
 - c. Alucoil North America; Larsen by Alucoil.
 - d. Carter Architectural Panels, Inc.
 - e. Etalbond.
 - f. PAC-CLAD Petersen; a Carlisle Company.
 - 2. Basis-of-Design: PAC-CLAD Petersen; a Carlisle Company; PAC-3000 RS.
- B. Aluminum-Faced Composite Wall and Soffit Panels: Formed with 0.020-inch- (0.50-mm-) thick, coil-coated aluminum sheet facings.
 - 1. Panel Thickness: 0.157 inch (4 mm).
 - 2. Core: Fire retardant.
 - 3. Exterior Finish: Two-coat fluoropolymer.
 - a. Color: As scheduled.
- C. Attachment Assembly Components: Formed from extruded aluminum.
- D. Attachment Assembly: Manufacturer's standard for installation system specified.

2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal composite material panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal composite material panels unless otherwise indicated.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal composite material panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal composite material panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal composite material panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

2.4 FABRICATION

- A. General: Fabricate and finish metal composite material panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 3. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall and soffit panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Aluminum Panels and Accessories:
 - 1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal composite material panel supports, and other conditions affecting performance of the Work.
 - 1. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal composite material wall and soffit panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and assemblies penetrating metal composite material panels to verify actual locations of penetrations relative to seam locations of metal composite material panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal composite material panel manufacturer's written recommendations.

3.3 METAL COMPOSITE MATERIAL PANEL INSTALLATION

- A. Install metal composite material panels, fasteners, trim and related sealants in accordance with manufacturer's recommendations, approved shop drawings, and code requirements, and as may be required for a weathertight installation.
 - 1. Flash and seal metal panels at perimeter of all openings. Fasten with manufacturer's approved concealed fasteners and attachment hardware.
 - 2. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal composite material panels are installed.
 - 3. Install flashing and trim as metal panel work proceeds.
 - 4. Provide weathertight conditions for all penetrations in metal composite material panels.
- B. Fasteners:
 - 1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal composite material panel manufacturer.
- D. Attachment Assembly, General: Install attachment assembly required to support metal composite material wall and soffit panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
 - 1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
- E. Installation: Attach metal composite material wall and soffit panels to supports at locations, spacings, and with fasteners recommended by manufacturer to achieve performance requirements specified.
 - 1. Rainscreen Systems: Do not apply sealants to joints unless otherwise indicated.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal composite material panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal composite material panel manufacturer; or, if not indicated, provide types recommended in writing by metal composite material panel manufacturer.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
 - 1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (605 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.4 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal composite material wall and soffit panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing agency to perform field tests and inspections.
- B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration according to AAMA 501.2.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal composite material wall and soffit panel installation, including accessories.
- D. Metal composite material wall and soffit panels will be considered defective if they do not pass test and inspections.

- E. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal composite material panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal composite material panel installation, clean finished surfaces as recommended by metal composite material panel manufacturer. Maintain in a clean condition during construction.
- B. After metal composite material panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal composite material panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 46 16
ALUMINUM SOFFITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes aluminum soffits.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings:
1. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.
 2. Include fabrication and installation layouts of aluminum soffit; details of edge conditions, joint, soffit profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
 3. Accessories: Include details of flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).
- C. Samples for Initial Selection: For aluminum soffit including related accessories.
- D. Samples for Verification: For each type, color, texture, and pattern required.
1. 12-inch- (300-mm-) long-by-actual-width Sample of soffit.
 2. 12-inch- (300-mm-) long-by-actual-width Samples of trim and accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of aluminum soffit.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of product, including related accessories, to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Furnish full lengths of aluminum soffit including related accessories, in a quantity equal to 2 percent of amount installed.

1.7 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
1. Build mockup of typical wall area as shown on Drawings.
 2. Build mockups for soffit including accessories.
 - a. Size: 48 inches (1200 mm) long by 60 inches (1800 mm) high.
 - b. Include outside corner on one end of mockup and inside corner on other end.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with labels intact until time of use.
- B. Store materials on elevated platforms, under cover, and in a dry location.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including cracking, fading, and deforming.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide aluminum soffit systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa).
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 MANUFACTURERS

- A. Source Limitations: Obtain products, including related accessories, from single source from single manufacturer.

2.3 ALUMINUM SOFFIT

- A. Aluminum Soffit: Formed and coated product complying with AAMA 1402.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Knotwood Architectural Systems.
 - b. Longboard Architectural Products.
 - c. Lumabuilt.
 - d. Trespa Pura.
 - 2. Basis-of-Design Product: Knotwood Architectural Systems; 6-Inch Aluminum Soffit.
- B. Texture: Wood grain.
- C. Ventilation: Provide perforated soffit unless otherwise indicated.
- D. Nominal Thickness: Manufacturer's standard.
- E. Finish: Manufacturer's standard PVDF system.
 - 1. Colors: As selected by Architect from manufacturer's full range of colors.

2.4 ACCESSORIES

- A. Aluminum Accessories: Where aluminum accessories are indicated, provide accessories complying with AAMA 1402.
 - 1. Texture: Wood grain.

2. Finish: Manufacturer's standard PVDF system.
- B. Decorative Accessories: Provide the following aluminum decorative accessories as indicated:
 1. J-Closure: Manufacturer's standard.
 2. Corner posts.
 3. Door and window casings.
 4. Entrance and window head pediments.
 5. Fasciae.
 6. Moldings and trim.
- C. Colors for Decorative Accessories: As selected by Architect from manufacturer's full range of colors.
- D. Flashing: Provide aluminum flashing complying with Section 07 62 00 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.
 1. Finish for Aluminum Flashing: Same as soffits.
- E. Fasteners:
 1. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch (6 mm), or three screw-threads, into substrate.
- F. Insect Screening for Soffit Vents: Aluminum, 18-by-16 (1.4-by-1.6-mm) mesh.
- G. Continuous Soffit Vents: Aluminum, hat-channel shape, with perforations; 2 inches (51 mm) wide and not less than 96 inches (2438 mm) long.
 1. Finish: Mill finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of aluminum soffit and related accessories.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
- B. Install aluminum soffits and related accessories according to AAMA 1402.
- C. Install joint sealants as specified in Section 07 92 00 "Joint Sealants" and to produce a weathertight installation.
- D. Where aluminum soffits contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.

3.4 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION

SECTION 07 52 16

STYRENE-BUTADIENE-STYRENE MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Qualifications, Standards and Materials for roofing assembly.
- B. Roof insulation.
- C. Modified bitumen roofing with base flashing.

1.2 REFERENCES

- A. American Society for Testing and Materials:
 - 1. ASTM D41 - Asphalt Primer Used in Roofing.
 - 2. ASTM D312 - Asphalt Used in Roofing.
 - 3. ASTM D2178 - Asphalt Glass Felt Used in Roofing.
 - 4. ASTM D4586 - Asphalt Roof Cement - Asbestos Free
- B. National Roofing Contractors Association
 - 1. NRCA Manual of Roof Maintenance and Roof Repair.
 - 2. NRCA Roofing and Waterproofing Manual
- C. Federal Standards - FS HH-1972 Insulation Board.
- D. Factory Mutual - FM 1-90 attachment of insulation and roof assembly.
- E. Underwriters Laboratories - UL Class A Fire Rated Assembly.

1.3 DEFINITIONS

- A. FM 1-90: All insulation board stock material will be fastened as per Factory Mutual 1-90 guidelines (most current edition). Insulation and fasteners will be specifically listed in FM ratings guide.
- B. UL Class A: All insulation and roof systems will have been tested, approved, and have achieved a Class A fire rating for type of building intended for construction.

1.4 SYSTEM DESCRIPTION

- A. Deck attached 2-layer rigid roof insulation with subsequent layer mopped in place insulation and coverboard; and two ply SBS modified bitumen roof system and compatible/specified flexible flashing materials; all requiring no additional coating or treatment to achieve a UL Class A rating.
- B. Performance Requirements: Roofing System shall prevent water migration from entering the building through the roof membrane or flashing. System shall have sufficient insulation and proper placement of vapor retarding materials so as to not cause internal condensation.

1.5 SUBMITTALS

- A. Product Data: Submit product data on all materials used in construction of specified roof system including, but not limited to, insulation, base sheets, mechanical fasteners, modified base and cap plies, flashing base and cap plies, flashing fasteners, bituminous materials and roof accessories.
- B. Shop Drawings: Indicated dimensions, layout, spans, joints construction details, methods of anchorage, method and sequence of installation.
- C. Test Reports: Provide delivery tickets for each batch of bitumen, stating type, equiviscous

temperature (EVT), flash point (FP), and finished blowing temperature (FBT).

- D. Manufacturer's Installation Instructions: Include installation sequence, special instructions and Material Safety Data Sheets.
- E. Manufacturer's Certificate: Certificate stating products meet or exceed all specified requirements.
- F. Contract Closeout Submittals:
 - 1. Project Record Documents.
 - 2. Contractors Five Year Labor and Material Warranty.
 - 3. Manufacturers Twenty-Year No-Dollar-Limit Labor and Material Warranty.

1.6 QUALITY CONTROL

- A. Work of this Section shall conform to NRCA Roofing and Waterproofing Manual and Manufacturer's Instructions.
- B. Qualifications for Work of this Section:
 - 1. Manufacturer specializing in the manufacturer of products in this Section with a minimum ten years documented experience of those products being used.
 - 2. Applicator specializing in applying the Work and Products of this Section with a minimum of five years documented experience and approved by the Manufacturer to install the necessary roof system and flashings so as to qualify and provide the specified 20 year NDL type warranty.
- C. Regulatory Requirements:
 - 1. Conform to all applicable local codes for roof assembly fire hazard.
 - 2. Provide certification of inspection confirming approval of design and installation by authority having jurisdiction.
 - 3. Fire Hazard Classification: UL Class A.
 - 4. Roof Assembly Classification: Factory Mutual Class 1-90 construction, in accordance with latest FM Construction Bulletin.
- D. Pre-Installation Conference:
 - 1. Convene a roofing pre-installation conference two weeks prior to commencing work of this Section, under provisions of applicable Section.
 - 2. Require attendance of parties directly affecting Work of this Section.
 - 3. Review conditions of demolition, if applicable, installation, installation procedures and coordination with related Work.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to the site and store/protect on site under provisions of applicable Section.
- B. Deliver products in manufacturer's original containers, dry, undamaged, with seal and labels in tact. Include test report data required in article 1.5 C of this Section.
- C. Store products in weather protected environment clear of ground moisture.
- D. Stand and store roll goods on end.
- E. Do not store more materials on the roof than can be installed within two days.
- F. Maximum allowable roof loading for storage purposes is 20 pounds per square foot.

1.8 PROJECT CONDITIONS

- A. Do not apply roofing during inclement weather.
- B. Do not apply roofing system to damp or frozen deck or substrate.
- C. Apply no more insulation than can be completely covered with new roof system by days end.

- D. Observe wind chill and other cold weather conditions for proper bituminous application temperatures.

1.9 SEQUENCING AND SCHEDULING

- A. Coordinate work under provisions of applicable Section.
- B. Coordinate work with other trades and work to ensure sufficient materials and man-power are available to completely install and make water-tight all roofing installed on a daily basis.
- C. Coordinate installation of associated metal flashing and roof related items as Work of this Section proceeds.

1.10 WARRANTY

- A. Provide five year warranty from installer covering damage to building resulting from failure to resist penetration of water and replacement of defective materials and labor.
- B. Manufacturer's Warranty: Provide a twenty (20) year No-Dollar-Limit System Warranty from roof system manufacturer covering full replacement of all materials (including insulation) and labor with no penal sum.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Roof System:
 - 1. Siplast
 - 2. Johns-Manville
- B. Fasteners:
 - 1. OMG, Inc.
 - 2. Construction Fasteners, Inc.
 - 3. Powers Fasteners (Rawl)
 - 4. Hilti
 - 5. Simplex
- C. Asphalt:
 - 1. Trumbull
 - 2. Siplast
 - 3. As approved by roofing materials manufacturer.
- D. Substitutions: Provide all applicable data for proposed substitution no less than ten days prior to bid due date for review and addendum purposes.

2.2 MATERIALS

- A. Sheet Materials:
 - 1. SBS Modified Bitumen Base Ply (Field Membrane): Asphalt elastomer sheet with fiberglass reinforcing
 - a. Paratech Glass Base
 - b. DynaBase
 - 2. SBS Modified Bitumen Cap Ply (Cap Sheet): Asphalt elastomer sheet with fiberglass reinforcing; White Reflective Surface with Solar Reflectance Index (SRI) of 82 (field coatings not acceptable) or greater:
 - a. Paratech Glass Cap FR TG BW
 - b. DynaWeld Cap FR CR G
 - 3. Modified Bitumen Flashing Ply (Base Flashing): Asphalt elastomer sheet; woven fiberglass or polyester mat reinforced; White Reflective Surface with Solar Reflectance Index (SRI) of 82 (field coatings not acceptable) or greater:
 - a. Paratech 180 Cap FR TG BW with Paratech Glass Base backer sheet
 - b. DynaWeld Cap FR CR G with DynaBase backer sheet

- B. Bituminous Materials
 - 1. Asphalt Bitumen: ASTM D312, Type IV, special steep.
 - 2. Asphalt Primer: ASTM D41
 - 3. Plastic Cement: ASTM D4586, Type I, asbestos free.
 - 4. Flashing Cement: MBR type only, compatible for use with SBS modified bitumen roof system.
- C. Insulation(s)
 - 1. Cover board: ASTM C728, Type 3; high density perlite based cover board with the following characteristics:
 - a. Board Density 14.5 lb/cu. ft.
 - b. Board Size 48" x 48"
 - c. Board Thickness 1/2"
 - d. R Factor 1.30
 - e. Board Edges Square
 - 2. Type II Insulation: Polyisocyanurate rigid roof insulation with compatible facer for use with mopping grade asphalt and having the following characteristics:
 - a. Aged R Value 5.7 per inch minimum
 - b. Size 48" x 48"
 - c. Thickness 1.5" and 3.0"
 - d. Board Edges Square
 - 3. Tapered Insulation and Crickets: Polyisocyanurate rigid roof insulation with the same characteristics as above, and:
 - a. Cricket and Saddle Taper slope 1/2 inch per foot minimum
 - b. Field Taper slope one-quarter inch per foot minimum
- D. Cants
 - 1. Fiber cant and Tapered Edge Strip: Asphalt impregnated wood fiberboard preformed to 45 degree angle for standard cant or taper as necessary; FIRE RATED ONLY.
 - 2. Substitutions: Under Provisions of applicable Section.
- E. Accessories
 - 1. Roof Nails: Galvanized or non-ferrous type, size as required to suit application.
 - 2. Mechanical Fasteners for Insulation to Steel Deck: #14 screws with corrosive resistant coating (able to pass 30 K cycles) and compatible metal plates; sufficient screw shank length to penetrate steel deck in accordance with manufacturer's instructions for base layer.
 - 3. Mechanical Fasteners for Flexible Flashing:
 - a. Masonry: Special heat treated, stress relieved, 1-1/4"; Masonry Nail manufactured by Simplex Nails, Inc.
 - b. Wood Blocking: High Carbon, zinc coated steel; annular threaded nail 1-inch shank nails; with minimum 1-inch x 30 gage metal disk; Roofing Nail, manufactured by Simplex Nails, Inc.
 - 4. Flexible vapor retarder: 6 mil polyethylene
 - 5. Compressible insulation: Un-faced R-19 batt insulation
 - 6. Granules: Manufacturer's reflective granules to match cap sheet membrane.
 - 7. Roof Penetration Flashing: PMMA resin flashing system from primary roof membrane manufacturer.
 - 8. Insulation Adhesive: Two Part Urethane Insulation Adhesive suitable for application temperatures and approved by Roofing Materials Manufacturer
 - 9. Walkpads: Additional ply of specified SBS modified bitumen cap sheet with selvage edge removed.
 - 10. Substitutions: Under Provisions of applicable Section.
- F. Source Quality Control
 - 1. Provide source, batch and test data on each shipment of asphalt bitumen.
 - 2. Include EVT for all asphalt.
 - a. Individual Containers: Label legible marked with data.
 - b. Bulk Shipment: Provide duplicate deliver ticket with data at time of delivery.
 - 3. Deliver asphalt to site, or provide certified samples if stored off-site, two week prior to beginning of installation. Owner may perform testing to confirm compliance.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive work.

- B. Verify that deck is supported and secured.
- C. Verify the deck is clean and smooth, free of depressions, waves, or other projections, properly sloped to drains or eaves.
- D. Verify that deck surfaces are dry and free of snow or ice.
- E. Verify that roof openings, curbs, pipes, sleeves, ducts, and vents through the roof are solidly set and wood nailing strips are in place.
- F. Beginning of installation means installer accepts existing surfaces.

3.2 PREPARATION

- A. Protect all building surfaces against damage from roofing work.
- B. Prevent debris and bitumen from drains, downspouts, underside of roof deck or other openings.
- C. Clean surfaces of roof deck and maintain free from all deleterious material during roofing operations.
- D. Verify flatness and tight joints of decking.

3.3 INSULATION APPLICATION

- A. All decks shall have multiple layer insulation schemes, unless otherwise noted.
 - 1. Non-nailable roof decks. Fasten insulation spaced in accord with Factory Mutual 1-90 requirements in the field, perimeters, and corners for mechanical fasteners. Factory Mutual requirements shall further be extended to provide compliance with entire roof assembly.
 - a. Steel roof decks. All areas of steel roof deck shall have two layers of polyisocyanurate insulation. Fasten first layer of 3.0" polyisocyanurate insulation with mechanical fasteners (screws and metal plates). Attach second layer of 1.5" polyisocyanurate insulation in solid mopping of asphalt. Install screw assemblies to hats of steel deck only. Length of fastener shall not protrude beyond underside of roof deck. Provide 48" x 48" maximum board size for mopped in insulation.
 - b. Concrete roof decks. All areas of concrete roof deck shall have two layers of polyisocyanurate insulation. Adhere first layer of 3.0" polyisocyanurate with solid mopping of asphalt. Subsequent layer of 1.5" polyisocyanurate to be installed with solid mopping of asphalt. Provide 48" x 48" maximum board size.
 - c. Canopy roof decks. Canopy decks without structural slope and not over interior space shall have one layer of one-quarter inch per foot tapered polyisocyanurate insulation mechanically fastened with minimum 1-1/2 inch starting thickness. Install screw assemblies to hats of steel deck only. Length of fastener shall not protrude beyond underside of roof deck.
- B. Multiple layer installation, break and stagger all joints 12" minimum. Solid moppings shall be minimum 25 lbs. per square at proper EVT application temperatures.
- C. Install one layer of 1/2" cover board in solid mopping of steep grade asphalt to all polyisocyanurate insulation. Mopping rate shall be not less than 25 pounds per 100 square feet at proper EVT for cover board application. Miter edges of cover boards at transitions of roof slope.
- D. Provide net slope of 1/4" per foot. Install crickets/saddles with minimum 1/2" per foot slope material in solid moppings of steep or special steep grade asphalt. Width of full diamond-shape crickets to be one-third its length with same proportions for half-diamond and "snubnose" configurations.
- E. Lay insulation boards with edges in moderate contact without forcing. Cut insulation boards to fit neatly to perimeters, blocking, and around all penetrations.
- F. Apply no more insulation than can be sealed and finished with complete membrane each day.
- G. All cut pieces of insulation shall have not less than 2 mechanical fasteners per piece for first layer application in steel roof decks.
- H. In no instance shall roof membrane plies be mopped or torched to polyisocyanurate insulation.
- I. On decks with slope one inch per foot or greater, provide wood back nailers for nailing of roofing felts. Wood nailers to be a minimum 3-1/2" wide and the same thickness as the insulation. Run nailers perpendicular to the roof slope and space at 32' -0" on center maximum (slopes 1 to 2 inches per foot), 10' -0" on center maximum (slopes 2 to 3 inches per foot), or 4' -0" on center maximum (slopes greater

than 3 inches per foot). Locate nailers along ridge.

3.4 ROOF MEMBRANE APPLICATION

- A. Equiviscous Temperature (EVT) at point of application: No more than 25 degrees F. (plus or minus) from published bitumen rating indicated on container label for application method used - manual mopping or mechanical spreading.
- B. Apply one ply of modified bitumen base ply, shingle fashion, working from low point or drain areas to high areas or peaks. Embed base ply into a uniform mopping of hot Type IV, special steep grade asphalt, at a rate of 25 pounds per 100 sq. ft. of roof area.
- C. Heat weld one ply of modified bitumen cap ply to base ply in accordance with manufacturer's instructions.
- D. Apply plies smooth, free of air pockets, wrinkles, fishmouths, and tears. Do not lay felts in a buck water fashion.
- E. Extend membrane felts up cant strips and at a minimum of 2 inches onto vertical surfaces. Mop additional ply of sheet products as dictated to act as base flashing over roofing membrane. Secure to nailing strips or substrates with proper fasteners spaced not more than 4 inches on center.
- F. Install two plies of felt and bitumen glaze coat for water cut-offs at end of day's operations. Seal top edge of field membrane and around penetrations with flashing cement at end of day's operations. Completely remove all cut-offs before resuming roofing operations.
- G. Mop and seal additional plies as dictated by Manufacturer to and around all roof penetrations.
- H. Prohibit foot and cart traffic over newly applied roof membrane products.
- I. Cover all asphalt spills or over mopped areas on top modified cap ply with matching granules immediately at time of asphalt application. The use of granules shall not preclude the careful and neat application of the finished surface ply.
- J. Cover all asphalt spills on top modified cap ply with matching chips immediately at time of application. The use of chips shall not preclude the careful and neat application of the finished surface ply.
- K. Aesthetic considerations: An aesthetically pleasing overall appearance of the finished roof system will be required prior to the work being accepted. Numerous patches and other repairs that will be sight exposed after the installation of the roof system has been completed will not be acceptable. Excessive patching will require removal and replacement if deemed necessary by the Architect or Manufacturer for aesthetic or roof warranty requirements.

3.5 FLASHINGS AND ACCESSORIES

- A. Apply flexible base flashings to seal membrane to vertical elements. Embed backer ply into a uniform mopping of hot Type IV asphalt at the rate as dictated by material manufacturer. Base flashing sheets to be cut from the end of the roll and torch applied vertically with selvage edge. Secure to nailing strips or proper substrate at 4 inches on center or as noted on drawings.
- B. Coordinate installation of related flashings so that all vertical surfaces or areas so requiring flashing are not left for more than 5 days of exposure.
- C. All temporary flashings and applications of bituminous cement used for temporary seal shall be completely removed prior to application of modified bitumen base flashing products.
- D. Penetration Flashing: Follow Manufacturer's instruction for application of PMMA resin flashing system. Embed granules matching cap sheet into flashing.
- E. Walkpads: Cut the walkpads into maximum 5 foot lengths and allow to relax until flat. Adhere the sheet in a full bed of Manufacturer's approved plastic cement. Walk-in each sheet after application to ensure proper adhesion. Use a minimum spacing of 2 inches between sheets to allow for proper drainage.

1. Install walkpads in locations as noted under "Notes to Contractor" on roof plan sheet, including entry points to roof, adjacent to entry points, around all rooftop HVAC units, and at service sides of other rooftop mechanical equipment.
2. Install walkpad material as sacrificial pads under pipe supports and other equipment supports that do not penetrate the roof as required by Manufacturer.
3. Install walkpad material under splash blocks, antenna mount sleds (if applicable), and other items sitting on roofs. All roof top equipment to be set and mounted to roof curbs that are flashed into the roofing system. Under no circumstances will equipment be placed onto supports that can rest on top of walkpads.
4. Install all walkpads so as not to cause water to pond.

3.6 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of applicable Section.
- B. Upon substantial completion, Owner may have Work examined, using applicable methods, to establish conditions of completed Project.
- C. Correct identified defects or irregularities. Cut out and repair membrane defects before end of each day or as dictated by Owner's Representative.

3.7 MANUFACTURERS FIELD SERVICES

- A. Request site attendance of roofing materials manufacturers during installation of the Work.

3.8 CLEANING

- A. Remove bituminous markings from finished areas and surfaces.
- B. In areas where finished surfaces are soiled by asphalt or any other source caused by Work of this Section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.
- C. Repair or replace defaced or disfigured finishes caused by Work of this Section.

3.9 PROTECTION

- A. Protect finished Work under applicable Section. Where traffic must continue over finished or existing roof membrane, protect surfaces with a cushion layer of insulation of at least 2" thick and one layer of 3/4" or greater plywood - all ballasted for site and personnel protection.
- B. Torch Safety: Crew members handling torches shall be trained by an Authorized Certified Roofing Torch Applicator (CERTA) Trainer, be certified according to CERTA torch safety guidelines as published by the National Roofing Contractor's Association (NRCA), and follow torch safety practices as required by the Contractor's insurance carrier. Designate one person on each crew to perform a daily fire watch of 4 hours minimum. The designated crew member shall watch for fires or smoldering materials on all areas during roof construction activity, and for the minimum period required by CERTA guidelines after roofing material application has been suspended for the day.

3.10 PROJECT FINISH OUT

- A. After all roofing and sheet metal is in place, apply not less than two applications of paint to all pipes, drain strainers, and other accessories as dictated by Architect.

END OF SECTION

SECTION 07 61 13
STANDING SEAM SHEET METAL ROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide warranted standing seam metal roof system with insulation and related trim to all roof decks indicated in Contract Documents.

1.2 REFERENCES

- A. American Society for Testing and Materials:
 - 1. ASTM A153 - Zinc Coating (Hot Dip) or Iron and Steel Hardware.
 - 2. ASTM A446 - Steel Sheet, Zinc Coated (Galvanized) by the Hot Dip Process, Structural (Physical) Quality.
 - 3. ASTM E84 - Surface Burning Characteristics of Building Materials
- B. American Institute of Steel Construction
 - 1. Code of Standards
- C. Federal Standards - FS HH-1972 Insulation Board
- D. Factory Mutual - FM 1-90 attachment of roof assembly.
- E. Underwriters Laboratories: - UL Class A Fire Rated Assembly.

1.3 DEFINITIONS

- A. FM 1-90: All insulation and/or nailer material will be fastened per Factory Mutual 1-90 guidelines (most current edition). Insulation and fasteners will be specifically listed in FM ratings guide.

1.4 SYSTEM DESCRIPTION

- A. Deck attached rigid composite wafer board and polyisocyanurate roof insulation with attached standing seam roof system and compatible/matching closure, fixture, and trim materials.
- B. Performance Requirements: Roofing System shall prevent water migration from entering the building through the roof metal system or flashing. System shall have proper placement of vapor retarding materials so as to not cause internal condensation.

1.5 SUBMITTALS

- A. Product Data: Provide data describing physical and performance characteristics and limitations including span tables; component profiles, fastening methods, joint detailing, and accessories; standard sizes, surface.
- B. Shop Drawings: Provide complete system drawings, including fully dimensioned panel layout, construction details, means of anchorage, method and sequence of installation, locations and size of shop cut openings, and type of closures, trim and fittings.
- C. Samples:
 - 1. Submit color chart of all pre-finished and/or galvalume metal to be used.
 - 2. Submit 12" x 12" sized sample illustrating selected profile, surface texture and color.
- D. Installers Certificate: Certifying that products and systems have been installed according to manufacturer's installation instructions and applicable codes and ordinances.
- E. Manufacturer's Installation Instructions: Include installation sequence, special instructions and Material Safety Data Sheets.
- F. Manufacturer's Certificate: Certificate stating products meet or exceed all specified requirements and that systems have been designed according to applicable codes and ordinances.
- G. Maintenance Data: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- H. Contract Closeout Submittals:
 - 1. Project Record Documents.

2. Contractors Five Year Labor and Material Warranty.
3. Manufacturers Twenty Year Finish Warranty.

1.6 QUALITY CONTROL

- A. Work of this Section shall conform to NRCA Roofing and Waterproofing Manual and Manufacturer's Instructions.
- B. Qualifications for Work of this Section:
 1. Manufacturer specializing in the manufacturer of products in this Section with a minimum ten years documented experience of those products being used.
 2. Applicator specializing in applying the Work and Products of this Section with a minimum of five years documented experience and approved by the Manufacturer to install the necessary roof system.
- C. Regulatory Requirements:
 1. Conform to all applicable local codes for roof assembly fire hazard and wind up-lift resistance.
 2. Provide certification of inspection confirming approval of design and installation by authority having jurisdiction.
 3. Roof Assembly Classification: Factory Mutual Class 1-90 construction, in accordance with latest FM Construction Bulletin.
- D. Pre-Installation Conference:
 1. Convene a roofing pre-installation conference two weeks prior to commencing work of this Section, under provisions of applicable Section.
 2. Require attendance of parties directly affecting Work of this Section.
 3. Review conditions of demolition, if applicable, installation, installation procedures and coordination with related Work.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to the site and store/protect on site under provisions of applicable Section.
- B. Deliver products in manufacturer's original containers, dry, undamaged, with seal and labels in tact. Include test report data.
- C. Store products in weather protected environment clear of ground moisture.
- D. Cut plastic wrapping materials to encourage ventilation.
- E. Do not store more materials on the roof than can be installed within two days.

1.8 PROJECT CONDITIONS

- A. Do not apply roofing underlayment during inclement weather.
- B. Do not apply roofing system to deformed or misaligned deck or substrate.

1.9 SEQUENCING AND SCHEDULING

- A. Coordinate work under provisions of applicable Section.
- B. Coordinate work with other trades and work to ensure sufficient materials and man-power are available to completely install and make water-tight all roofing installed on a daily basis.
- C. Coordinate installation of associated metal flashing and roof related items as Work of this Section proceeds.

1.10 WARRANTY

- A. Provide five year warranty from installer covering damage to building resulting from failure to resist penetration of water and replacement of defective materials and labor.
- B. Manufacturer's Warranty: Provide a twenty year finish warranty for roof panel and trim materials manufacturer covering the pre-finished or galvalume coating against fade, chalking, flaking and the like.
- C. Manufacturer's Watertightness Warranty: Provide a twenty (20) year No-Dollar-Limit System Warranty from roof system manufacturer covering full replacement of all materials (including insulation) and labor with no penal sum.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Roof System:
 - 1. McElroy
 - 2. Petersen
 - 3. Prior approved alternate
- B. Fasteners:
 - 1. ITW Buildex
 - 2. OMG, Inc.
 - 3. As recommended by primary metal roof system manufacturer.
- C. Substitutions: Provide all applicable data for proposed substitution no less than ten days prior to bid due date for review and addendum purposes.

2.2 MATERIALS

- A. Type I - Standing Seam Roof System
 - 1. 24 gage (warranted) pre-finish galvanized sheet steel or heavier gage as necessary to adequately bridge spans encountered.
 - 2. Finish shall be Kynar baked enamel finish from manufacturer's standard colors.
 - 3. 0.5 ounces per square foot with minimum yield of 50,000 psi.
 - 4. 16" maximum panel width smooth panel, 2" seam height, and double-folded seams.
 - a. Equal to Petersen - Tite-Loc Plus

NOTE: All materials used in this Section must match those found in Section 07 62 00
- B. Bituminous Materials
 - 1. High temp (heat resistant to 300 degrees) self-adhering membrane underlayment as approved by metal roof Manufacturer.
- C. Insulation: Nail base type
 - 1. Wafer board / polyisocyanurate Composite: Rigid polyisocyanurate with factory laminated OSB nailing surface suitable for use under metal roof system and over metal roof deck and having the following characteristics:
 - a. Finish Surface 7/16" OSB wood finish
 - b. Board Size 96" x 48"
 - c. Board Thickness 3.0"
 - d. R Factor 5.7 per 1" thickness of polyisocyanurate
 - e. Board Edges Square
 - 2. Polyisocyanurate rigid roof insulation with compatible facer for use with mopping grade asphalt and having the following characteristics:
 - a. Board Size 96" x 48"
 - b. Board Thickness 2.0"
 - c. R-Factor 5.7 per 1" thickness of polyisocyanurate
 - d. Board Edges Square
- D. Accessories
 - 1. Internal and External Corners: Matching metal as standing seam roof system.
 - 2. Mechanical Fasteners for Nailers and Insulation to Steel Deck: #14 screws with corrosive resistant coating (able to pass 30 K cycles) and compatible metal plates; sufficient screw shank length to penetrate steel deck in accordance with manufacturer's instructions.
 - 3. Sealants and Gaskets: Manufacturer's standard type suitable for use with installation of metal roof system; non-staining; skinning; non-shrinking; non-sagging; ultra-violet resistant for exterior applications; color as selected. EPDM 45 mil sheet as detailed.
 - 4. Contour Closures: Waterproof, all weather type, cured resilient without final set.
 - 5. Fasteners - Metal Roof Clip/Cleat Use: As approved by metal panel manufacturer and having corrosion protecting coating.
 - 6. Touch-Up Paint: As supplied from and by the manufacturer to match finish.
 - 7. Bituminous Paint: As approved by manufacturer, in writing.
 - 8. Concealed Panel Clips: Articulating and rigid cleats and supplied by metal roof manufacturer for system being used only.
 - 9. Nails for securing underlayment: Galvanized roofing nail equal to Berridge Coated Felt Cap
 - 10. Snow Retention System: Equal to S-5! ColorGard Snow Retention System with stainless steel non-penetrating clamps to fit metal panel profile. Provide pre-finished sheet metal to match standing-seam metal roof panel.
 - 11. Substitutions: Under Provisions of applicable Section.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive work.

- B. Verify that deck is supported and secured.
- C. Verify the deck is clean and smooth, free of depressions, waves, or other projections, properly sloped to eaves.
- D. Verify that deck surfaces are dry and free of snow or ice.
- E. Verify that roof openings, curbs, pipes, sleeves, ducts, and vents through the roof are solidly set and wood nailing strips are in place.
- F. Verify that structural framing members are sufficiently sound to receive and hold deck and associated members; ensure all structure and deck is aligned within tolerances in the AISC Code of Standards.
- G. Take site dimensions affecting Work of this Section.
- H. Report any discrepancies to the Owner or his representative in writing.
- I. Beginning of installation means installer accepts existing surfaces.

3.2 FABRICATION

- A. Roof Panels: Minimum 24 gage thick sheet stock (heavier gages as necessary for span and conditions as encountered); maximum length without horizontal joints. Ensure product and system choice will conform to roof radius and slopes involved.
- B. Internal and External Corners: Same matching sheet materials; thickness and finish to match roof panel; profile to suit system and seams as encountered; brake formed, shop cut and factory mitered to required edges, angles and tolerances.
- C. Expansion and Control Joints: Same materials and finish as panels; 22 gage thick; manufacturer's standard brake formed type of profile to suit system.
- D. Trim, Closure Pieces, Caps and Fascias: Same material, thickness and finish as sheet and panel stock; brake formed to required profiles.
- E. Anchorage and Support Members: As dictated by manufacturer for system being installed.
- F. Fabrication of component profiles, corner trim, or closures on the job site is prohibited.
- G. Ridge, curb or other pre-fabricated accessory shall be by metal panel manufacturer only and shall match profile of standing seam panel to which it shall nest and join to.

3.3 INSULATION APPLICATION

- A. Ensure all surfaces are in clean and dry condition.
- B. Lay 2.0" polyisocyanurate insulation over metal roof areas. Length of insulation boards to run perpendicular to the slope.
- C. Lay second layer of 3.0" nailbase insulation over 2.0" polyisocyanurate insulation. Length of nailbase insulation to run perpendicular to roof slope. Offset all insulation joints 12" minimum. Mechanically fasten both layers. Mechanical fastening pattern shall provide for compliance with FM 1-90 requirements. Plates or disks shall be used with fasteners if required to achieve aforementioned 1-90 specification.
- D. Size and install insulation on metal roof decks so that insulation joints occur over hats of roof deck only. Mechanical fasteners shall penetrate hats of deck only. Length of fasteners shall not protrude beyond underside of flutes of metal roof deck.
- E. Lay insulation boards with edges in moderate contact without forcing. Cut insulation boards to fit neatly to perimeters, blocking and around all penetrations.
- F. All cut sections of insulation shall have not less than two fasteners when installed over metal roof deck.
- G. Install one ply of ice and watershield underlayment to entire surface of specified insulation board. Ensure underlayment is installed horizontally, starting at eave to ridge with 18" minimum end laps. Apply underlayment smooth, free of air pockets, wrinkles, fishmouths, and tears. Do not install underlayment in a buck water fashion.
- H. Underlayment shall be exposed for not longer than maximum allowable days outlined by Manufacturer. Contractor will be responsible for wind and wrinkle repair just prior to metal roof application.

- I. If underlayment is deemed by Owner's representative to have been exposed to the weather for too long a period, Contractor shall overlay an additional layer of underlayment just prior to application of shingle roof system.

3.4 METAL ROOF SYSTEM APPLICATION

- A. Underlayment and clips:
 1. Verify application of underlayment to all areas.
 2. Install metal panel concealed articulating and rigid cleats in proper spacing so as to achieve specified wind up-lift resistance. Use not less than three fasteners per cleat or as directed by material manufacturer.
 3. Fasten cleats through nail base insulation so that fastener is secured to metal roof deck.
 4. Length of fastener shall not protrude beyond the underside of the metal roof deck.
- B. Install metal roof panels in continuous length working from eave edge to eave edge or wall without transverse joints in panels. Install sealant at all side laps prior to crimping and sealing. Manufacturer's standards are to be followed through entire installation. Where transverse joints must be installed, offset end laps 36" minimum with adjacent panels. Provide a panel layout for approval prior to start of metal roof system installation.
- C. Install closures, trim, and accessories meeting all manufacturer's specifications and requirements to achieve complete water-tight metal roof assembly.
- D. Protect surfaces in contact with cementitious materials and dissimilar metal with bituminous paint. Allow to dry prior to installation.
- E. All fastening of roof system, cleats, accessories and the like shall be aligned with structure, level and plumb within specified tolerances. Provide expansion and control joints where required and to reduce oil canning or stress.
- F. Remove site cuttings from finish surfaces.
- G. Prohibit foot and cart traffic over newly applied roof system.
- H. Install specified snow retention system per manufacturer's guidelines

3.5 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of applicable Section.
- B. Correct identified defects or irregularities. Cut out and repair defects before end of each day or as dictated by Owner's Representative.

3.6 MANUFACTURERS FIELD SERVICES

- A. Request site attendance of roofing materials manufacturers during installation of the Work.

3.7 CLEANING

- A. Remove visible markings from finished areas and surfaces leaving all exposed surfaces smooth and free of imperfections.
- B. In areas where finished surfaces are soiled by asphalt or any other source caused by Work of this Section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.
- C. Repair or replace defaced or disfigured finishes caused by Work of this Section.

3.8 PROTECTION

- A. Protect finished Work under applicable Section.

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Roofing related metal trim, flashing and counter flashing, scuppers, equipment curb cap flashing and counter flashing, expansion curb flashing, vent pipe, and pipe penetration flashing.
 2. Pre-engineered metal coping and edge metal assemblies.
 3. Pre-finished metal gutters and downspouts.
 4. Lead flashing at roof drains.
 5. Metal panel parapet cladding and accessories.
 6. Roof penetration flashing system.

1.2 REFERENCES

- A. American Society for Testing and Materials:
1. ASTM A153 - Zinc-Coating (Hot-Dip Galvanizing) for Iron and Steel Hardware.
 2. ASTM A525 - Sheet Steel, Zinc-Coated (Hot-Dip Galvanized)
 3. ASTM A755 - Fluoropolymer, Coil-Coated Galvanized Steel Sheet
 4. ASTM B32 - Solder, Grade Sn50
 5. ASTM D4586 – Type 1, asphalt based, asbestos-free, Roofing Cement.
- B. Federal Standards:
1. ANSI/SPRI -ES1 Wind Design Standard for Edge Systems Used with Low-Sloped Roofing
 2. FS O-F Flux, Soldering, Paste and Liquid
 3. FF QQ-L-201f Lead Sheet
 4. FS QQ-S-571 Solder, tin alloy.
 5. FS TT-C-494 Coating Compound, Bituminous, Solvent Type Acid Resistant.
- C. National Roofing Contractors Association (NRCA):
1. The NRCA Roofing and Waterproofing Manual.
- D. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
1. SMACNA Architectural Sheet Metal Manual.

1.3 RELATED SECTIONS

- A. Section 06 10 53 – Miscellaneous Rough Carpentry
- B. Section 07 52 16 – SBS Modified Bituminous Membrane Roofing

1.4 SYSTEM DESCRIPTION

- A. Work of this Section shall serve to physically protect the roof edges, curbs, utility penetrations and expansion joints from water infiltration, and from damage that would permit water to enter the roofing system or building interior.
- B. Metal parapet cladding will protect roof side of designated parapet wall surfaces from water penetration.

1.5 QUALITY CONTROL

- A. Work of this Section shall conform to applicable local code requirements for roof assembly, fire hazard and wind up-lift resistance as herein specified.
1. Edge metal and Wall coping assemblies shall be designed and installed in accord with the requirements of ANSI/SPRI ES-1.

- B. Qualifications for Work of this Section:
 - 1. Manufacturer: Company specializing in the manufacturer of products in this Section with a minimum five years documented experience with those products being used.
 - 2. Applicator: Company specializing in applying the Work and Products of this Section with a minimum of three years documented experience and approved by the Manufacturer to install the necessary roof system.
 - a. Contractor fabricated edge and coping assemblies are required to meet ANSI/SPRI ES-1 testing protocol. Field-assembled fabrications may be manufactured and installed only by a NRCA member Contractor that is sub-listed through NRCA to install its approved assemblies.
- C. Pre-Installation Conference:
 - 1. Review conditions of demolition, if applicable, installation, installation procedures and coordination with related Work.

1.6 SUBMITTALS

- A. Product Data: Provide data describing the physical and performance characteristics, and limitations including span tables; component profiles, fastening methods, joint detailing, and accessories; standard sizes, surface
- B. Shop Drawings: Provide complete system drawings, including fully dimensioned fabrication drawings and construction details, indicating means of anchorage, method and sequence of installation, locations and size of shop cut openings, and type of closures, trim and fittings.
- C. Samples:
 - 1. Submit 12" x 12" sample illustrating selected profile, surface texture and color.
- D. Installers Certificate: Certifying that products have been installed according to the manufacturer's installation instructions and applicable codes and ordinances.
- E. Maintenance Data: Include manufacturer's recommendations for cleaning agents and cleaning methods; precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- F. Contract Closeout Submittals:
 - 1. Contractors Five Year Labor and Material Warranty.
 - 2. Metal Supplier's 20-year finish warranty.
 - 3. Pre-fabricated Edge/Coping Assembly Supplier's 20-year performance warranty

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to the site and store/protect per manufacturer's instructions.
- B. Deliver products in manufacturer's original packaging; dry, undamaged, with seals and labels in tact.
- C. Store products in weather protected environment clear of ground moisture.
- D. Cut plastic wrapping materials where appropriate to promote ventilation.
- E. Do not store any materials on the roof, overnight.

1.8 PROJECT CONDITIONS

- A. Do not apply sheet metal assemblies or devices which are deformed or misaligned
- B. Do not apply work of this section to decks or substrates which are not properly prepared.

1.9 SEQUENCING AND SCHEDULING

- A. Coordinate work under provisions of applicable Section.

- B. Coordinate work to ensure sufficient materials and man-power are available to completely install and make water-tight all details on a daily basis.
- C. Coordinate installation of metal flashing and roof related items as Work proceeds.

1.10 WARRANTY

- A. Provide five (5) year warranty from installing contractor covering damage to roofing components resulting from failure of sheet metal material, and/or workmanship, to resist penetration of water. Warranty will cover material and labor to replace deficient sheet metal and damaged roofing components.
- B. Pre-engineered, pre-fabricated edge metal and coping assemblies shall provide a 20 year warranty against failure to resist water penetration, and/or failure to resist 3-second gust wind speed of up to 90 mile per hour. Warranty will cover material and labor to replace deficient sheet metal and damaged roofing components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Sheet Metal
 - 1. McElroy
 - 2. Peterson
 - 3. Prior approved alternate.
- B. Fasteners:
 - 1. ITW Buildex
 - 2. OMG, Inc.
 - 3. Prior approved alternate.

2.2 MATERIALS

- A. Galvanized Steel - Minimum 24 gage ASTM A525, ASTM G-90 hot dipped galvanized steel sheet.
- B. Pre-finished Galvanized Steel - Minimum 24 gage core metal, ASTM A755 coil-coated steel, finished with 70% fluoropolymer (e.g. Kynar 500) baked enamel finish capable of receiving a 20 year finish warranty against fade, peel, cracking and chalking.
- C. Pre-Engineered Edge and Coping Assemblies: Factory-fabricated assemblies, independently tested and warranted to meet or exceed performance requirements of ANSI/SPRI ES-1, comprised of Kynar-coated, G-90 galvanized steel having a minimum core metal thickness of 24 gage, with underlying carriage frame of galvanized steel having a minimum core metal thickness of 20 gage, secured through pre-punched holes with #9x1-1/2 inch long, stainless steel fasteners.
 - 1. Pac-tite; as manufactured by Petersen
 - 2. Perma-Tite Metal Coping; as manufactured by Metal Era.
 - 3. Permasnap MC coping system, as manufactured by W.P. Hickman.
 - 4. Contractor Installed Assemblies may be substituted and installed only by Authorized Fabricators for NRCA's ANSI/SPRI ES-1 certification
 - 5. Prior approved alternate.
- D. Lead: FS QQ-L-201F, 36"x36" square, minimum 4 pound per square foot stock for drain flashing.
- E. Fasteners: All exposed fasteners to receive metal-jacketed neoprene or EPDM washers. Where fasteners attach straps to gutters or downspouts to walls, the washers may be omitted. Exposed horizontal surface fasteners are not permitted, recognized, or acceptable unless directed otherwise. Other cleats, screws, rivets, bolts, etc. shall be of matching material to which they attach or be galvanically compatible to the surface to which they are secured.
 - 1. Steel Roofing Nails: 11 gauge hot-dipped galvanized nails with annular threaded rings and 3/8" diameter heads in lengths sufficient to penetrate the substrate a minimum of 1-1/4". Use only where specified.
 - 2. Screws: #12 stainless steel or brass self-tapping screws with hexagonal heads. Provide metal

- jacketed neoprene rubber washer at exposed locations. Install fasteners spaced at 12" on center unless otherwise noted.
3. Attachment to Masonry: Tapcons equal to ITW Buildex. Only use in concealed conditions.
 4. Blind Rivets: Stainless steel Series 44. Both rivet and mandrel are to be stainless steel. A mixture of materials will not be permitted.

2.3 COMPONENTS

- A. Metal, flashing, flashing receivers, counter flashing, panel trim, and fasteners; all profiled to suit details and site requirements.
- B. Metal liner panels, with associated furring, sill trim, head trim, jamb trim, corner closures, and neoprene closures.

2.4 ACCESSORIES

- A. Bituminous Paint: As approved by manufacturer, in writing.
- B. Sealants:
 1. Type 1: Single component, gun grade urethane sealant for general purpose sheet metal work; Sonneborn Sonolastic NP1.
 2. Type 2: Butyl Rubber sealant tape.
- C. Asphalt Primer: ASTM D-41, asphalt cut-back type.
- D. Asphalt Felt Sheathing: ASTM D226, No. 30 asphalt impregnated, non-perforated roofing felt.
- E. Waterproof Membrane: ASTM D412, 45 mil non-reinforced EPDM
- F. Self-adhering Membrane: Equal to Grace Ice and Water Shield
- G. Substitutions: Submit under Provisions of applicable Section.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive the Work of this Section.
- B. Verify that roof openings, curbs, pipes, sleeves, drains or vents through the roof are solidly set; reglets are in place, and that nailing strips are located.
- C. Verify that roofing components, accessories and terminations are in place, sealed and secure; ready for sheet metal protection and detail installation.
- D. Take site dimensions affecting Work of this Section.
- E. Report any discrepancies to the Owner's Representative in writing.
- F. Beginning Work signifies that contractor accepts existing surfaces and conditions.

3.2 PREPARATION

- A. Field measure site conditions prior to submitting shop drawing.
- B. Do not order or fabricate sheet metal components prior to approval of shop drawings.
- C. Apply bituminous protective backing on surfaces in contact with dissimilar materials.

3.3 FABRICATION

- A. Form sections true to shape, accurate in size and free from distortion or defects.
- B. Fabricate cleats and starters of same material as surface sheet. Unless otherwise detailed, cleats and hook strips shall be one gage heavier than sheet being retained.
- C. Hem exposed edges of metal a minimum of 3/4 inch; miter and seam corners.
- D. Provide end-caps, mitered corners and the like, with joints soldered water tight.
 - 1. At exposed conditions designated to receive pre-finished galvanized steel fabrication, provide soldered galvanized fabrication below with pre-finished steel cover piece, i.e.; coping corners.
- E. Fabricate corners from one piece with equal legs extending not less than 18 inches or more than 36 inches in each direction from the corner.
- F. Fabricate vertical faces with bottom edge formed outward 5/8 inch (min.) at 30-45 degrees, and hemmed to form a drip leg.
- G. Form sections square, true and accurate in size, in maximum possible lengths; free of distortion or defects detrimental to appearance or performance. Allow for expansion and build in appropriate number of control devices for specific detail encountered.
- H. Sheet metal fabrications coming into contact with galvanically incompatible surfaces are to be coated with protective backing paint to a minimum dry film thickness of 15 mils.

3.4 PRE-ENGINEERED METAL COPING SYSTEM

- A. Comply with approved coping system manufacturer's written installation instructions in setting and securing coping system.
- B. Secure coping system with mechanical fasteners which provide a minimum pull-out resistance of 240 pounds.
- C. For Contractor installed assemblies: Modify wood blocking at coping conditions to provide 3/4 inch per foot slope.

3.5 INSTALLATION

- A. Install starter, edge strips and cleats before installation of sheet metal accessories.
- B. Install metal fabrications in the longest practical length so as to minimize joints.
- C. Anchor flashings to walls and substrates utilizing galvanically compatible fasteners.
- D. Secure flashings in place using concealed fasteners. Use exposed fasteners only in locations so detailed and approved by Special Consultant.
- E. Execute joints in adjacent pieces of material per the following schedule:
 - 1. Wall /Curb Counter flashing: 4" lap joint in direction of water flow with two (2) rows of Type 2 sealant.
 - 2. Counter flashing Receiver: Bayonet-style interlocking lap per detail drawings.
 - 3. Coping: Pre-Engineered assembly Wider than 10 inches: Standing seam. Less than 10 inches: 1/4" wide gap joint with 6 inch wide cover plate and backer plate set in two (2) rows of Type 2 sealant.
 - 4. Expansion Joint Hood: 4" lap joint in direction of water flow with two (2) rows of Type 1 sealant.
 - 5. Gravel Edge Guard: 1/4" wide gap joint with 6 inch wide cover plate set in two (2) rows of type 1 sealant.
 - 6. Pre-finished gutter: 4" lap joint in direction of water flow with two (2) rows of Type 2 sealant, pop-riveted at 1 inch o/c.

- F. Apply plastic cement (asbestos free type only) between metal flashing and bituminous underlayment. (example: edge metal, drains, scuppers, etc.).
- G. Fit flashings tightly into place. Make corners square, surface true and straight in planes, and lines accurate to profiles.
- H. Solder non-moving metal joints water tight for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with clean water.
- I. Secure galvanized metal fabrications with stainless steel fasteners.
- J. Flash plumbing vent stacks with PMMA resin flashing system. Embed granules matching cap sheet into flashing.
- K. Provide 12" minimum horizontal lap at stepped through wall flashing locations. Install end dams soldered watertight.
- L. Metal flashing work is to conform to detail drawings provided. Where no detail drawing is provided, refer to listed SMACNA and NRCA reference manuals.

3.6 FIELD QUALITY CONTROL

- A. Correct identified defects or irregularities. Cut out and repair defects before end of each day or as directed by Owner's Representative.

3.7 CLEANING

- A. Remove visible marks from finished surfaces leaving all exposed surfaces smooth and free of imperfections.
- B. Where finished surfaces are soiled as a result of the Work of this Section, consult manufacturer of the marred or damaged surface for guidance in the proper restoration of the surface. Conform to their written instructions.

3.8 SHEET METAL SCHEDULE

- A. Pre-Finished Steel: All metal accessory components which are exposed to public view or to building occupant view.
- B. Pre-Finished Steel: Metal liner panels at inside face of designated parapet including head and sill trim.
- C. Galvanized Steel: Flashing and counter flashing and accessories not exposed to public or occupant view.
- D. Lead: Roof drain flashing.

END OF SECTION

SECTION 07 62 10

FLEXIBLE FLASHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Formed Products: Concealed flashing within wall assemblies to protect and shed incidental water to the exterior that is not specified as part of the air/moisture barrier system.

1.2 PERFORMANCE REQUIREMENTS

- A. General: Flashing and trim assemblies as indicated shall withstand structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
 - 1. Submit documentation of compatibility with air/moisture barrier.
- B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Do not store flashing materials in contact with other materials that might cause staining, denting, or other surface damage. Store flashing materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

PART 2 - PRODUCTS

2.1 FLEXIBLE FLASHING

- A. Self-Adhesive flexible flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 40 mils.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advanced Building Products Inc.; Strip-N-Flash.
 - b. Carlisle Coatings & Waterproofing; CCW-705 Air & Vapor Barrier Strips.
 - c. GCP Applied Technologies Inc.; Perm-A-Barrier Wall Membrane.
 - d. Henry; Blueskin SA

2.2 HIGH TEMPERATURE FLASHING

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by manufacturer.
 - 1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F.
 - 2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F.

3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle Coatings & Waterproofing Inc.; CCW WIP 300HT.
 - b. GCP Applied Technologies Inc.; Grace Ultra.
 - c. Henry Company; Blueskin PE200 HT.
 - d. Owens Corning; WeatherLock Specialty Tile & Metal High Temperature Underlayment.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, separators, sealants, and other miscellaneous items as required for complete metal flashing installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
 1. Verify compliance with requirements for installation tolerances of substrates.
 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FLASHING INSTALLATION

- A. General: Install as indicated on Drawings and per Manufacturer's recommendations.
- B. Self-Adhering Sheet Flashing: Install self-adhering sheet flashing, wrinkle free. Apply primer if required by flashing manufacturer. Comply with temperature restrictions of flashing manufacturer for installation. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover flashing with subsequent construction within 14 days.
- C. Location:
 1. Flexible Flashing: As indicated on drawings, or at all exterior windows, doors or other penetrations where high temperature flashing is not required.
 2. High Temperature Flashing: As indicated on drawings, or at all locations where flashing will be in contact with metal coping or metal panels where high temperatures exist.

END OF SECTION

SECTION 07 72 00
ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Roof curbs.
 - 2. Equipment supports.
 - 3. Roof hatches.
 - 4. Pipe and duct supports.
 - 5. Pipe portals.

1.2 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For roof accessories.
 - 1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.
- C. Delegated-Design Submittal: For roof curbs and equipment supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordinating requirements with roof membrane system.
 - 2. Wind-Restraint Details: Detail fabrication and attachment of wind restraints. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.5 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.
- B. Special Warranty on Painted Finishes for Roof Hatch: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design roof curbs and equipment supports to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Wind-Restraint Performance: As indicated on Drawings.
- D. Roof Hatch: Meets requirements of ICC-500-2014 and FEMA 361, 320.

2.2 ROOF CURBS

- A. Pre-Fabricated Roof Curbs: Welded 18 gauge galvanized steel and integral base plate with factory installed 2 by 4 pressure treated wood nailer, insulation board, and heavy gauge galvanized steel counterflashing. Reinforcing on sides greater than 36 inches. Curbs to be provided at all mechanical rooftop units and as shown on Drawings. Unit shall be tapered to provide level rooftop units, as manufactured by The Pate Company, Model #PC-2.
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported
- D. Construction:
 - 1. Curb Profile: Manufacturer's standard compatible with roofing system.
 - 2. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
 - 3. Fabricate curbs to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
 - 4. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange.
 - 5. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
 - 6. Insulation: Factory insulated with 1-1/2-inch- (38-mm-) thick glass-fiber board insulation.
 - 7. Liner: Same material as curb, of manufacturer's standard thickness and finish.
 - 8. Nailer: Factory-installed wood nailer along top flange of curb, continuous around curb perimeter.
 - 9. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
 - 10. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from 3/4-inch- (19-mm-) thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
 - 11. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.
 - 12. Damper Tray: Provide damper tray or shelf with opening 3 inches (76 mm).

2.3 EQUIPMENT SUPPORTS

- A. Equipment Supports: Internally reinforced perimeter metal equipment supports capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements; with welded corner joints, and integrally formed structure-mounting flange at bottom.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AES Industries, Inc.
 - b. Air Balance; a division of MESTEK, Inc.
 - c. Conn-Fab Sales, Inc.

- d. LMCurbs.
 - e. Louvers & Dampers, Inc.; a division of Mestek, Inc.
 - f. Milcor; Commercial Products Group of Hart & Cooley, Inc.
 - g. Roof Products, Inc.
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported.
- D. Material: Zinc-coated (galvanized) steel sheet, 0.052 inch (1.32 mm) thick.
- 1. Finish: Mill phosphatized.
- E. Construction:
- 1. Curb Profile: Manufacturer's standard compatible with roofing system.
 - 2. Insulation: Factory insulated with 1-1/2-inch- (38-mm-) thick glass-fiber board insulation.
 - 3. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
 - 4. Nailer: Factory-installed continuous wood nailers 3-1/2 inches (90 mm) wide on top flange of equipment supports, continuous around support perimeter.
 - 5. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb of size and spacing required to meet wind uplift requirements.
 - 6. Platform Cap: Where portion of equipment support is not covered by equipment, provide weathertight platform cap formed from 3/4-inch- (19-mm-) thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
 - 7. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
 - 8. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
 - 9. Fabricate equipment supports to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
 - 10. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.

2.4 ROOF HATCHES

- A. Roof Hatches: Metal roof-hatch units with lids curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, integral metal cant, and integrally formed deck-mounting flange at perimeter bottom.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Roof Penetration Housings, LLC.
 - 2. Basis-of-Design Product: Roof Penetration Housings, LLC; Tornado Rated Roof Hatch – CRH 4032 Series.
- B. Type and Size: Single-leaf lid, as indicated.
- C. Loads: Minimum 40-lbf/sq. ft. (1.9-kPa) external live load and 20-lbf/sq. ft. (0.95-kPa) internal uplift load.
- D. Hatch Material: Zinc-coated (galvanized) steel sheet.
- 1. Thickness: 3/16 inch.
 - 2. Finish: Manufacturer's standard industrial coating.
- E. Construction:
- 1. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
 - 2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
 - 3. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
 - 4. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
 - 5. Fabricate curbs to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
- F. Lifting Mechanisms: Manufacturer to provide gas spring operators to provide assisting lifting of cover. One shall be auto safety locking in open position.
- 1. Construction: Bolted to internal framework.

- G. Hardware: Spring operators, hold-open arm, stainless-steel spring latch with turn handles, stainless-steel butt- or pintle-type hinge system, and padlock hasps inside and outside.
 - 1. Provide two-point latch on lids larger than 84 inches (2130 mm).
 - H. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
 - 1. Height: 42 inches (1060 mm) above finished roof deck.
 - 2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches (31 mm) in diameter or galvanized-steel tube, 1-5/8 inches (41 mm) in diameter.
 - 3. Flat Bar: Galvanized steel, 2 inches (50 mm) high by 3/8 inch (9 mm) thick.
 - 4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches (533 mm) in diameter.
 - 5. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
 - 6. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
 - 7. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
 - 8. Fabricate joints exposed to weather to be watertight.
 - 9. Fasteners: Manufacturer's standard, finished to match railing system.
 - 10. Finish: Manufacturer's standard.
 - a. Color: As selected by Architect from manufacturer's full range.
 - I. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
 - 1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
 - 2. Height: 42 inches (1060 mm) above finished roof deck.
 - 3. Material: Steel tube.
 - 4. Post: 1-5/8-inch- (41-mm-) diameter pipe.
 - 5. Finish: Manufacturer's standard baked enamel or powder coat.
 - a. Color: As selected by Architect from manufacturer's full range.
- 2.5 PIPE AND DUCT SUPPORTS
- A. Fixed-Height Cradle-Type Pipe Supports: Polycarbonate pipe stand accommodating up to 1-1/2-inch- (38-mm-) diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.
 - B. Fixed-Height Roller-Bearing Pipe Supports: Polycarbonate pipe stand with polycarbonate roller carrying assembly accommodating up to 7-inch- (178-mm-) diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.
 - C. Adjustable-Height Roller-Bearing Pipe Supports: Polycarbonate pipe stand base, pipe support, and roller housing, with stainless-steel threaded rod designed for adjusting support height, accommodating up to 18 inch (457 mm) diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.
 - D. Adjustable-Height Structure-Mounted Pipe Supports: Extruded-aluminum tube, filled with urethane insulation; 2 inches (50 mm) in diameter; accommodating up to 7-inch- (178-mm-) diameter pipe or conduit, with provision for pipe retainer; with aluminum baseplate, EPDM base seal, manufacturer's recommended hardware for mounting to structure or structural roof deck as indicated, stainless-steel roller and retainer, and extruded-aluminum carrier assemblies; as required for quantity of pipe runs and sizes.
 - E. Curb-Mounted Pipe Supports: Galvanized steel support with welded or mechanically fastened and sealed corner joints, straight sides, and integrally formed deck-mounting flange at perimeter bottom; with adjustable-height roller-bearing pipe support accommodating up to 20-inch- (508-mm-) diameter pipe or conduit and with provision for pipe retainer; as required for quantity of pipe runs and sizes.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. MIRO Industries.
 - b. Pate Company (The).
 - c. PHP Systems/Design.

d. Thaler Metal Industries Ltd.

2.6 PIPE PORTALS

- A. Curb-Mounted Pipe Portal: Insulated roof-curb units with welded or mechanically fastened and sealed corner joints, straight sides, and integrally formed deck-mounting flange at perimeter bottom; with weathertight curb cover with single or multiple collared openings and pressure-sealed conically shaped EPDM protective rubber caps sized for piping indicated, with stainless-steel snaplock swivel clamps.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.
- B. Flashing Pipe Portal: Formed aluminum membrane-mounting flashing flange and sleeve with collared opening and pressure-sealed conically shaped EPDM protective rubber cap sized for piping indicated, with stainless-steel snaplock swivel clamps.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.

2.7 METAL MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation.
 - 1. Exposed Coil-Coated Finish: Preprimed by the coil-coating process to comply with ASTM A 755/A 755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
 - 2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil (0.013 mm).
- B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, AZ50 (AZM150) coated.
 - 1. Exposed Coil-Coated Finish: Preprimed by the coil-coating process to comply with ASTM A755/A755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
 - 2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil (0.013 mm).
- C. Aluminum Extrusions and Tubes: ASTM B 221 (ASTM B 221M), manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.
- D. Stainless-Steel Sheet and Shapes: ASTM A 240/A 240M or ASTM A 666, Type 304.
- E. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.
- F. Steel Tube: ASTM A 500/A 500M, round tube.
- G. Galvanized-Steel Tube: ASTM A 500/A 500M, round tube, hot-dip galvanized according to ASTM A 123/A 123M.
- H. Steel Pipe: ASTM A 53/A 53M, galvanized.

2.8 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Cellulosic-Fiber Board Insulation: ASTM C 208, Type II, Grade 1, thickness as indicated.
- C. Glass-Fiber Board Insulation: ASTM C 726, nominal density of 3 lb/cu. ft. (48 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C), thickness as indicated.
- D. Polyisocyanurate Board Insulation: ASTM C 1289, thickness and thermal resistivity as indicated.

- E. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.
- F. Security Grilles: 3/4-inch (19-mm) diameter, ASTM A 1011/A 1011M steel bars spaced 6 inches (150 mm) o.c. in one direction and 12 inches (300 mm) o.c. in the other; factory finished as follows:
 - 1. Surface Preparation: Remove mill scale and rust, if any, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 - 2. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment.
 - 3. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, lead- and chromate-free, universal primer; selected for resistance to normal atmospheric corrosion, for compatibility with substrate and field-applied finish paint system indicated, and for capability to provide a sound foundation for field-applied topcoats under prolonged exposure.
- G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- H. Underlayment:
 - 1. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 - 2. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
 - 3. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
 - 4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- I. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- J. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
- K. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.
- L. Asphalt Roofing Cement: ASTM D 4586/D 4586M, asbestos free, of consistency required for application.

2.9 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions.
 - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.

2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
1. Coat concealed side of stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
 3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.
- C. Roof Curb Installation: Install each roof curb so top surface is level.
- D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.
- E. Roof-Hatch Installation: Install in accordance with manufacturer's written instructions and recommendations.
1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
 2. Attach safety railing system to roof-hatch curb.
 3. Attach ladder-assist post according to manufacturer's written instructions.
- F. Pipe Support Installation: Comply with MSS SP-58 and MSS SP-89. Install supports and attachments as required to properly support piping. Arrange for grouping of parallel runs of horizontal piping, and support together.
1. Pipes of Various Sizes: Space supports for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
- G. Preformed Flashing-Sleeve and Flashing Pipe Portal Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.
- H. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.
- 3.3 REPAIR AND CLEANING
- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780/A 780M.
- B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 09 91 13 "Exterior Painting."
- C. Clean exposed surfaces according to manufacturer's written instructions.
- D. Clean off excess sealants.
- E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 81 00
APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes sprayed fire-resistive materials.

1.2 DEFINITIONS

- A. SFRM: Sprayed fire-resistive materials.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Framing plans or schedules, or both, indicating the following:
 - 1. Extent of fireproofing for each construction and fire-resistance rating.
 - 2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
 - 3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
 - 4. Treatment of fireproofing after application.
- C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard dimensions in size.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Product Certificates: For each type of fireproofing.
- C. Evaluation Reports: For fireproofing, from ICC-ES.
- D. Preconstruction Test Reports: For fireproofing.
- E. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.
- B. Mockups: Build mockups to set quality standards for materials and execution.
 - 1. Build mockup of each type of fireproofing and different substrate as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 44 deg F (7 deg C) or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

- B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
- B. Source Limitations: Obtain fireproofing from single source.
- C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Steel members are to be considered unrestrained unless specifically noted otherwise.
- D. Asbestos: Provide products containing no detectable asbestos.

2.2 SPRAYED FIRE-RESISTIVE MATERIALS

- A. Standard Durability SFRM: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. GCP Applied Technologies; Monokote MK-6 Series
 - b. Carbolite Company; RPM International; AD Southwest Fireproofing Type 5GP
 - c. Isolatak International, Inc; Cafco 300
 - 2. Application: Designated for interior locations and concealed conditions by a qualified testing agency acceptable to authorities having jurisdiction.
 - 3. Bond Strength: Minimum 200-lbf/sq. ft.) cohesive and adhesive strength based on field testing according to ASTM E 736.
 - 4. Density: Not less than 15 lb/cu. ft. and as specified in the approved fire-resistance design, according to ASTM E 605.
 - 5. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E 605, whichever is thicker, but not less than 0.375 inch (9 mm).
 - 6. Combustion Characteristics: ASTM E 136.
 - 7. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 0.
 - b. Smoke-Developed Index: 0.
 - 8. Compressive Strength: Minimum 10 lbf/sq. in. according to ASTM E 761.
 - 9. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
 - 10. Deflection: No cracking, spalling, or delamination according to ASTM E 759.
 - 11. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
 - 12. Air Erosion: Maximum weight loss of 0.0 g/sq. ft. in 24 hours according to ASTM E 859.
 - 13. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G 21.
 - 14. Finish: Spray-textured finish
 - a. Color: As selected by Architect from manufacturer's full range.

2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with one or both of the following requirements:
 - 1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

2. Primer's bond strength in required fire-resistance design complies with specified bond strength for fireproofing and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests according to ASTM E 736.
- C. Bonding Agent: Product approved by fireproofing manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design.
1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
 2. Verify that objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
 3. Verify that substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.
- B. Verify that concrete work on steel deck is complete before beginning fireproofing work.
- C. Verify that roof construction, installation of rooftop HVAC equipment, and other related work are complete before beginning fireproofing work.
- D. Conduct tests according to fireproofing manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.
- E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.
- B. Clean substrates of substances that could impair bond of fireproofing.
- C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.
- D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

- A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.
- B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
 2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.

- D. Metal Decks:
 - 1. Do not apply fireproofing to underside of metal deck substrates until concrete topping, if any, is completed.
 - 2. Do not apply fireproofing to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fireproofing.
 - E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.
 - F. Spray apply fireproofing to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.
 - G. Extend fireproofing in full thickness over entire area of each substrate to be protected.
 - H. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.
 - I. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.
 - J. Cure fireproofing according to fireproofing manufacturer's written instructions.
 - K. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.
 - L. Finishes: Where indicated, apply fireproofing to produce the following finishes:
 - 1. Spray-Textured Finish: Finish left as spray applied with no further treatment.
 - 2. Skip-Troweled Finish with Corner Beads: Even, leveled surface produced by troweling spray-applied finish to smooth out the texture, eliminate surface markings, and square off edges.
- 3.4 FIELD QUALITY CONTROL
- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Test and inspect as required by the IBC, Subsection 1705.13, "Sprayed Fire-Resistant Materials."
 - B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
 - C. Fireproofing will be considered defective if it does not pass tests and inspections.
 - 1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
 - 2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
 - D. Prepare test and inspection reports.
- 3.5 CLEANING, PROTECTING, AND REPAIRING
- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
 - B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing is without damage or deterioration at time of Substantial Completion.
 - C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.
 - D. Repair fireproofing damaged by other work before concealing it with other construction.
 - E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION

SECTION 07 84 13

PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in horizontal assemblies.
 - 3. Penetrations in smoke barriers.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.
- B. Product Certificates:
 - 1. Certifying the non-metallic plumbing piping system and the fire sprinkler piping system manufacturers evaluated and approved the firestopping products for installation with or near its piping system.
 - 2. Certifying the firestopping products comply with NFPA 13 requirements for material compatibility with non-metallic pipe and tubing.

1.5 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by firestopping manufacturer.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.
- C. Ensure firestopping products are coordinated and compatible with the non-metallic plumbing piping system and the fire sprinkler piping system.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Compatibility: Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.
 - 1. For penetrations involving CPVC piping, provide through-penetration firestop systems which include materials that have been tested to be compatible with CPVC piping.
- B. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."
 - 3) FM Global in its "Building Materials Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any. Provide firestopping, including products specified in Section 07 84 43 "Joint Firestopping," by same manufacturer as products of this section regardless of installer. All firestopping products within this section shall be of one manufacturer.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. 3M Fire Protection Products.
 - b. A/D Fire Protection Systems Inc.
 - c. GCP Applied Technologies Inc.
 - d. Hilti, Inc.
 - e. Johns Manville.
 - f. Nelson Firestop Products.
 - g. RectorSeal Corporation.
 - h. Specified Technologies Inc.
 - i. Tremco, Inc.; Tremco Fire Protection Systems Group.
 - j. USG Corporation.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 - 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 - 1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 - 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
 - 3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
 - 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
- F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
 - 1. Permanent forming/damming/backing materials.
 - 2. Substrate primers.
 - 3. Collars.
 - 4. Steel sleeves.

2.3 FILL MATERIALS

- A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- D. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- F. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- G. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- I. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Ensure penetration firestopping products are coordinated and compatible with one another, with the substrates forming openings, and with penetrating items.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.
 - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing and inspecting agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Where Intertek ETL SEMKO-listed systems are indicated, they refer to design numbers in Intertek ETL SEMKO's "Directory of Listed Building Products" under "Firestop Systems."
- C. Where FM Global-approved systems are indicated, they refer to design numbers listed in FM Global's "Building Materials Approval Guide" under "Wall and Floor Penetration Fire Stops."
- D. Refer to Drawings.

END OF SECTION

SECTION 07 84 43

JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Joints in or between fire-resistance-rated constructions.
 - 2. Joints at exterior curtain-wall/floor intersections.
 - 3. Joints in smoke barriers.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.
- B. Product Certificates:
 - 1. Certifying the non-metallic plumbing piping system and the fire sprinkler piping system manufacturers evaluated and approved the joint firestopping products for installation with or near its piping system.
 - 2. Certifying the joint firestopping products comply with NFPA 13 requirements for material compatibility with non-metallic pipe and tubing.

1.5 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by firestopping manufacturer.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.
- C. Ensure joint firestopping products are coordinated and compatible with the non-metallic plumbing piping system and the fire sprinkler piping system.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Compatibility: Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.
 - 1. For penetrations involving CPVC piping, provide through-penetration firestop systems which include materials that have been tested to be compatible with CPVC piping.
- B. Fire-Test-Response Characteristics:
 - 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."

2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases. Provide firestopping, including products specified in Section 07 84 13 "Penetration Firestopping," by same manufacturer as products of this section regardless of installer. All firestopping products within this section shall be of one manufacturer.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. 3M Fire Protection Products.
 - b. A/D Fire Protection Systems Inc.
 - c. GCP Applied Technologies Inc.
 - d. Hilti, Inc.
 - e. Johns Manville
 - f. Nelson Firestop Products.
 - g. RectorSeal Corporation.
 - h. Specified Technologies Inc.
 - i. Tremco, Inc.; Tremco Fire Protection Systems Group
 - j. USG Corporation.
- C. Joints at Exterior Curtain-Wall/Floor Intersections: Provide joint firestopping systems with rating determined per ASTM E 2307.
 - 1. F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
 - 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A/D Fire Protection Systems Inc.
 - b. GCP Applied Technologies Inc.
 - c. Hilti, Inc.
 - d. Johns Manville
 - e. Nelson Firestop Products.
 - f. RectorSeal Corporation.
 - g. Specified Technologies Inc.
 - h. 3M Fire Protection Products.
 - i. Thermafiber, Inc.
 - j. Tremco, Inc.; Tremco Fire Protection Systems Group
 - k. USG Corporation.

- D. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. 3M Fire Protection Products.
 - b. A/D Fire Protection Systems Inc.
 - c. GCP Applied Technologies Inc.
 - d. Hilti, Inc.
 - e. Johns Manville
 - f. Nelson Firestop Products.
 - g. RectorSeal Corporation.
 - h. Specified Technologies Inc.
 - i. Tremco, Inc.; Tremco Fire Protection Systems Group
 - j. USG Corporation.
 - 2. L-Rating: Not exceeding 5.0 cfm/ft. (0.00775 cu. m/s x m) of joint at both ambient and elevated temperatures.
- E. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- F. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:
 - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.

2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.7 JOINT FIRESTOPPING SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.

3.8 FIRE-RESISTIVE JOINT SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.
- B. Where Intertek ETL SEMKO-listed systems are indicated, they refer to design numbers in Intertek ETL SEMKO's "Directory of Listed Building Products" under product category Firestop Systems.

3.9 FIRE-RESISTIVE JOINT SYSTEMS

- A. Refer to Drawings.

END OF SECTION

SECTION 07 91 00

PREFORMED JOINT SEALS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Preformed, foam joint seals.

1.2 ACTION SUBMITTALS

- A. Product Data: For each preformed joint seal product.
- B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each type and color of preformed joint seal required, provide Samples with joint seals in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint seals.
- D. Preformed Joint Seal Schedule: Include the following information:
 - 1. Joint seal location and designation.
 - 2. Joint width and movement capability.
 - 3. Joint seal manufacturer and product name.
 - 4. Joint seal color.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each preformed joint seal for tests performed by manufacturer and witnessed by a qualified testing agency.

1.4 QUALITY ASSURANCE

- A. Mockups: Install mockups of assemblies specified in other Sections that are indicated to receive preformed joint seals specified in this Section. Use materials and installation methods specified in this Section.

1.5 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace preformed joint seals that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish preformed joint seals to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PREFORMED, FOAM JOINT SEALS

- A. Preformed, Foam Joint Seals: Manufacturer's standard joint seal manufactured from urethane or EVA (ethylene vinyl acetate) foam with minimum density of 10 lb/cu. ft. (160 kg/cu. m) and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths based on design criteria indicated, with factory- or field-applied adhesive for bonding to substrates.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. EMSEAL Joint Systems, Ltd.
 - b. LymTal International Inc.
 - c. MM Systems Corporation.
 - d. Nystrom, Inc.
 - e. Pecora Corporation.

- f. Sandell Manufacturing Co., Inc.
- g. Schul International Company, Inc.
- h. Watson Bowman Acme Corp.
- 2. Design Criteria:
 - a. Nominal Joint Width: As indicated on Drawings.
 - b. Movement Capability: -25 percent/+25 percent.
- 3. Joint Seal Color: As selected by Architect from full range of industry colors.

2.2 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by preformed-joint-seal manufacturer for joint substrates indicated.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to preformed joint seal manufacturer, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces, and formulated to promote best adhesion to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with preformed joint seals and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive preformed joint seals, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting preformed-joint seal performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing preformed joint seals to comply with preformed joint seal manufacturer's written instructions and the following requirements:
 - 1. Remove foreign material from joint substrates that could interfere with adhesion of preformed joint seal, including dust, paints (except for permanent protective coatings tested and approved for seal adhesion and compatibility by seal manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimal bond with preformed joint seals. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Exterior insulation and finish systems.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint seals. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
- B. Joint Priming: Prime joint substrates where recommended by preformed joint seal manufacturer or as indicated by tests or prior experience. Apply primer to comply with joint seal manufacturer's written instructions. Confine primers to areas of joint seal bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of adhesive or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION

- A. General: Comply with preformed joint seal manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Installation of Preformed, Foam Joint Seals:
 - 1. Install each length of seal immediately after removing protective wrapping.
 - 2. Firmly secure compressed joint seals to joint gap side to obtain full bond using exposed pressure-sensitive adhesive or field-applied adhesive as recommended by manufacturer.
 - 3. Do not pull or stretch material. Produce seal continuity at splices, ends, turns, and intersections of joints.
 - 4. For applications at low ambient temperatures, heat foam joint seal material in compliance with manufacturer's written instructions.

3.4 PROTECTION

- A. Protect preformed joint seals from damage resulting from construction operations or other causes so seals are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated seals immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nonstaining silicone joint sealants.
 - 2. Urethane joint sealants.
 - 3. Mildew-resistant joint sealants.
 - 4. Butyl joint sealants.
 - 5. Latex joint sealants.
 - 6. Sealing interior and exterior wall to floor or roof decking/construction for fire resistive or thermal, moisture, or acoustical barrier.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.
- B. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.
- C. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- D. Product Certificates:
 - 1. Certifying the non-metallic plumbing piping system and the fire sprinkler piping system manufacturers evaluated and approved the joint sealant products for installation with or near its piping system.
 - 2. Certifying the joint sealant products comply with NFPA 13 requirements for material compatibility with non-metallic pipe and tubing.
- E. Field-Adhesion-Test Reports: For each sealant application tested.
- F. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

- C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.
 - 3. Stain Testing: Use ASTM C 1248 to determine stain potential of sealant when in contact with masonry substrates.
 - 4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
 - 5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
 - 7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
 - 1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
 - 2. Conduct field tests for each kind of sealant and joint substrate.
 - 3. Notify Architect seven days in advance of dates and times when test joints will be erected.
 - 4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
 - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - 5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
 - 6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.7 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 COORDINATION

- A. Ensure joint sealant products are coordinated and compatible with the non-metallic plumbing piping system and the fire sprinkler piping system.

1.9 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: From date of Substantial Completion.
 - a. Urethane Sealants: 10 years.
 - b. Silicone Sealants: 20 years.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
 - 1. For penetrations involving CPVC piping, provide through-penetration firestop systems which include materials that have been tested to be compatible with CPVC piping.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.
- B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
 - 1. Products: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 795 Silicone Building Sealant (VOC: 28 g/L).
 - b. GE Construction Sealants; Momentive Performance Materials Inc; SCS9000 SilPruf NB (VOC: 37 g/L).
 - c. Pecora Corporation; 864NST (VOC: <100 g/L).
 - d. Sika Corporation Industry Products; Sikasil WS-295 FPS (VOC: 37 g/L)
 - e. Tremco Inc., Tremco CS&W Group; Spectrem 2 (VOC: 42 g/L).

2.3 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. Products: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Master Builders Solutions Construction Systems US, LLC; Aktiengesellschaft; MasterSeal TX1 (VOC: 36 g/L).
 - b. C.R. Laurence Co, Inc.; CRL M64 (VOC: 9 g/L).
 - c. Pecora Corporation; DynaTrol I-XL (VOC: <100 g/L).
 - d. Sika Corporation Industry Products; Sikaflex Textured Sealant.
 - e. Tremco Inc., Tremco CS&W Group; Vulkem 116 (49 g/L).
- B. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Master Builders Solutions Construction Systems US, LLC; Aktiengesellschaft; MasterSeal SL 1 (VOC: 104 g/L).
 - b. Pecora Corporation; Urexpan NR-201 (VOC: <50 g/L).

- c. Sika Corporation Industry Products; Sikaflex 1c SL (VOC: 40 g/L).
 - C. Urethane, M, P, 50, T, NT: Multicomponent, pourable, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 50, Uses T and NT.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. LymTal International, Inc.; Iso-Flex 888QC.
- 2.4 MILDEW-RESISTANT JOINT SEALANTS
- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
 - B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. C.R. Laurence Co, Inc.; CRL 33S Silicone (VOC: 30 g/L).
 - b. Dow Corning Corporation; 786 Silicone Sealant (VOC: 33 g/L).
 - c. GE Construction Sealants; Momentive Performance Materials Inc.; SCS1700 Sanitary (VOC: 20 g/L).
 - d. Pecora Corporation; Pecora 898NST (VOC: 50 g/L).
 - e. Sika Corporation Industry Products; Sikasil GP (VOC: 29 g/L).
 - f. Soudal Accumetric; Silirub RTV1 (VOC: 30 g/L).
 - g. Tremco Inc., Tremco CS&W Group; Tremsil 200 (VOC: 1 g/L).
- 2.5 BUTYL JOINT SEALANTS
- A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. C.R. Laurence Co, Inc.; CRL 777 Butyl Rubber (VOC: 240 g/L)..
 - b. Pecora Corporation; BC-158 (VOC: <250 g/L).
 - c. Tremco Inc., Tremco CS&W Group; Butyl Sealant (VOC: 232 g/L)
- 2.6 LATEX JOINT SEALANTS
- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. C.R. Laurence Co, Inc.; CRL 321 (VOC: 22 g/L).
 - b. Pecora Corporation; AC-20 (VOC: 20 g/L).
 - c. Tremco Incorporated; Tremflex 834 (VOC: 31 g/L).
- 2.7 JOINT-SEALANT BACKING
- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Alcot Plastics Ltd.; Alcot Plastics Backer Rod.
 - b. Master Builders Solutions Construction Systems US, LLC; Aktiengesellschaft; MasterSeal 920.
 - B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
 - C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.8 SEALING TOP OF WALL TO BOTTOM OF DECKING

- A. Materials for Sealing Top of Wall to Bottom of Decking:
1. For use at non-fire-rated (thermal and/or acoustical) construction: The following products are acceptable for thermal and air seal between top of wall and bottom of deck. At Contractor's option, use one of the following products:
 - a. Closed cell two-component spray-applied polyurethane foam insulation and air barrier:
 - 1) Basis-of-Design Product: Huntsman Building Solutions; Icynene ProSeal.
 - b. Single component, gun-applied, closed cell polyurethane insulating foam sealant for gaps up to 3 inches:
 - 1) Basis-of-Design Product: Dow Chemical Company; Great Stuff Pro, Gaps, and Cracks.
 - c. Firmly pack gaps and voids above the stud track with Mineral Fiber Batt insulation (Refer to Division 07 Thermal or Acoustical Insulation). Caulk gun or trowel apply, and trowel coat to form a continuous seal between top of sheathing and bottom of deck:
 - 1) Basis-of-Design Product: USG; Acoustical Sealant.
 - d. Confirm chemical compatibility of sealant used with adjacent air barrier system(s).
 - e. Where top of wall sealant is used at perimeter wall construction, apply in manner to achieve a continuous air seal from top of air barrier system to bottom of deck, without gaps or voids. Confirm acceptable detail(s) with air barrier system manufacturer. Refer to Division 07 "Air Barrier" Section for air barrier materials.
 - f. Where top of wall sealant will be exposed in finished interior space, apply in a manner to produce an aesthetic finished result, flush with the face of wall. Cut spray foam flush with face of wall and neatly trowel acoustical sealant to a semi-smooth finish, and remove excess material.

2.9 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 3. Remove laitance and form-release agents from concrete.

4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
 4. Provide flush joint profile at locations indicated on Drawings according to Figure 8B in ASTM C 1193.
 5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings according to Figure 8C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.

- b. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.
 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
 1. Joint Locations:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Joints between different materials listed above.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Urethane, M, P, 50, T, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
 1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Control and expansion joints in unit masonry.
 - c. Joints between metal panels.
 - d. Joints between different materials listed above.
 - e. Perimeter joints between materials listed above and frames of openings.
 - f. Control and expansion joints in overhead surfaces.
 - g. Other joints as indicated on Drawings.
 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
 1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.

- b. Control and expansion joints in ceramic tile flooring.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, S, P, 25, T, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Ceramic tile control and expansion joints.
 - c. Vertical joints on exposed surfaces of walls and partitions.
 - d. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, S, NS, 25, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
 - 1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors, and elevator entrances.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Acrylic latex.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- G. Joint-Sealant Application: Concealed mastics.
 - 1. Joint Locations:
 - a. Aluminum thresholds.
 - b. Sill plates.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Butyl-rubber based.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION

SECTION 07 92 19

ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes acoustical joint sealants.

1.2 ACTION SUBMITTALS

- A. Product Data: For each acoustical joint sealant.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Acoustical-Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each kind of acoustical joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.
- B. Sample Warranties: For special warranties.

1.4 COORDINATION

- A. Ensure joint sealant products are coordinated and compatible with the non-metallic plumbing piping system and the fire sprinkler piping system.

1.5 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace acoustical joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish acoustical joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E 90.
- B. Compatibility: Provide sealants composed of components that are compatible with each other, substrates forming openings, and items penetrating sealant under conditions of service and application.
 - 1. For penetrations involving CPVC piping, provide sealants which include materials that have been tested to be compatible with CPVC piping.

2.2 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C 834.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Franklin International; Titebond GREENchoice Professional Acoustical Smoke & Sound Sealant.

- b. GE Construction Sealants; Momentive Performance Materials Inc.
 - c. Grabber Construction Products.
 - d. Hilti, Inc.
 - e. OSI Sealants; Henkel Corporation.
 - f. Pecora Corporation; Pecora AIS-919 Acoustical and Insulation Latex Sealant.
 - g. United States Gypsum Company; SHEETROCK Acoustical Sealant
2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

2.3 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where recommended by acoustical-joint-sealant manufacturer. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

- A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.
- B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C 919, ASTM C 1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.
- C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of acoustical joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect acoustical joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 07 95 13.13

INTERIOR EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes interior expansion joint cover assemblies.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.
- B. Shop Drawings: For each expansion joint cover assembly.
 - 1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams showing entire route of each expansion joint.
 - 2. Where expansion joint cover assemblies change planes, provide isometric or clearly detailed drawing depicting how components interconnect.
- C. Samples for Verification: For each type of expansion joint cover assembly, full width by 6 inches (150 mm) long in size.
- D. Expansion Joint Cover Assembly Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
 - 1. Manufacturer and model number for each expansion joint cover assembly.
 - 2. Expansion joint cover assembly location cross-referenced to Drawings.
 - 3. Nominal, minimum, and maximum joint width.
 - 4. Movement direction.
 - 5. Materials, colors, and finishes.
 - 6. Product options.
 - 7. Fire-resistance ratings.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each fire-resistance-rated expansion joint cover assembly, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.4 QUALITY ASSURANCE

- A. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Build mockup of typical expansion joint cover assembly as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Furnish units in longest practicable lengths to minimize field splicing.
- B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Provide expansion joint cover assemblies with fire barriers identical to those of systems tested for fire resistance according to UL 2079 or ASTM E 1966 by a qualified testing agency.
 - 1. Hose Stream Test: Wall-to-wall and wall-to-ceiling assemblies shall be subjected to hose stream testing.
- B. Expansion Joint Design Criteria:
 - 1. Type of Movement: Thermal.
 - a. Nominal Joint Width: As indicated on Drawings.
 - b. Minimum Joint Width: As indicated on Drawings.
 - c. Maximum Joint Width: As indicated on Drawings.

2.3 FLOOR EXPANSION JOINT COVERS

- A. Center-Plate Floor Joint Cover: Assembly consisting of center plate that slides over metal frames fixed to sides of joint gaps.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
 - b. Balco, Inc.
 - c. Construction Specialties, Inc.
 - d. InPro Corporation (IPC).
 - e. MM Systems Corporation.
 - f. Nystrom, Inc.
 - g. Watson Bowman Acme Corp.
 - 2. Basis-of-Design Product: Construction Specialties, Inc.; RFC.
 - 3. Application: Floor to floor.
 - 4. Installation: Surface mounted .
 - 5. Load Capacity:
 - a. Uniform Load: 50 lb/sq. ft. (244 kg/sq. m).
 - b. Concentrated Load: 300 lb (136 kg).
 - c. Maximum Deflection: 0.0625 inch (1.6 mm).
 - 6. Fire-Resistance Rating: Not less than that of adjacent construction .
 - 7. Cover-Plate Design: Plain .
 - 8. Exposed Metal:
 - a. Aluminum: Clear anodic, Class I .
- B. Center-Plate Floor Joint Cover: Assembly consisting of center plate that slides over metal frames fixed to sides of joint gaps.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
 - b. Balco, Inc.
 - c. Construction Specialties, Inc.
 - d. InPro Corporation (IPC).
 - e. MM Systems Corporation.
 - f. Nystrom, Inc.
 - g. Watson Bowman Acme Corp.
 - 2. Basis-of-Design Product: Construction Specialties, Inc.; RFWC.
 - 3. Application: Floor to wall.
 - 4. Installation: Surface mounted.
 - 5. Load Capacity:
 - a. Uniform Load: 50 lb/sq. ft. (244 kg/sq. m).
 - b. Concentrated Load: 300 lb (136 kg).
 - c. Maximum Deflection: 0.0625 inch (1.6 mm).
 - 6. Fire-Resistance Rating: Not less than that of adjacent construction .
 - 7. Cover-Plate Design: Plain.
 - 8. Exposed Metal:
 - a. Aluminum: Clear anodic, Class I.

- C. Glide-Plate Floor Joint Cover: Assembly consisting of center plate that slides in and out of slots in metal frames fixed to sides of joint gap.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
 - b. Balco, Inc.
 - c. Construction Specialties, Inc.
 - d. InPro Corporation (IPC).
 - e. MM Systems Corporation.
 - f. Nystrom, Inc.
 - g. Watson Bowman Acme Corp.
 2. Basis-of-Design Product: Construction Specialties, Inc.; RFC Series.
 3. Application: Floor to floor.
 4. Installation: Recessed.
 5. Load Capacity:
 - a. Uniform Load: 50 lb/sq. ft. (244 kg/sq. m).
 - b. Concentrated Load: 300 lb (136 kg).
 - c. Maximum Deflection: 0.0625 inch (1.6 mm).
 6. Fire-Resistance Rating: Not less than that of adjacent construction .
 7. Exposed Metal:
 - a. Aluminum: Clear anodic, Class I .

2.4 WALL EXPANSION JOINT COVERS

- A. Elastomeric-Seal Wall Joint Cover: Assembly consisting of elastomeric seal anchored to frames fixed to sides of joint gap.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
 - b. Balco, Inc.
 - c. Construction Specialties, Inc.
 - d. InPro Corporation (IPC).
 - e. MM Systems Corporation.
 - f. Nystrom, Inc.
 - g. Watson Bowman Acme Corp.
 2. Basis-of-Design Product: Construction Specialties, Inc.; GTW.
 3. Application: Wall to wall.
 4. Fire-Resistance Rating: Not less than that of adjacent construction .
 5. Exposed Metal:
 - a. Aluminum: Clear anodic, Class I .
 6. Seal: Preformed elastomeric membranes or extrusions.
 - a. Color: As selected by Architect from manufacturer's full range.
- B. Elastomeric-Seal Wall Joint Cover: Assembly consisting of elastomeric seal anchored to frames fixed to sides of joint gap.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
 - b. Balco, Inc.
 - c. Construction Specialties, Inc.
 - d. InPro Corporation (IPC).
 - e. MM Systems Corporation.
 - f. Nystrom, Inc.
 - g. Watson Bowman Acme Corp.
 2. Basis-of-Design Product: Construction Specialties, Inc.; GTWC.
 3. Application: Wall to corner.
 4. Fire-Resistance Rating: Not less than that of adjacent construction.
 5. Exposed Metal:
 - a. Aluminum: Clear anodic, Class I .
 6. Seal: Preformed elastomeric membranes or extrusions.
 - a. Color: As selected by Architect from manufacturer's full range.

2.5 MATERIALS

- A. Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 for extrusions; ASTM B 209 (ASTM B 209M), Alloy 6061-T6 for sheet and plate.
 - 1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
- B. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes or extrusions to be installed in metal frames.
- C. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to comply with performance criteria for required fire-resistance rating.
- D. Moisture Barrier: Manufacturer's standard, flexible elastomeric material.
- E. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.7 ACCESSORIES

- A. Moisture Barriers: Manufacturer's standard continuous, waterproof membrane within joint and attached to substrate on sides of joint.
 - 1. Provide where indicated on Drawings.
- B. Manufacturer's standard attachment devices. Include anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces where expansion joint cover assemblies will be installed for installation tolerances and other conditions affecting performance of the Work.
- B. Notify Architect where discrepancies occur that will affect proper expansion joint cover assembly installation and performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.
- B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.
- B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.
 - 1. Repair or grout block out as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
 - 2. Install frames in continuous contact with adjacent surfaces.
 - a. Shimming is not permitted.
 - 3. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
 - 4. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
 - 5. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.

6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.
 - C. Seals: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
 1. Provide in continuous lengths for straight sections.
 2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
 3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
 - D. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.
 - E. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.
 - F. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion joint cover assembly materials and associated work so complete assemblies comply with performance requirements.
 1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.
 - G. Moisture Barrier Drainage: If indicated, provide drainage fittings and connect to drains.
- 3.4 PROTECTION
- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
 - B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion joint cover assemblies. Reinstall cover plates or seals prior to Substantial Completion.

END OF SECTION

SECTION 07 95 13.16

EXTERIOR EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes exterior building expansion joint cover assemblies.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.
- B. Shop Drawings: For each expansion joint cover assembly.
 - 1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams showing entire route of each expansion joint.
 - 2. Where expansion joint cover assemblies change planes, provide isometric or clearly detailed drawing depicting how components interconnect.
- C. Samples for Verification: For each type of expansion joint cover assembly, full width by 6 inches (150 mm) long in size.
- D. Expansion Joint Cover Assembly Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
 - 1. Manufacturer and model number for each expansion joint cover assembly.
 - 2. Expansion joint cover assembly location cross-referenced to Drawings.
 - 3. Nominal, minimum, and maximum joint width.
 - 4. Movement direction.
 - 5. Materials, colors, and finishes.
 - 6. Product options.
 - 7. Fire-resistance ratings.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each fire-resistance-rated expansion joint cover assembly, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.4 QUALITY ASSURANCE

- A. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Build mockup of typical expansion joint cover assembly as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Furnish units in longest practicable lengths to minimize field splicing.
- B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Provide expansion joint cover assemblies with fire barriers identical to those of systems tested for fire resistance according to UL 2079 or ASTM E 1966 by a qualified testing agency.

1. Hose Stream Test: Wall-to-wall and wall-to-soffit assemblies shall be subjected to hose stream testing.
 - B. Expansion Joint Design Criteria:
 1. Type of Movement: Thermal.
 - a. Nominal Joint Width: As indicated on Drawings.
 - b. Minimum Joint Width: As indicated on Drawings.
 - c. Maximum Joint Width: As indicated on Drawings.
- 2.3 EXTERIOR EXPANSION JOINT COVERS
- A. Basis-of-Design Product: Subject to compliance with requirements, provide products by one of the following:
 1. Balco, Inc.
 2. Construction Specialties, Inc.
 3. MM Systems, Inc.
 - B. Source Limitations: Obtain expansion control systems from single source and from single manufacturer.
 - C. Vapor Barrier:
 1. Basis-of-Design Product: Construction Specialties, Inc.; VB.
 - a. Type: Flexible waterproof joint backup.
 - b. Location: Use at face of sheathing, behind exterior expansion joint covers, and sealed into adjacent waterproofing, air barrier, or weatherization systems on either side. Coordinate transition / installation detailing acceptable to air barrier and weatherization systems with which this product interfaces.
 - D. Wall-to-Wall:
 1. Basis-of-Design Product: Construction Specialties, Inc.; VF.
 2. Design Criteria:
 - a. Nominal Joint Width: 1 inch.
 - b. Type of Movement: Thermal, moisture, structural / tear away.
 - c. Finish: As selected by Architect from manufacturer's standard range of colors.
- 2.4 MATERIALS
- A. Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 for extrusions; ASTM B 209 (ASTM B 209M), Alloy 6061-T6 for sheet and plate.
 1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
 - B. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes or extrusions to be installed in metal frames.
 - C. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to comply with performance criteria for required fire-resistance rating.
 - D. Moisture Barrier: Manufacturer's standard, flexible elastomeric material.
- 2.5 ALUMINUM FINISHES
- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
- 2.6 ACCESSORIES
- A. Moisture Barriers: Manufacturer's standard continuous, waterproof membrane within joint and attached to substrate on sides of joint.
 1. Provide where indicated on Drawings.
 - B. Manufacturer's standard attachment devices. Include anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces where expansion joint cover assemblies will be installed for installation tolerances and other conditions affecting performance of the Work.
- B. Notify Architect where discrepancies occur that will affect proper expansion joint cover assembly installation and performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.
- B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.
- B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.
 - 1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
 - 2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
 - 3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
 - 4. Install frames in continuous contact with adjacent surfaces.
 - a. Shimming is not permitted.
 - 5. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.
- C. Seals: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
 - 1. Provide in continuous lengths for straight sections.
 - 2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
 - 3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
- D. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.
- E. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.
- F. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion joint cover assembly materials and associated work so complete assemblies comply with performance requirements.
 - 1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.
- G. Moisture Barrier Drainage: If indicated, provide drainage fitting and connect to drains.

3.4 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect the installation from damage by work of other Sections.

END OF SECTION

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Interior standard steel doors and frames.
 - 2. Exterior standard steel doors and frames.

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.3 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference in compliance with requirements in Division 01 with attendance by representatives of Supplier, Door and Door Hardware Installer(s), Security System Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
 - 7. Details of anchorages, joints, field splices, and connections.
 - 8. Details of accessories.
 - 9. Details of moldings, removable stops, and glazing.
 - 10. Insulation values for exterior doors and frames.
- C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For door inspector.
 - 1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
 - 2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
 - 3. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.

- B. Product Test Reports: For each type of fire-rated hollow-metal door and frame assembly for tests performed by a qualified testing agency indicating compliance with performance requirements.
- C. Field quality control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.
- B. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:
 - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.
- C. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies shall meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:
 - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jams and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ceco Door; ASSA ABLOY.
 - 2. Curries Company; ASSA ABLOY.
 - 3. DE LA FONTAINE.
 - 4. Fleming Door Products Ltd.; ASSA ABLOY.
 - 5. Gensteel Doors, Inc.
 - 6. Hollow Metal Xpress.
 - 7. Mesker Door Inc.
 - 8. Republic Doors and Frames.
 - 9. Steelcraft; an Allegion brand.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.
 - 2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
- B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing in accordance with NFPA 257 or UL 9.
- C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.50 deg Btu/F x h x sq. ft. (2.84 W/K x sq. m) when tested in accordance with ASTM C518.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B..
 - 1. Doors:
 - a. Thickness: 1-3/4 inches (44.5 mm).
 - b. Face: Uncoated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
 - c. Edge Construction: Model 2, Seamless.
 - d. Edge Bevel: Provide manufacturer's standard beveled or square edges.
 - e. Core: Manufacturer's standard.
 - f. Fire-Rated Core: Manufacturer's standard core for fire-rated and temperature-rise-rated doors.
 - g. Use other core type(s) where required to achieve indicated R-values, STC ratings, and fire ratings, as approved by Architect.
 - h. Where doors are indicated in partitions required to comply with STC rating, the door STC rating shall be equal to or greater than the partition in which the door is located, unless otherwise noted.
 - 2. Frames:
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
 - b. Sidelite Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction: Face welded.
 - d. Frame Size: As scheduled on Drawings.
 - 3. Exposed Finish: Prime.

2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A..
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A60 (ZF180) coating.
 - d. Edge Construction: Model 2, Seamless.
 - e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
 - f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
 - g. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
 - h. Core: Polyurethane.
 - i. Fire-Rated Core: Manufacturer's standard core for fire-rated doors.
 - j. Exterior doors and doors between conditioned and unconditioned spaces, shall have a minimum R value of 4.
 - k. Where doors are indicated in partitions required to comply with STC rating, the door STC rating shall be equal to or greater than the partition in which the door is located, unless otherwise noted.
 - 2. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A60 (ZF180) coating.
 - b. Construction: Full profile welded.
 - c. Frame Size: As scheduled on Drawings.
 - 3. Exposed Finish: Prime.

2.5 BORROWED LITES

- A. Fabricate of uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
- B. Construction: Face welded.

- C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.
- D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.6 HOLLOW-METAL PANELS

- A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

2.7 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 - 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
 - 3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.8 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- G. Glazing: Comply with requirements in Section 08 80 00 "Glazing."
- H. Sound deadening pack door frame tightly with mineral fiber batt insulation.

2.9 FABRICATION

- A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 - 1. Sidelite Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding, or by rigid mechanical anchors.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
 - C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
 - D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.
 1. Provide stops and moldings flush with face of door, and with beveled stops unless otherwise indicated.
 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
 4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
 5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.
- 2.10 STEEL FINISHES
- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
 - B. Field Painting: Refer to Drawings for paint finish.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
 3. Floor Anchors: Secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 4. Solidly pack mineral-fiber insulation inside frames.
 5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.

6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
 - C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
 1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
 2. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.
 3. Smoke-Control Doors: Install doors in accordance with NFPA 105.
 - D. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with hollow-metal manufacturer's written instructions.
- 3.3 FIELD QUALITY CONTROL
- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
 - B. Inspections:
 1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
 2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.
 - C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
 - D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
 - E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.
- 3.4 REPAIR
- A. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION

SECTION 08 11 69

METAL STORM DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Metal storm fire-rated door and frame assembly systems.

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to SDI A250.8.

1.3 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, joints, field splices, and connections.
 - 7. Details of accessories.
 - 8. Details of moldings, removable stops, and glazing.
 - 9. Details of conduit and preparations for power, signal, and control systems.
- C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jams and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Conform to the Federal Emergency Management Agency (FEMA) 320 AND 361 guidelines and ANSI ICC 500-2020 standards providing security and safety for tornado shelters and severe storm areas of refuge.
 - 1. Provide label on assembly denoting compliance with requirements.

2.2 MANUFACTURERS

- A. Available Manufacturers:
 - 1. Amweld International, LLC.
 - 2. Ceco Door Products; an Assa Abloy Group company.
 - 3. Curries Company; an Assa Abloy Group company.
 - 4. Deansteel.
 - 5. Mesker Door Inc.
 - 6. Pioneer Industries, Inc.
 - 7. Republic Doors and Frames.
 - 8. Steelcraft; an Allegion.
- B. Basis of Design: Steelcraft, PW14 Paladin Series Doors and FP14 Paladin Series Frames.
- C. Source Limitations:
 - 1. Obtain interior hollow-metal work from single source from single manufacturer.

2.3 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
- B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.4 INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames SDI A250.8, Level 2.
 - 1. Physical Performance: Level B according to SDI A250.4.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule on Drawings.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Galvannealed, cold-rolled steel sheet, minimum thickness of 0.67 inch (1.7 mm).
 - d. Edge Construction: Model 2, Seamless.
 - e. Core: Kraft-paper honeycomb with Vertical steel stiffener.
 - f. Fire-Rated Core: Manufacturer's standard core for fire-rated and temperature-rise-rated doors.
 - 3. Frames:
 - a. Materials: Galvannealed steel sheet, minimum thickness of 0.067 inch (1.7 mm).
 - b. Construction: Fully welded.
 - c. Throat Width: Coordinate throat width with partition thickness, increase throat width to accommodate heavy gage metal studs.
 - d. Exposed Finish: Prime.

2.5 FRAME ANCHORS

- A. Jamb Anchored.
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
 - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
 - 3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 - 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.6 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- G. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.
- H. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.7 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
 - 1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch (0.66 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart. Spot weld to face sheets no more than 5 inches (127 mm) o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
 - 2. Fire Door Cores: As required to provide fire-protection and temperature-rise ratings indicated.
 - 3. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches (3.2 mm in 51 mm).
 - 4. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
 - 5. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.

- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 3. Grout Guards (if required): Weld guards to frame at back of hardware mortises in frames to be grouted.
 4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:
 - 1) Two anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
 - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
 - c. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
 6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 4. Provide loose stops and moldings on inside of hollow-metal work.
 5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
- G. Head Reinforcement: Provide minimum of 0.093-inch- (2.3-mm-) thick, steel channel or angle stiffener for opening widths more than 48 inches (1219 mm).

2.8 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.9 ACCESSORIES

- A. Grout Guards (if required): Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 as required by standards specified.
1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 3. Metal-Stud Partitions with Openings Requiring Ratings and Temperature-Rise Limits: Solidly pack mineral-fiber insulation inside frames.
 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 5. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 6. In-Place Metal -Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
 7. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 - 2. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

3.4 FIELD QUALITY CONTROL

- A. Refer to Section 01 40 00 "Quality Requirements." Contractor Quality Control Representative shall perform contractor quality control inspections.
 - 1. Inspect door installation, fit and clearance. Verify required FEMA 361/ICC 500 label.
 - 2. Inspect fire door label for specified fire test ratings and requirements.
 - 3. Inspect door hardware installation and operation for conformance with FEMA 361/ICC 500 requirements.
 - 4. Document preparatory, initial and follow-up inspection in Contractor's Test and Inspection Reports.
 - 5. Test and Inspection Reports shall be available to Architect upon request.
- B. Hardware Supplier Field Services: At completion of hardware installation hardware consultant to inspect tornado shelter storm door hardware installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's installation instructions and conforming to the Storm Shelter Requirements.
- C. Correct deficiencies in products and installation found not to be in compliance with Contract Documents.

3.5 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

END OF SECTION

SECTION 08 14 16
FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid-core flush wood doors with plastic-laminate-faces.
 - 2. Factory fitting flush wood doors to frames and factory machining for hardware.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product, including the following:
 - 1. Door core materials and construction.
 - 2. Door edge construction
 - 3. Door face type and characteristics.
 - 4. Factory-machining criteria.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:
 - 1. Door schedule indicating door location, type, size, fire protection rating, and swing.
 - 2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
 - 3. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
 - 4. Dimensions and locations of blocking for hardware attachment.
 - 5. Dimensions and locations of mortises and holes for hardware.
 - 6. Clearances and undercuts.
 - 7. Requirements for veneer matching.
- C. Samples for Verification:
 - 1. Plastic laminate, 6 inches (150 mm) square, for each color, texture, and pattern selected.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Special warranties.

1.5 QUALITY ASSURANCE

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies shall comply with qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
 - 1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.
- B. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies shall comply with qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:
 - 1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until building is enclosed and weathertight, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during remainder of construction period.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Delamination of veneer.
 - b. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
 - c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.
 - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Wood Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with UL 10C.
 - 1. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
- B. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

2.3 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with AWI/AWMAC/WI's "Architectural Woodwork Standards." and ANSI/WDMA I.S. 1A.
 - 1. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with the Contract Documents in addition to those of the referenced quality standard.

2.4 SOLID-CORE FLUSH WOOD DOORS WITH PLASTIC-LAMINATE FACES

- A. Interior Doors:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. ABS-American Building Supply, Inc.; a Jeld-Wen Company.
 - b. ASSA ABLOY.
 - c. Eggers Industries.; a VT Industries Inc. Company.
 - d. Haley Brothers, Inc.
 - e. Lambton Doors.

- f. Oregon Door.
- g. Oshkosh Door Company.
- h. VT Industries Inc.
- 2. Performance Grade:
 - a. ANSI/WDMA I.S. 1A Heavy Duty unless otherwise indicated on Drawings.
 - b. ANSI/WDMA I.S. 1A Extra Heavy Duty: public toilets, janitor's closets, exits, and where indicated on Drawings.
- 3. Architectural Woodwork Standards Grade: Custom.
- 4. Plastic-Laminate Faces: High-pressure decorative laminates complying with NEMA LD 3, Grade HGS.
- 5. Colors, Patterns, and Finishes: As scheduled.
- 6. Exposed Vertical and Top Edges: Hardwood edges for staining to match faces.
 - a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
 - b. Fire-Rated Pairs of Doors: Provide formed-steel edges and astragals with intumescent seals.
 - 1) Finish steel edges and astragals with baked enamel same color as doors.
 - c. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
 - 1) Screw-Holding Capability: 475 lbf (2110 N) in accordance with WDMA T.M. 10.
- 7. Core for Non-Fire-Rated Doors:
 - a. ANSI A208.1, Grade LD-1 particleboard.
 - 1) Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
 - 2) Provide doors with glued-wood-stave or WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 08 71 00 "Door Hardware."
- 8. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.
 - a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as needed to eliminate through-bolting hardware.
- 9. Construction: Three plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before faces are applied.

2.5 LIGHT FRAMES

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.
 - 1. Wood Species: Same species as door faces.
 - 2. Profile: Manufacturer's standard shape.
 - 3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.
- B. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch- (1.2-mm-) thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish; and approved for use in doors of fire-protection rating indicated on Drawings.

2.6 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated.
 - 1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 - 2. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
 - 1. Locate hardware to comply with DHI-WDHS-3.
 - 2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
 - 3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.

4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
 5. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Openings: Factory cut and trim openings through doors.
1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. Glazing: Factory install glazing in doors. Comply with applicable requirements in Section 08 80 00 "Glazing."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 08 71 00 "Door Hardware."
- B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Install frames level, plumb, true, and straight.
1. Install fire-rated doors and frames in accordance with NFPA 80.
 2. Install smoke- and draft-control doors in accordance with NFPA 105.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
 2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80.

3.4 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 08 31 13

ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide access doors and frames for walls and ceilings as indicated on Drawings and as required for access to equipment and by Authorities Having Jurisdiction, whether or not locations for access doors and frames are specifically indicated on Drawings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For access doors and frames.
- C. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.
- D. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items with concealed framing, suspension systems, piping, ductwork, and other construction. Show the following:
 - 1. Method of attaching door frames to surround construction.
 - 2. Ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, and special trim.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing and inspecting agency.
 - 1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, section 5.2.3.1.

1.4 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

1.5 QUALITY ASSURANCE

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:
 - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

1.6 COORDINATION

- A. Verification: Coordinate with other trades to determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, electrical, or other concealed work.
 - 1. Size panels as required by controls to be accessed. Provide adequate sizes to service equipment accessed by doors and panels, and acceptable to authorities having jurisdiction.
 - 2. For replacement of access doors in existing construction, field measure to match existing opening sizes.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection and temperature-rise limit ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

- A. Flush Access Doors with Concealed Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Acudor Products, Inc.
- b. Babcock-Davis.
- c. J. L. Industries; a division of Activar Construction Products Group.
- d. Karp Associates, Inc.
- e. Larsen's Manufacturing Company.
- f. Milcor Inc.
- g. Nystrom, Inc.
2. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
3. Locations: Wall surfaces and gypsum board ceilings. Install at all locations where valves or controls are concealed within walls, whether specifically shown on Drawings or not.
4. Door Size: 30 by 30 inches where intended for passage, and sizes as required for intended service purpose in other locations.
5. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage, factory primed.
6. Stainless Steel Sheet for Door: Nominal 0.062 inch (1.59 mm), 16 gage, ASTM A480/A480M No. 4 finish.
7. Frame Material: Same material and thickness as door.
8. Latch and Lock: Cam latch, screwdriver operated.

2.3 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush Access Doors with Concealed Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Acudor Products, Inc.
 - b. Babcock-Davis.
 - c. J. L. Industries; a division of Activar Construction Products Group.
 - d. Karp Associates, Inc.
 - e. Larsen's Manufacturing Company.
 - f. Milcor Inc.
 - g. Nystrom, Inc.
2. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with concealed flange for gypsum board installation, self-closing door, and concealed hinge.
3. Locations: Wall surfaces and gypsum board ceilings. Install at all locations where valves or controls are concealed within walls, whether specifically shown on Drawings or not.
4. Door Size: 30 by 30 inches where intended for passage, and sizes as required for intended service purpose in other locations.
5. Fire-Resistance Rating: Not less than that of adjacent construction.
6. Temperature-Rise Rating: 450 deg F (250 deg C) at the end of 30 minutes.
7. Uncoated Steel Sheet for Door: Nominal 0.036 inch (0.91 mm), 20 gage, factory primed.
8. Frame Material: Same material, thickness, and finish as door.
9. Latch and Lock: Self-closing, self-latching door hardware, operated by knurled-knob.

2.4 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- C. Stainless Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.
- D. Frame Anchors: Same material as door face.
- E. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.5 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 - 1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
- D. Latch and Lock Hardware:
 - 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.

2.6 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
- E. Stainless Steel Finishes:
 - 1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 - 2. Polished Finish: ASTM A480/A480M No. 4 finish. Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 3. Run grain of directional finishes with long dimension of each piece.
 - a. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
 - 1. Fire-Rated Door Inspections: Inspect each fire-rated access door in accordance with NFPA 80, section 5.2.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated access door indicating compliance with each item listed in NFPA 80.

3.4 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

3.5 SCHEDULE

- A. Provide access doors where indicated and in the following locations:
 - 1. Access required by code.
 - 2. Access required for servicing operable, adjustable, or resettable fire suppression, plumbing, mechanical, electrical, life safety, security, and communication systems.
- B. Sizes: Provide the following unless noted otherwise:
 - 1. Ceilings and Soffits: 24 inches by 24 inches minimum.
 - 2. Toilet Rooms: 12 inches by 12 inches minimum at each fixture chase wall.
- C. Materials:
 - 1. Uncoated steel sheet unless noted otherwise.
 - 2. Stainless Steel:
 - a. Toilet rooms, locker rooms, and food service areas.
 - b. Walls scheduled to receive tile finish, epoxy paint, or FRP panels.

END OF SECTION

SECTION 08 33 00

SIDE-ACTING FIRE AND SMOKE RATED DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Side-acting fire and smoke rated doors with integral egress doors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Furnish shop drawings for architect's approval. Include elevations, sections, and details indicating dimensions, materials, finishes, conditions for anchorage and support of each door.
- C. Certifications:
 - 1. Submit manufacturer's Underwriters Laboratories, Intertek or Factory Mutual laboratory testing listing report verifying product compliance in accordance with the required fire and smoke ratings.
 - 2. Submit manufacturer's Code Compliance Research Report published by an independent third-party testing agency that is certified by the International Accreditation Service confirming compliance of the fire door assembly in accordance with the International Building Code.
 - 3. Provide assemblies that have been tested, certified and labeled for a minimum 3-hour rating.

1.3 INFORMATIONAL SUBMITTALS

- A. Maintenance and Operating Manuals: Furnish complete manuals describing the materials, devices and procedures to be followed in operating and maintaining all doors under this section. Include manufacturer's brochures and parts lists describing the actual materials used in the product.

1.4 QUALITY ASSURANCE

- A. Fire and Smoke Rated Assemblies: Provide all doors with fire and smoke resistance rating required to comply with governing regulations which are inspected, tested, listed and labeled by Underwriters Laboratories, Intertek or Factory Mutual and complying with NFPA 80 for class of opening. Provide units tested in accordance with the requirements of UL 10B, UL 1784, NFPA 252, ASTM E-152. Provide testing laboratory label permanently fastened to each fire and smoke door assembly.
- B. Regulatory Requirements:
 - 1. Comply with applicable requirements of the laws, codes, ordinances and regulations of federal, state and municipal authorities having jurisdiction.
 - 2. Listed under a certified Code Compliance Research Report in accordance with the applicable sections of the International Building Code.
- C. Testing: Provide documentation from a certified testing agency that the fire door's self-closing governor mechanism and fire door operator have been tested for a minimum of 50,000 cycles and 500 self closing trip tests.
- D. Manufacturer Requirements: Door manufacturer shall have been in the business of and have experience in manufacturing the type of product covered under this specification section as well as giving credible service for a minimum of five (5) years. Provide list of at least ten (10) completed projects which include the products covered under this section.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. General: Deliver and store materials in manufacturer's original packaging, labeled to show name, brand and type. Store materials in a protected dry location off the ground in accordance with manufacturer's instructions.

1.6 WARRANTY

- A. Door Warranty: Provide Two (2) Year Warranty signed by the manufacturer and installer agreeing to repair or replace work which has failed as a result of defects in materials or workmanship. Upon notification within the warranty period, such defects shall be repaired at no cost to the Owner.

PART 2 - PRODUCTS

2.1 SIDE-ACTING FIRE AND SMOKE RATED DOORS WITH INTEGRAL EGRESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. McKEON.
- B. Basis-of-Design Product: McKEON; Safescape S7902.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

2.3 MATERIALS

- A. General: Each unit shall consist of an interlocking slat curtain designed to travel in a horizontal plane, smoothly and without binding. Curtain shall be driven to the open and closed position by a positive action sprocket and integral endless drive chain system.
- B. Curtain: Shall be fabricated of G90 galvanized steel interlocking slats with an approximate cross section not less than 3 inches wide by 7/8-inch deep.
- C. Leading Edge: Curtain shall be furnished with a structural steel member of tubular design to provide stiffness, limit deflection and provide for a tight fitting closure.
- D. Receiving Edge: Shall be fabricated of a steel member with sufficient depth, designed to accept the leading edge and form a tight fitting closure when the door is the fully closed position.
- E. Swinging Egress Doors: Incorporated within the curtain shall be swinging type steel doors designed and built as an integral part of the fire door's assembly.
 - 1. Door Frames: Shall be an all-steel unit type ASTM A366 hot rolled steel, 14 gauge with the same labeled fire resistance rating as specified for door.
 - 2. Door Assemblies: Complete with doors, hinges, and locking channel mechanisms. 20 gauge stretcher leveled, electro galvanized and bonderized steel faces.
 - 3. Hardware:
 - a. Fire Exit Device: Flush mounted integral type fire exit devices on one face and with pull handles on opposite face of the swinging doors.
 - b. Closers: Shall be concealed type.
- F. Head Track: Shall be of not less than 1/8" thick steel and shall be provided with an integral locking bar. The faying surface shall not be less than 38% of the flat plate area when the door is in the closed position. Locking bar shall lock and retain the curtain in place.
- G. Floor Track: Shall be no greater than 1½" deep and include integral removable stainless steel protective cover plates to allow for easy cleaning and proper maintenance.
- H. Perimeter Smoke Seals: Provide internal, fully concealed UL Classified smoke seals located within the head track assembly. Externally mounted smoke seals shall not be acceptable.
- I. Counterbalance Unit: The fire door shall be counterbalanced by means of adjustable steel counterweight system that is to be located in an area as indicated in the construction drawings.
- J. Electric Motor Operator: Fire door shall be provided with a compact power unit designed and built by the door manufacturer. Operator shall be equipped with an adjustable screw-type limit switch to break the circuit at termination of travel. High efficiency planetary gearing running in an oil bath, shall be furnished together with a centrifugal governor, magnetic operated brake and a fail-safe magnetic release device, completely housed to protect against damage, dust and moisture. An efficient overload protection device, which will break the power circuit and protect against damage to the motor windings shall be integral with the unit. Operator is to be housed in a NEMA type 1 enclosure.
 - 1. Motor: Shall be intermediate duty, thermally protected, ball bearing type with a class A or better insulation. Horsepower of motor is to be 1/3hp minimum or of manufacturer's recommended size, which ever is greater.
 - 2. Starter: Shall be size "0" magnetic reversing starter, across the line type with mechanical and electrical interlocks, with 10 amp continuous rating and 24 volt control circuit.
 - 3. Reducer: Planetary gear type, 80% efficiency minimum.
 - 4. Brake: Magnetically activated, integral within the operator's housing.
 - 5. Control Station: Provide flush mount key switch control station marked open, close and stop.

- K. Self-Closing Mechanism: The fire door is to be designed with a centrifugal governor as an integral part of the operator's construction. The automatic release mechanism shall be activated by smoke detector or fire alarm. When activated the door is released and begins to close due to the captured counterweight force. The speed of the door shall be governed by a centrifugal governor, designed to match the normal operating speed of the door, at a rate of not greater than 9" per second or less than 6" per second. The fire door shall self-close under its own power. Battery back-up systems to achieve self-closing are not acceptable.
- L. Magnetic Release with 10 Second Time Delay: A fail-safe magnetic release device shall be built into the operator as an integral part of the release mechanism. When power is interrupted to the release mechanism by the smoke detector or fire alarm, the door shall begin to self-close. In the event of power failure the time delay shall prevent the fire door from closing for a period of 10 seconds. Once the 10 seconds have lapsed, the fire door shall self-close without the aid of electricity or battery back-up systems. Once power has been restored the automatic reset time delay as well as the fire door shall reset themselves.
- M. Obstruction Sensing Device: The fire door shall be designed with a radio activated obstruction sensing safety edge. In the event that the safety edge meets an obstruction during the normal closing operation, the door shall stop, reverse and return to the open position. In the event the safety edge meets an obstruction during the self-closing operation, the door shall reverse and attempt to close three times. In the event that the obstruction has not been removed during the third attempt, the door shall come to rest on the obstruction and once the obstruction has been removed the fire door shall continue to the fully closed position.
- N. Easy Trip Test Feature: The fire door shall be designed so that it may be trip tested simply by cutting power to the operator. By turning the power switch off, the door shall self-close. Once the fire door has satisfactorily closed, it shall be reset simply by turning the power back on. No ladders or tools shall be needed to reset the door or the time delay unit.
- O. Finish: After completion of fabrication, clean all metal surfaces to remove dirt and chemically treat to provide for powder coat adhesion. Provide powder coat finish of color as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and field conditions to which this work is to be performed and notify architect if conditions of surfaces exist which are detrimental to proper installation and timely completion of work.
- B. Verify all dimensions taken at job site affecting the work. Notify the architect in any instance where dimensions vary.
- C. Coordinate and schedule work under this section with work of other sections so as not to delay job progress.

3.2 INSTALLATION

- A. Perform installation using only factory approved and certified representatives of the door manufacturer.
- B. Install door assemblies at locations shown in perfect alignment and elevation, plumb, level, straight and true.
- C. Adjust door installation to provide uniform clearances and smooth non-binding operation.
- D. Install wiring in accordance with applicable local codes and the National Electrical Code Standard. Materials shall be UL listed.
- E. Test door closing sequence when activated by the building's fire alarm system. Reset door after successful test.

3.3 PROTECTION AND CLEANING

- A. Protect installed work using adequate and suitable means during and after installation until accepted by owner.
- B. Remove, repair or replace materials which have been damaged in any way.
- C. Clean surfaces of grime and dirt using acceptable and recommended means and methods.

END OF SECTION

SECTION 08 33 13

COILING COUNTER DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Counter doors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type and size of coiling counter door and accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
 - 3. Include description of automatic closing device and testing and resetting instructions.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 4. Show locations of controls, locking devices, and other accessories.
 - 5. Include diagrams for power, signal, and control wiring.
- C. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:
 - 1. Curtain slats.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For coiling counter doors to include in maintenance manuals.
- B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
 - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain coiling counter doors from single source from single manufacturer.

2.2 COUNTER DOOR ASSEMBLY

- A. Counter Door: Coiling counter door formed with curtain of interlocking metal slats.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. C.H.I. Overhead Doors, Inc.
 - b. Clopay Building Products.

- c. Overhead Door Company.
- 2. Basis-of-Design Product: Overhead Door Company; Model 650.
- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
 - 1. Include tamperproof cycle counter.
- C. Door Curtain Material: Galvanized steel.
- D. Door Curtain Slats: Flat profile slats of 1-1/4-inch (32-mm) center-to-center height.
 - 1. Gasket Seal. Manufacturer's standard continuous gaskets between slats.
- E. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, fabricated stainless steel and finished to match door.
- F. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.
- G. Hood: Galvanized steel.
 - 1. Shape: As indicated on Drawings.
 - 2. Mounting: As indicated on Drawings.
- H. Locking Devices: Equip door with slide bolt for padlock.
- I. Manual Door Operator: Push-up operation.
- J. Curtain Accessories: Equip door with push/pull handles.
- K. Door Finish:
 - 1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.

2.3 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate coiling counter door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
 - 1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm); and as required.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.4 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
 - 1. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized-steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.
- B. Integral Frame, Hood, and Fascia: Welded sheet metal assembly of the following sheet metal(s):
 - 1. Galvanized Steel: Hot-dip galvanized-steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.

2.5 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

2.6 CURTAIN ACCESSORIES

- A. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

2.7 COUNTERBALANCE MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.8 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Push-up Door Operation: Design counterbalance mechanism so that required lift or pull for door operation does not exceed 25 lbf (111 N).

2.9 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.10 ALUMINUM FINISHES

- A. Mill Finish: Manufacturer's standard.

2.11 STEEL AND GALVANIZED-STEEL FINISHES

- A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrate areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install coiling counter doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install coiling counter doors, hoods, controls, and operators at the mounting locations indicated for each door.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and to furnish reports to Architect.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain coiling counter doors.

END OF SECTION

SECTION 08 33 23

OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Service doors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
 - 5. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
 - 1. Include similar Samples of accessories involving color selection.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Special warranty.
- B. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
 - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
 - 1. Obtain operators and controls from overhead coiling-door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design".
- B. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:
 - 1. Design Wind Load: As indicated on Drawings.
 - 2. Testing: According to ASTM E330/E330M.
 - 3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
 - 4. Operability under Wind Load: Design overhead coiling doors to remain operable under uniform pressure (velocity pressure) of 20-lbf/sq. ft. (960-Pa) wind load, acting inward and outward.

2.3 DOOR ASSEMBLY

- A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cookson Company.
 - b. Cornell Iron Works, Inc.
 - c. Overhead Door Corporation.
 - d. Raynor.
 - e. Wayne-Dalton Corp.
 - 2. Basis-of-Design Product: Overhead Door Corporation; Model 620.
- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
 - 1. Include tamperproof cycle counter.
- C. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. (5.1 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E283.
- D. Door Curtain Material: Galvanized steel.
- E. Door Curtain Slats: Flat profile slats of 2-5/8-inch (67-mm) center-to-center height.
 - 1. Gasket Seal. Manufacturer's standard continuous gaskets between slats.
- F. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from hot-dip galvanized steel and finished to match door.
- G. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- H. Hood: Match curtain material and finish.
 - 1. Shape: Round.
 - 2. Mounting: As indicated on Drawings.
- I. Locking Devices: Equip door with locking device assembly.
 - 1. Locking Device Assembly: Manufacturer's standard cylinder lock.
- J. Electric Door Operator:
 - 1. Basis-of-Design Product: Overhead Door Corporation; Model RSX Commercial Standard Duty Door Operator.
 - 2. Usage Classification: Accommodate standard usage, up to 60 cycles per hour during peak usage periods.
 - 3. Operator Location: As indicated on Drawings.
 - 4. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 ft. (2.44 m) or lower.
 - 5. Motor Exposure: Interior.
 - 6. Motor Electrical Characteristics: As recommended by manufacturer.
 - 7. Emergency Manual Operation: Chain type.
 - 8. Obstruction-Detection Device: Automatic photoelectric sensor; self-monitoring type.
 - 9. Control Station(s): Interior mounted.
- K. Curtain Accessories: Equip door with weatherseals

- L. Door Finish:
 - 1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.

2.4 MATERIALS, GENERAL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
 - 1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with ASTM A653/A653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm); and as required.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

2.6 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
 - 1. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized-steel sheet with G90 (Z275) zinc coating, complying with ASTM A653/A653M.
 - 2. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

2.7 LOCKING DEVICES

- A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
 - 1. Lock Cylinders: As specified in Section 08 71 00 "Door Hardware".
 - 2. Keys: Two for each cylinder.
- B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.8 CURTAIN ACCESSORIES

- A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
 - 1. At door head, use 1/8-inch- (3-mm-) thick, replaceable, continuous-sheet baffle secured to inside of hood or field-installed on the header.
 - 2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- (3-mm-) thick seals of flexible vinyl, rubber, or neoprene.
- B. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.

2.9 COUNTERBALANCE MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.10 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf (111-N) force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.11 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-rewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
 - 1. Comply with NFPA 70.
 - 2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door Operator Location(s): Operator location indicated for each door.
 - 1. Wall Mounted: Operator is mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall-mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.
- D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.
 - 1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
 - 2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 - 3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.
 - 1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
 - a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained or constant pressure on close button.

- G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
 - 1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).
- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.12 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.13 STEEL AND GALVANIZED-STEEL FINISHES

- A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with the accessibility standard.
- D. Power-Operated Doors: Install automatic garage doors openers according to UL 325.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
 - 1. Adjust exterior doors and components to be weather resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

3.5 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service includes 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies are to be manufacturer's authorized replacement parts and supplies.
 - 1. Perform maintenance, including emergency callback service, during normal working hours.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION

SECTION 08 33 26

OVERHEAD COILING GRILLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Open-curtain overhead coiling grilles.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling grille and accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components, profiles for curtain components, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 4. For exterior components, include details of provisions for assembly expansion and contraction.
 - 5. Show locations of controls, locking devices, and other accessories.
 - 6. Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For overhead coiling grilles to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and Texas Accessibility Standards (TAS).

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain overhead coiling grilles from single source from single manufacturer.
 - 1. Obtain operators and controls from overhead coiling-grille manufacturer.

2.2 OPEN-CURTAIN GRILLE ASSEMBLY

- A. Open-Curtain Grille: Overhead coiling grille with a curtain having a network of horizontal rods that interconnect with vertical links.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cookson Company.
 - b. Cornell Iron Works, Inc.
 - c. McKeon.
 - d. Overhead Door Corporation.
 - e. Raynor.
 - 2. Basis-of-Design Product: McKeon; Safescape, Model G1500.
- B. Operation Cycles: Grille components and operators capable of operating for not less than 20,000. One operation cycle is complete when a grille is opened from the closed position to the fully open position and returned to the closed position.
 - 1. Include tamperproof cycle counter.

- C. Grille Curtain Material: Aluminum.
 - 1. Rod Spacing: Approximately 2-5/8 inches (67 mm) o.c.
 - 2. Link Spacing: Approximately 7 inches (178 mm) apart in a straight in-line pattern.
 - 3. Spacers: Metal tubes matching curtain material.
 - D. Bottom Bar: Continuous channel or doubled angles, fabricated from- stainless steel and finished to match grille.
 - E. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.
 - F. Swinging Egress Door: Incorporate a swinging type steel door designed and built as integral part of the grille assembly.
 - 1. Steel Door Frame: All steel unit type complying with ASTM A1008 (ASTM1008M), minimum 0.083 inches (2 mm).
 - 2. Steel Door Assembly: Complete with door, hinge, locking channel mechanism.
 - 3. Hardware:
 - a. Panic Exit Device: Flush mounted integral type panic exit device on one face and with pull handle on opposite face of swing door.
 - b. Closer: Surface mounted 90 degrees, pocketed application.
 - c. Electro Magnetic Door Holder: Surface mounted with proper projection to hold swinging door in the open position.
 - G. Hood: Match curtain material and finish.
 - 1. Shape: As indicated on Drawings.
 - 2. Mounting: As indicated on Drawings.
 - H. Locking Devices: Equip grille with locking device assembly.
 - 1. Locking Device Assembly: Cremone type, both jamb sides locking bars, operable from inside with thumb turn.
 - I. Electric Grille Operator:
 - 1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
 - 2. Operator Location: As indicated on Drawings .
 - 3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.4 m) or lower.
 - 4. Motor Exposure: Interior.
 - 5. Emergency Manual Operation: Push-up type.
 - 6. Obstruction-Detection Device: Automatic photoelectric sensor ; self-monitoring.
 - 7. Control Station: Interior mounted.
 - 8. Other Equipment: Emergency-egress release.
 - J. Curtain Accessories: Equip grille with astragal and push/pull handles.
 - K. Grille Finish:
 - 1. Aluminum Finish: Clear anodized.
- 2.3 MATERIALS, GENERAL
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 2.4 GRILLE CURTAIN MATERIALS AND CONSTRUCTION
- A. Open-Curtain Grilles: Fabricate metal grille curtain as an open network of horizontal rods, spaced at regular intervals, that are interconnected with vertical links, which are formed and spaced as indicated and are free to rotate on the rods.
 - 1. Aluminum Grille Curtain: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
 - B. Bottom Bar: Manufacturer's standard continuous shape unless otherwise indicated, finished to match grille.
 - 1. Astragal: Equip grille bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.

- C. Grille Curtain Jamb Guides: Manufacturer's standard shape having curtain groove with return lips or bars to retain curtain. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise; with removable stops on guides to prevent overtravel of curtain.

2.5 HOODS AND ACCESSORIES

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
 - 1. Aluminum: 0.040-inch- (1.02-mm-) thick aluminum sheet, complying with ASTM B 209 (ASTM B 209M), of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.
- B. Push/Pull Handles: Equip push-up-operated or emergency-operated grille with lifting handles on each side of grille, finished to match grille.

2.6 LOCKING DEVICES

- A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
 - 1. Lock Cylinders: Cylinders standard with manufacturer.
 - 2. Keys: Three for each cylinder.
- B. Safety Interlock Switch: Equip power-operated grilles with safety interlock switch to disengage power supply when grille is locked.

2.7 COUNTERBALANCING MECHANISM

- A. General: Counterbalance grilles by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of parts and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.8 ELECTRIC GRILLE OPERATORS

- A. General: Electric grille operator assembly of size and capacity recommended and provided by grille manufacturer for grille and operation cycles requirement specified, with electric motor and factory-rewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking grille, and accessories required for proper operation.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Chamberlain Group, Inc. (The).
 - 2. Comply with NFPA 70.
 - 3. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each grille.

- C. Grille Operator Location(s): Operator location indicated for each grille.
 - 1. Top-of-Hood Mounted: Operator is mounted to the right or left grille head plate, with the operator on top of the grille-hood assembly and connected to the grille drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.
 - D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.
 - 1. Electrical Characteristics: As recommended by manufacturer.
 - 2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate grille in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
 - 3. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 - 4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
 - E. Limit Switches: Equip motorized grille with adjustable switches interlocked with motor controls and set to automatically stop grille at fully opened and fully closed positions.
 - F. Obstruction-Detection Device: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of grille opening. Activation of sensor immediately stops and reverses downward grille travel.
 - 1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in grille opening without contact between grille and obstruction.
 - a. Self-Monitoring Type: Designed to interface with grille operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, grille closes only with sustained or constant pressure on close button.
 - G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
 - 1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
 - H. Emergency Manual Operation: Equip electrically powered grille with capability for emergency manual operation. Design manual mechanism so required force for grille operation does not exceed 25 lbf (111 N).
 - I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
 - J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
 - K. Emergency-Egress Release: Flush, wall-mounted handle mechanism, for accessibility-code-compliant egress feature, not dependent on electric power. The release allows an unlocked grille to partially open without affecting limit switches to permit passage, and it automatically resets motor drive upon return of handle to original position.
 - L. Self-Opening Mechanism: Automatic release mechanism triggered by smoke detector, fire alarm or power failure. When activated, the grille self-opens by means of a fail-safe operator to the fully open position without the need for power operation or battery backup systems. When the alarm is cleared and power is restored, the grille will operate normally.
- 2.9 GENERAL FINISH REQUIREMENTS
- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
 - B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- 2.10 ALUMINUM FINISHES
- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm- or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install overhead coiling grilles and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports, according to manufacturer's written instructions and as specified.
- B. Install overhead coiling grilles, hoods, controls, and operators at the mounting locations indicated for each grille.
- C. Accessibility: Install overhead coiling grilles, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Power-Operated Grilles: Install automatic garage grille openers according to UL 325.

3.3 STARTUP SERVICE

- A. Perform installation and startup checks according to manufacturer's written instructions.
- B. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- C. Test grille opening when activated by detector, fire-alarm system, emergency-egress release, or self-opening mechanism as required. Reset grille-opening mechanism after successful test.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly, so that grilles operate easily, free of warp, twist, or distortion.
 - 1. Adjust exterior components to be weather resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.

3.5 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of coiling-grille Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for grille operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 1. Perform maintenance, including emergency callback service, during normal working hours.
 - 2. Include 24-hour-per-day, 7-day-per-week, emergency callback service.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling grilles.

END OF SECTION

SECTION 08 34 73.16

WOOD SOUND CONTROL DOOR ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes wood sound control door assemblies.

1.2 COORDINATION

- A. Coordinate installation of anchorages for sound control door assemblies. Furnish setting drawings, templates, and directions for installing anchorages. Deliver sleeves, inserts, anchor bolts, and items with integral anchors to Project site in time for installation.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review procedures for coordinating frame and anchor installation with wall construction.
 - 2. Review required field quality-control procedures.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include sound ratings, construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.
- B. Shop Drawings: For sound control door assemblies.
 - 1. Include elevations of each door design.
 - 2. Include details of sound control seals, door bottoms, and thresholds.
 - 3. Include details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 4. Include frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 5. Include locations of reinforcements and preparations for hardware.
 - 6. Include details of each different wall opening condition.
 - 7. Include details of anchorages, joints, field splices, and connections.
 - 8. Include details of accessories.
 - 9. Include details of moldings, removable stops, and glazing.
 - 10. Include details of conduits and preparations for power, signal, and control systems.
- C. Samples for Initial Selection: For units with factory-applied finishes.
- D. Samples for Verification: For each type of exposed finish not less than 3 by 5 inches (76 by 127 mm).
 - 1. Doors and Frames: Samples approximately 12 by 12 inches (305 by 305 mm).
 - a. Doors: Include section of vertical-edge, top, and bottom construction; automatic door bottom or gasket; core construction; glazing; and hinge and other applied hardware reinforcement.
 - b. Frames: Include profile, corner joint, floor and wall anchors, and seals.
- E. Schedule: Provide a schedule of sound control door assemblies prepared using same reference numbers for details and openings as those on Drawings. Coordinate with the Door Hardware Schedule.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of sound control door assembly.
- C. Product Test Reports: For each sound control door assembly, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Field quality-control reports.
- E. Sample Warranty: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sound control door assemblies to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Manufacturer: Minimum five (5) years documented experience producing systems specified in this section.
- B. Installer: Minimum five (5) years documented experience producing systems specified in this section, and approved by manufacturer.
- C. Acoustical Testing Agency Qualifications: An independent agency accredited as an acoustical laboratory according to the National Voluntary Laboratory Accreditation Program of NIST.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Avoid the use of nonvented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-(102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install wood sound control doors until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Sound Rating: Provide sound control door assemblies identical to those of assemblies tested as sound-retardant units by an acoustical testing agency, and have the following minimum rating:
 - 1. STC Rating: As indicated on Drawings as calculated by ASTM E 413 when tested in an operable condition according to ASTM E 90.
- B. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Smoke- and Draft Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

2.2 WOOD SOUND CONTROL DOORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Ambico Limited.
 - 2. Eggers Soundwood.
 - 3. Krieger Specialty Products Company.
 - 4. Marshfield DoorSystems, Inc.
 - 5. Overly Door Company.
 - 6. Security Acoustics.
 - 7. Vancouver Door Company.
- B. Basis-of-Design Manufacturer: Eggers Soundwood.
- C. Source Limitations: Obtain wood sound control door assemblies, including doors, frames, sound control seals, hinges, thresholds, and other items essential for sound control, from single source from single manufacturer.
- D. Doors: Flush-design sound control doors, thickness as required to provide STC rating; with manufacturer's standard sound-retardant core as required to provide STC and fire rating indicated. Fabricate according to WDMA 1.S.1-A.

- E. Materials: Comply with Section 08 14 16 "Flush Wood Doors" for grade, faces, veneer matching, fabrication, finishing, and other requirements unless otherwise indicated.
 - 1. Glazing: As required by sound control door assembly manufacturer to comply with sound control and fire-rated-door labeling requirements.
- F. Finishes:
 - 1. Factory finish sound control wood doors to match doors specified in Section 08 14 16 "Flush Wood Doors."

2.3 SOUND CONTROL FRAMES

- A. Frames: Fabricate sound control door frames with corners mitered, reinforced, and continuously welded the full depth and width of frame. Fabricate according to NAAMM-HMMA 865.
 - 1. Weld frames according to NAAMM-HMMA 820.
 - 2. Exterior Frames: Fabricate from metallic-coated steel sheet 0.079-inch (2.01-mm) nominal thickness or thicker as required to provide STC rating indicated.
 - 3. Interior Frames: Fabricate from cold-rolled steel sheet unless otherwise indicated, 0.075-inch (1.90-mm) nominal thickness or thicker as required to provide STC rating indicated.
 - 4. Hardware Reinforcement: Fabricate according to NAAMM-HMMA 865 of same material as face sheets.
 - 5. Head Reinforcement: Metallic-coated steel channel or angle stiffener, 0.108-inch (2.74-mm) nominal thickness.
 - 6. Jamb Anchors:
 - a. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.064-inch (1.63-mm) nominal-thickness metallic-coated steel with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.156 inch (3.9 mm) thick.
 - b. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.048-inch (1.21-mm) nominal-thickness uncoated steel unless otherwise indicated.
 - c. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter, metallic-coated steel bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
 - 7. Floor Anchors: Not less than 0.079-inch (2.01-mm) nominal-thickness metallic-coated steel, and as follows:
 - a. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 - b. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at finish floor surface.
 - 8. Ceiling Struts: Minimum 3/8-inch-thick by 2-inch- (9.5-mm-thick by 50-mm-) wide uncoated steel unless otherwise indicated.
 - 9. Plaster Guards: Metallic-coated steel sheet, not less than 0.026 inch (0.6 mm) thick.
- B. Materials:
 - 1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
 - 2. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
 - 3. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.
 - 4. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M or ASTM F 2329.
 - 5. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching sound control door frames of type indicated.
 - 6. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers.
- C. Finishes:
 - 1. Factory-Applied Paint Finish: Manufacturer's standard primer and finish coats, complying with SDI A250.3 for performance and acceptance criteria.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.4 HARDWARE

- A. Sound Control Door Hardware: Manufacturer's standard sound control system, including head and jamb seals, door bottoms, cam-lift hinges, and thresholds, as required by testing to achieve STC and fire rating indicated.
 - 1. Head and Jamb Seals: One of the following:
 - a. Neoprene Compression Seals: One-piece units consisting of closed-cell sponge neoprene seal held in place by metal retainer, with retainer cover of same material as door frame; attached to door frame with concealed screws.
 - b. Silicone Compression Seals: One-piece units consisting of silicone compression bulb and stabilizer flange; attached to door frame adhesively.
 - c. Magnetic Seals: One-piece units consisting of closed-cell sponge neoprene seal and resiliently mounted magnet held in place by metal retainer, with retainer cover of same material as door frame; attached to door frame with concealed screws.
 - 2. Door Bottoms: Neoprene or silicone gasket held in place by metal housing; mortised into bottom edge of door.
 - 3. Cam-Lift Hinges: Full-mortise template type that raises door 1/2 inch (13 mm) when door is fully open; with hardened pin; fabricated from stainless steel.
 - 4. Thresholds: Flat, smooth, unfluted type as recommended by manufacturer; fabricated from aluminum.
 - a. Finish: Clear anodic finish.
- B. Other Hardware: Comply with requirements in Section 08 71 00 "Door Hardware."

2.5 SOUND CONTROL ACCESSORIES

- A. Glazing: Manufacturers' standard factory-installed glazing.
- B. Grout: Comply with ASTM C 476, with a slump of not more than 4 inches (102 mm) as measured according to ASTM C 143/C 143M.
- C. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.6 FABRICATION

- A. Wood Sound Control Door Fabrication: Factory fit doors to suit frame-opening sizes indicated, with uniform clearances and bevels according to WDMA I.S.1-A unless otherwise indicated. Comply with final door hardware schedules and hardware templates.
 - 1. Comply with requirements in NFPA 80 for fire-rated and smoke control doors.
 - 2. Glazed Lites: Factory install glazed lites according to requirements of tested assembly to achieve STC rating indicated.
 - 3. Locate door hardware as indicated, or if not indicated, according to DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - a. Coordinate measurements of hardware mortises in steel frames to verify dimensions and alignment before factory machining.
- B. Sound Control Frame Fabrication: Fabricate sound control frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
 - 1. Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated from same thickness metal as frames.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 - 4. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches (1524 mm) in height.
 - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) in height.

- 3) Four anchors per jamb from 90 to 96 inches (2286 to 2438 mm) in height.
- 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm), or fraction thereof, more than 96 inches (2438 mm) in height.
- b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches (1524 mm) in height.
 - 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) in height.
 - 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) in height.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm), or fraction thereof, more than 96 inches (2438 mm) in height.
 - 5) Two anchors per head for frames more than 42 inches (1066 mm) wide and mounted in metal-stud partitions.
- c. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
5. Head Reinforcement: For grouted frames more than 48 inches (1219 mm) wide, weld continuous head reinforcement to back of frame at head full width of opening.
6. Hardware Preparation: Factory prepare sound control frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping.
 - a. Reinforce frames to receive nontemplated mortised and surface-mounted door hardware.
7. Plaster Guards: Weld guards to frame at back of hardware cutouts and glazing-stop screw and sound control seal preparations to close off interior of openings in frames to be grouted.
8. Tolerances: Fabricate frames to tolerances indicated in NAAMM-HMMA 865.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of sound control door frame connections before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace sound control door frames to the following tolerances:
 1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install sound control door assemblies plumb, rigid, properly aligned, and securely fastened in place; comply with manufacturer's written instructions.
- B. Frames: Install sound control door frames in sizes and profiles indicated.
 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. At openings requiring smoke and draft control, install frames according to NFPA 105.

- c. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, and dress; make splice smooth, flush, and invisible on exposed faces.
 - d. Install sound control frames with removable glazing stops located on secure side of opening.
 - e. Remove temporary braces only after frames or bucks have been properly set and secured.
 - f. Check squareness, twist, and plumbness of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Apply corrosion-resistant coating to backs of frames to be filled with mortar, grout, and plaster containing antifreezing agents.
 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 3. Metal-Stud Partitions: Fully fill frames with mineral-fiber insulation.
 4. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 5. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 6. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.
 7. Grouted Frames: Solidly fill space between frames and substrate with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
 8. Installation Tolerances: Adjust sound control door frames for squareness, alignment, twist, and plumbness to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.
 - C. Doors: Fit sound control doors accurately in frames, within clearances indicated below. Shim as necessary.
 1. Non-Fire-Rated Doors: Fit non-fire-rated doors accurately in frames with the following clearances:
 - a. Jambs: 1/8 inch (3 mm).
 - b. Head with Butt Hinges: 1/8 inch (3 mm).
 - c. Head with Cam-Lift Hinges: As required by manufacturer, but not more than 3/8 inch (9.5 mm).
 - d. Sill: Manufacturer's standard.
 - e. Between Edges of Pairs of Doors: 1/8 inch (3 mm).
 2. Fire-Rated Doors: Install fire-rated doors with clearances according to NFPA 80.
 - D. Sound Control Seals: Where seals have been factory prefit and preinstalled and subsequently removed for shipping, reinstall seals and adjust according to manufacturer's written instructions.
 - E. Cam-Lift Hinges: Install hinges according to manufacturer's written instructions.
 - F. Thresholds: Set thresholds in full bed of sealant complying with requirements in Section 07 92 00 "Joint Sealants."
 - G. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with sound control door assembly manufacturer's written instructions.
 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- B. Testing Services: Perform testing for verification that assembly complies with STC rating requirements.
 - 1. Acoustical testing and inspecting agency shall select one sound control door(s) at random from sound control door assemblies that are completely installed for testing.
 - 2. Field tests shall be conducted according to ASTM E 336, with results calculated according to ASTM E 413. Acceptable field NIC values shall be within 5 dB of laboratory STC values.
 - 3. Inspection Report: Acoustical testing agency shall submit report in writing to Architect and Contractor within 24 hours after testing.
 - 4. If tested door fails, replace or rework all sound control door assemblies to bring them into compliance at Contractor's expense.
 - a. Additional testing and inspecting at Contractor's expense will be performed to determine if replaced or additional work complies with specified requirements.
 - C. Prepare test and inspection reports.
- 3.5 ADJUSTING AND CLEANING
- A. Final Adjustments: Check and adjust seals, door bottoms, and other sound control hardware items right before final inspection. Leave work in complete and proper operating condition.
 - B. Remove and replace defective work, including defective or damaged sound seals and doors and frames that are warped, bowed, or otherwise unacceptable.
 - 1. Adjust gaskets, gasket retainers, and retainer covers to provide contact required to achieve STC rating.
 - C. Grouted Frames: Clean grout off sound control door frames immediately after installation.
 - D. Metallic-Coated Surfaces: Clean abraded areas of frames and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

SECTION 08 36 13.05

SECTIONAL GLASS DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes upward acting sectional door assemblies including brackets, guides, tracks, hardware, operators, and installation accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type and size of sectional door and accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 4. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied finishes.
 - 1. Include Samples of accessories involving color selection.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranties: For special warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sectional doors to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and Texas Accessibility Standards (TAS).

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Failure of components or operators before reaching required number of operation cycles.
 - c. Faulty operation of hardware.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
 - e. Delamination of exterior or interior facing materials.
 - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain sectional doors from single source from single manufacturer.
 - 1. Obtain operators and controls from sectional door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Sectional doors shall comply with performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.
- B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
 - 1. Design Wind Load: 20 PSF.
 - 2. Testing: According to ASTM E 330.
 - 3. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.
 - a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of the door width.
 - b. Deflection of horizontal track assembly shall not exceed 1/240 of the door height.
 - 4. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.

2.3 DOOR ASSEMBLY

- A. Full-Vision Aluminum Sectional Door: Sectional door formed with hinged sections and fabricated according to DASMA 102 unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Clopay Corporation.
 - b. Overhead Door Corporation.
 - c. Wayne-Dalton Corp.
 - 2. Basis-of-Design Product: Overhead Door Corporation; Model 521, Impact Rated.
- B. Number of Panels: As indicated on Drawings.
- C. Number of Sections: As indicated on Drawings.
- D. Insulation for Stiles and Rails: Manufacturer's standard polyurethane insulation.
- E. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
- F. Air Infiltration: Maximum rate of 0.08 cfm/sq. ft. 0.406 L/s per sq. m at 15 and 25 mph 24.1 and 40.2 km/h when tested according to ASTM E 283.
- G. Aluminum Sections: As indicated on Drawings.
- H. Track Configuration: 2-inch, full vertical lift. Coordinate track design to avoid conflict with other overhead obstructions.
- I. Weatherseals:
 - 1. Bottom, flexible PVC. Side and top gaskets as required to seal against air leakage in compliance with local code requirements.
 - a. EPDM bulb-type strip at bottom section.
 - b. Flexible jamb seals.
 - c. Flexible header seal.
- J. Roller-Tire Material: Case-hardened steel.
- K. Locking Devices: Equip door with locking device assembly.
 - 1. Locking Device Assembly: Cremone type, both jamb sides, locking bars, operable from inside with thumb turn outside with cylinder.
- L. Counterbalance Type: Torsion spring.

- M. Electric Door Operator:
1. General: Provide electric door operator provided by door manufacturer for door with operational life specified complete with electric motor and factory pre-wired motor controls, starter, gear-reduction unit, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation. Comply with NFPA 70.
 2. Usage Classification: Light duty, up to 10 cycles per hour.
 3. Operator Type: Manufacturer's standard for door requirements.
 4. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet 2.4 m or lower.
 5. Motor Exposure: Interior, clean, and dry.
 6. Emergency Manual Operation: Chain type.
 7. Obstruction-Detection Device: Automatic photoelectric sensor.
 8. Control Station: Interior-side mounted.
 9. Other Equipment: Audible and visual signals.

- N. Door Finish:
1. Aluminum Finish: Color anodized.
 - a. Color: Black.

2.4 MATERIALS, GENERAL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 ALUMINUM DOOR SECTIONS

- A. Sections: Extruded-aluminum stile and rail members with dimensions and profiles as indicated on Drawings; members joined by welding or with concealed, 1/4-inch- 6-mm- minimum diameter, aluminum or nonmagnetic stainless-steel through bolts, full height of door section; and with meeting rails shaped to provide a weather-resistant seal.
1. Aluminum: ASTM B 221 ASTM B 221M extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; minimum thickness 0.065 inch 1.7 mm for door section 1-3/4 inches 44 mm deep, and as required to comply with requirements.
 2. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Ensure that reinforcement does not obstruct vision lites.
 3. Provide reinforcement for hardware attachment.
- B. Full-Vision Sections: Manufacturer's standard, tubular, aluminum-framed section fully glazed with 6-mm-thick, clear acrylic glazing set in vinyl, rubber, or neoprene glazing channel and with removable extruded-vinyl or aluminum stops.
1. Glazing: 1/2-inch thick, Low-E coated, clear, insulated glass.
 2. Provide security film on glazing as indicated on Drawings.

2.6 TRACKS, SUPPORTS, AND ACCESSORIES

- A. Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and weight, designed for lift type indicated and clearances indicated on Drawings. Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides for required door type, size, weight, and loading.
1. Galvanized Steel: ASTM A 653/A 653M, minimum G60 Z180 zinc coating.
 2. Slope tracks at an angle from vertical or design tracks to ensure tight closure at jambs when door unit is closed.
 3. Track Reinforcement and Supports: Galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches 51 mm apart for door-drop safety device.
 - a. For Vertical Track: Continuous reinforcing angle attached to track and attached to wall with jamb brackets.
- B. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of sectional door unless otherwise indicated.

2.7 HARDWARE

- A. General: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.
- B. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch-2.01-mm-)nominal coated thickness at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible. Provide double-end hinges where required, for doors more than 16 feet 4.88 m wide unless otherwise recommended by door manufacturer.
- C. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3-inch- 76-mm- diameter roller tires for 3-inch- 76-mm- wide track and 2-inch- 51-mm- diameter roller tires for 2-inch- 51-mm- wide track.

2.8 LOCKING DEVICES

- A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded deadbolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
- B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.9 COUNTERBALANCE MECHANISM

- A. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from steel-spring wire complying with ASTM A 229/A 229M, mounted on torsion shaft made of steel tube or solid steel. Provide springs designed for number of operation cycles indicated.
- B. Cable Drums and Shaft for Doors: Cast-aluminum or gray-iron casting cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft. Provide one additional midpoint bracket for shafts up to 16 feet 4.88 m long and two additional brackets at one-third points to support shafts more than 16 feet 4.88 m long unless closer spacing is recommended by door manufacturer.
- C. Cables: Galvanized-steel, multistrand, lifting cables with cable safety factor of at least 5 to 1.
- D. Cable Safety Device: Include a spring-loaded steel or spring-loaded bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either lifting cable breaks.
- E. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
- F. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.

2.10 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and "operation cycles" requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Chamberlain Group, Inc. (The).
 - b. Overhead Door Corporation.
 - 2. Basis-of-Design Product: Model RSX.
 - 3. Comply with NFPA 70.
 - 4. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door-Operator Type: Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.
 - 1. Jackshaft, Center Mounted: Jackshaft operator mounted on the inside front wall above door and connected to torsion shaft with an adjustable coupling or drive chain.

- D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.
 - 1. Electrical Characteristics: As recommended by manufacturer.
 - 2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. 203 mm/s and not more than 12 in./sec. 305 mm/s, without exceeding nameplate ratings or service factor.
 - 3. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 - 4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
 - 5. Use adjustable motor-mounting bases for belt-driven operators.
 - E. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
 - F. Obstruction Detection Device: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
 - 1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
 - a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained pressure on close button.
 - G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure, push-button control labeled "Close."
 - 1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
 - H. Emergency Manual Operation: Equip electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf/111 N.
 - I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
 - J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
 - K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.
- 2.11 GENERAL FINISH REQUIREMENTS
- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
 - B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- 2.12 ALUMINUM FINISHES
- A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - 1. Color: Black.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Tracks:
 - 1. Fasten vertical track assembly to opening jambs and framing, spaced not more than 24 inches 610 mm apart.
 - 2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.
- C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Power-Operated Doors: Install automatic sectional doors openers according to UL 325.

3.3 STARTUP SERVICES

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.
- D. Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780/A 780M.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION

SECTION 08 41 13

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Aluminum-framed storefront systems.
 - 2. Aluminum-framed entrance door systems.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - 2. Include full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
 - 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
 - 4. Include point-to-point wiring diagrams showing the following:
 - a. Power requirements for each electrically operated door hardware.
 - b. Location and types of switches, signal device, conduit sizes, and number and size of wires.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- E. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
 - 1. For Installer and field testing agency.
 - 2. For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed in the state in which Project is located.
- B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
 - 1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.
- C. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Field quality-control reports.

- E. Sample Warranties: For special warranties.
- 1.5 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.
- 1.6 QUALITY ASSURANCE
- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 - B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.
- 1.7 MOCKUPS
- A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Testing shall be performed on mockups in accordance with requirements in "Field Quality Control" Article.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- 1.8 WARRANTY
- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water penetration through fixed glazing and framing areas.
 - e. Failure of operating components.
 - 2. Warranty Period: Two years from date of Substantial Completion.
 - B. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D 4214.
 - c. Cracking, peeling, or chipping.
 - 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS
- A. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing accessories, from single manufacturer.
- 2.2 PERFORMANCE REQUIREMENTS
- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design aluminum-framed entrances and storefronts.

- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
- D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
 - 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m).
 - 2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).
 - a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.
 - 3. Cantilever Deflection: Limited to 2L/175 at unsupported cantilevers.
- E. Structural: Test in accordance with ASTM E330/E330M as follows:
 - 1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
 - 2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 - 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
 - 1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- G. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:
 - 1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
 - 2. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.
- H. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:
 - 1. Thermal Transmittance (U-factor):
 - a. Fixed Glazing and Framing Areas: U-factor for the system of not more than that required by applicable building code as determined in accordance with NFRC 100.
 - b. Entrance Doors: U-factor of not more than that required by applicable building code as determined in accordance with NFRC 100.
 - 2. Solar Heat-Gain Coefficient (SHGC):
 - a. Fixed Glazing and Framing Areas: SHGC for the system of not more than that required by applicable building code as determined in accordance with NFRC 200.
 - b. Entrance Doors: SHGC of not more than that required by applicable building code as determined in accordance with NFRC 200.

3. Air Leakage:
 - a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa) when tested in accordance with ASTM E283.
 - b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. (5.08 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
- I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
 2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested in accordance with AAMA 501.5.
 - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
 - b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).
 - c. Interior Ambient-Air Temperature: 75 deg F (24 deg C).

2.3 STOREFRONT SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Arcadia.
 2. Kawneer North America; an Arconic company.
 3. Oldcastle BuildingEnvelope.
 4. Tubelite Inc.
 5. U.S. Aluminum; a brand of C.R. Laurence.
 6. YKK AP America, Inc.
- B. Basis-of-Design Product: Kawneer North America; an Arconic company; TriFab VersaGlaze 451T Framing System.
- C. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 1. Exterior Framing Construction: Thermally broken.
 2. Interior Vestibule Framing Construction: Nonthermal.
 3. Glazing System: Retained mechanically with gaskets on four sides.
 4. Glazing Plane: Front.
 5. Fabrication Method: Field-fabricated stick system.
 6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 7. Steel Reinforcement: As required by manufacturer.
- D. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.4 ENTRANCE DOOR SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Arcadia.
 2. Kawneer North America; an Arconic company.
 3. Oldcastle BuildingEnvelope.
 4. Tubelite Inc.
 5. U.S. Aluminum; a brand of C.R. Laurence.
 6. YKK AP America, Inc.
- B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.
 1. Door Construction:
 - a. Interior Doors – Heavy Duty: 2 -inch overall thickness, with minimum 0.1875-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - b. Exterior Doors: 2-1/4 -inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members, thermally broken. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded.

2. Door Design: As indicated, with minimum 10 inch bottom rail.
3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.
4. Finish: Match adjacent storefront framing finish.
5. Provide sound-insulated mullion mates at all storefront types, both specified herein and other Sections, to match height of windows and depth of exterior wall framing, where interior partition walls meet back side of window storefront framing mullions.

2.5 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 08 71 00 "Door Hardware."
- B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door, to comply with requirements in this Section.
 1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products complying with BHMA standard referenced.
 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
 3. Opening-Force Requirements:
 - a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
 - b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.
- C. Designations: Requirements for design, grade, function, finish, quantity, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:
 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
 2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.
- D. Cylinders:
 1. As specified in Section 08 71 00 "Door Hardware."
- E. Weather Stripping: Manufacturer's standard replaceable components.
 1. Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
- F. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- G. Thresholds: BHMA A156.21 raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (12.7 mm).

2.6 GLAZING

- A. Glazing: Comply with Section 08 80 00 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.

2.7 MATERIALS

- A. Sheet and Plate: ASTM B209 (ASTM B209M).
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
- C. Structural Profiles: ASTM B308/B308M.

2.8 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.

2. Reinforce members as required to receive fastener threads.
 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.
- E. Rigid PVC filler.

2.9 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
 2. Accurately fitted joints with ends coped or mitered.
 3. Physical and thermal isolation of glazing from framing members.
 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 5. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Storefront Framing: Fabricate components for assembly using screw-spline system.
- F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
1. At interior and exterior doors, provide compression weather stripping at fixed stops.
- G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
 2. At exterior doors, provide weather sweeps applied to door bottoms.
- H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- I. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.10 BRAKE METAL

- A. Material: Extruded Aluminum.
- B. Thickness: 0.090 inches (2.38mm) unless noted otherwise.
- C. Finish: Match storefront.
- D. Texture: Smooth.
- E. Profile: As indicated.
- F. Provide brake metal trim in locations specifically shown on Drawings and other locations as required for complete installation. Thicknesses indicated on Drawings and specifications are minimum thicknesses regardless of minimum thickness to prevent oil canning.

- G. Aluminum Sills: Where indicated on Drawings, (or where sill dimension is too small for solid surface, quartz), provide interior aluminum window sill with nominal 2-inch vertical return at inside face of wall, hemmed bottom edge, and hemmed and closed ends. Match finish of adjacent window.

2.11 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - 1. Color: Black.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.
- E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- F. Seal perimeter and other joints watertight unless otherwise indicated.
- G. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
 - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- H. Set continuous sill members and flashing in full sealant bed, as specified in Section 07 92 00 "Joint Sealants," to produce weathertight installation.
- I. Install joint filler behind sealant as recommended by sealant manufacturer.
- J. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF GLAZING

- A. Install glazing as specified in Section 08 80 00 "Glazing."

3.4 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOORS

- A. Install entrance doors to produce smooth operation and tight fit at contact points.
 - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.5 ERECTION TOLERANCES

- A. Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:
 - 1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
 - 2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
 - 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).

- c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.
 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested in accordance with AAMA 501.2 and shall not evidence water penetration.
 - a. Perform a minimum of three tests in areas as directed by Architect.
 - b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.
- C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.7 MAINTENANCE SERVICE

- A. Entrance Door Hardware Maintenance:
 1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
 2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Use parts and supplies that are the same as those used in the manufacture and installation of original equipment.

END OF SECTION

SECTION 08 43 29

SLIDING ALUMINUM-FRAMED STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes sliding aluminum-framed storefronts for interior locations.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions.
- B. Shop Drawings: For sliding aluminum-framed glass doors.
 - 1. Include plans, elevations, sections, and details.
 - 2. Detail attachments to other work, and between units, if any.
 - 3. Include hardware and required clearances.
- C. Samples: For each exposed product and for each color specified, 12-inch-long (300-mm-long) section with weather stripping, glazing bead, and factory-applied color finish.
- D. Product Schedule: For sliding aluminum-framed glass doors.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each sliding aluminum-framed glass door, for tests performed by manufacturer and witnessed by a qualified testing agency, and for each class and performance grade indicated, tested at AAMA gateway size.
- C. Field quality-control reports.
- D. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes, weather stripping, operable panels, and operating hardware to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating sliding aluminum-framed glass doors that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.
- B. Installer Qualifications: An installer acceptable to sliding aluminum-framed glass door manufacturer for installation of units required for this Project.
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockup for sliding aluminum-framed glass doors, as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Kawneer North America; an Alcoa company.
 - 2. Nana Wall Systems, Inc.
 - 3. YKK AP America Inc.
- B. Basis-of-Design Product: Kawneer North America; 1010 Sliding Mall Front.
 - 1. Framing Member Profile: 1-3/8 inch deep.
- C. Source Limitations: Obtain sliding aluminum-framed glass doors from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
 - 1. Product Certification: AAMA certified with label attached to each door.

2.3 SLIDING ALUMINUM-FRAMED STOREFRONTS

- A. Frames and Door Panels: Fabricated from aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.
 - 1. Thermally Improved Construction: Fabricate frames and door panels with an integral, concealed, low-conductance thermal barrier located between exterior and interior surfaces in a manner that eliminates direct metal-to-metal contact.
- B. Threshold and Sill Cap/Track: Provide extruded-aluminum threshold and track of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated; with manufacturer's standard finish.
 - 1. Low-Profile Floor Track: ADA-ABA compliant.

2.4 GLAZING

- A. Glass and Glazing: Manufacturer's standard glazing system that produces weathertight seal. Comply with requirements indicated in Section 08 80 00 "Glazing."
 - 1. Glass: ASTM C 1036, Type 1, q3, Category II safety glass complying with testing requirements in 16 CFR 1201.
 - 2. Safety Glazing Labeling: Permanently mark safety glazing with certification label of the SGCC. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
 - 3. Apply film as indicated on Drawings.

2.5 HARDWARE

- A. General: Provide manufacturer's standard hardware, fabricated from a corrosion-resistant material compatible with aluminum complying with AAMA 907 and designed to smoothly operate, tightly close, and securely lock sliding aluminum-framed glass doors.
- B. Door Pulls: Provide manufacturer's standard pull.
 - 1. Color and Finish: As selected by Architect from manufacturer's full range.
- C. Lock: Install manufacturer's keyed cylinder lock and locking device on each movable panel, lockable from the inside and outside. Adjust locking device to allow unobstructed movement of the panel across adjacent panel in the direction indicated.
 - 1. Keying System: All cylinders keyed alike.

2.6 ACCESSORIES

- A. Fasteners: Noncorrosive and compatible with door members, trim, hardware, anchors, and other components.
 - 1. Exposed Fasteners: Do not use exposed fasteners to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

- B. Anchors, Clips, and Accessories: Provide anchors, clips, and accessories of aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron for sliding aluminum-framed glass doors, complying with ASTM B 456 or ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
 - 1. Windborne-Debris Resistance: Provide anchors of same design used in windborne-debris resistance testing.

2.7 FABRICATION

- A. Fabricate sliding aluminum-framed glass doors in sizes indicated. Include a complete system for assembling components and anchoring doors.
- B. Fabricate sliding aluminum-framed glass doors that are reglazable without dismantling panel framing.
- C. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.
- D. Factory-Glazed Fabrication: Glaze sliding aluminum-framed glass doors in the factory where practical and possible for applications indicated. Comply with requirements in Section 08 80 00 "Glazing" and with AAMA/WDMA/CSA 101/I.S.2/A440.

2.8 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - 1. Color: Black.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of threshold substrate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight sliding aluminum-framed glass door installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing doors, hardware, accessories, and other components.
- B. Install sliding aluminum-framed glass doors level, plumb, square, true to line, without distortion, without warp or rack of frames and panels, and without impeding thermal movement; anchored securely in place to structural support; and in proper relation to wall flashing, vapor retarders, air barriers, water/weather barriers, and other adjacent construction.
- C. Set sill members in bed of sealant or with gaskets, as indicated, to provide weathertight construction.
- D. Install sliding aluminum-framed glass doors and components to drain condensation, water penetrating joints, and moisture migrating within doors to the exterior.

- E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Lubricate hardware and moving parts.
- B. Adjust operating panels and screens to provide a tight fit at contact points and weather stripping for smooth operation, without binding, and a weathertight closure. Adjust hardware for proper alignment, smooth operation, and proper latching without unnecessary force or excessive clearance.
- C. Clean exposed surfaces immediately after installing sliding aluminum-framed glass doors. Avoid damaging protective coatings and finishes. Remove nonpermanent labels, excess sealants, glazing materials, dirt, and other substances.
- D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- E. Protect sliding aluminum-framed glass door surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances contact sliding aluminum-framed glass door surfaces, remove contaminants immediately according to manufacturer's written instructions.
- F. Refinish or replace sliding aluminum-framed glass doors with damaged finishes.
- G. Replace damaged components.

END OF SECTION

SECTION 08 44 13

GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Glazed aluminum curtain wall systems:
 - a. Conventionally glazed, field assembled.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - 2. Include full-size isometric details of each type of vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
 - 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- D. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
 - 1. For Installer and field testing agency.
 - 2. For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the state in which Project is located.
- B. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components from manufacturer.
 - 1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AGM) contractors and that employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 WARRANTY

- A. Special Assembly Warranty: Manufacturer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.
 - c. Deterioration of metals and other materials beyond normal weathering.
 - d. Water penetration through fixed glazing and framing areas.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design glazed aluminum curtain walls.
- B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Glazed aluminum curtain walls shall withstand movements of supporting structure, including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
- D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
 - 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans of greater than 13 feet 6 inches (4.1 m).

2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).
 3. Cantilever Deflection: Limited to $2l/175$ at unsupported cantilevers.
- E. Structural: Test in accordance with ASTM E330/E330M as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft. (720 Pa).
- G. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft. (720 Pa).
 2. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters or water that is drained to exterior.
- H. Interstory Drift: Accommodate design displacement of adjacent stories indicated.
1. Test Performance: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.4 at design displacement.
- I. Energy Performance: Certified and labelled by manufacturer for energy performance as follows:
1. Thermal Transmittance (U-factor):
 - a. Fixed Glazing and Framing Areas: U-factor for the system of in accordance with building code requirements not more than as determined in accordance with NFRC 100.
 2. Solar Heat Gain Coefficient (SHGC):
 - a. Fixed Glazing and Framing Areas: SHGC for the system of not more than in accordance with building code requirements as determined in accordance with NFRC 200.
 3. Air Leakage:
 - a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa) when tested in accordance with ASTM E283.
- J. Noise Reduction: Test in accordance with ASTM E90, with ratings determined by ASTM E1332, as follows:
1. Outdoor-Indoor Transmission Class: Minimum 30.
- K. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
 2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested in accordance with AAMA 501.5.
 - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
 - b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).
- 2.2 SOURCE LIMITATIONS
- A. Obtain all components of curtain-wall system and storefront system, including framing and accessories, from single manufacturer.
- 2.3 GLAZED ALUMINUM CURTAIN WALL SYSTEMS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Kawneer North America; an Alcoa company.
 2. Oldcastle BuildingEnvelope.

3. Tubelite.
 4. YKK AP America, Inc.
- B. Basis-of-Design Product: Kawneer North America; 1600 System 1 Curtain Wall.
- C. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: Thermally broken.
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: Front.
 4. System: Stick system.
 5. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 6. Steel Reinforcement: As required by manufacturer.
- D. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.
1. Include snap-on aluminum trim that conceals fasteners.
- E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- F. Glazing: As specified in Section 08 80 00 "Glazing".
- G. Entrance Door Systems: Comply with Section 08 41 13 "Aluminum-Framed Entrances and Storefronts".
- 2.4 GLAZING
- A. Glazing: Comply with Section 08 80 00 "Glazing."
- B. Glazing Gaskets: ASTM C509 or ASTM C864. Comply with Section 08 80 00 "Glazing."
1. Color: Black.
- C. Glazing Sealants: Comply with Section 08 80 00 "Glazing."
- 2.5 MATERIALS
- A. Sheet and Plate: ASTM B209 (ASTM B209M).
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
- C. Structural Profiles: ASTM B308/B308M.
- D. Steel Reinforcement (if required for spans encountered):
1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
 2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
 3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
- E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.
- 2.6 ACCESSORIES
- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 2. Reinforce members as required to receive fastener threads.
 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.7 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from exterior.
 - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Fabricate components to resist water penetration as follows:
 - 1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
 - 2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.
- E. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method.
- F. Factory-Assembled Frame Units:
 - 1. Rigidly secure nonmovement joints.
 - 2. Prepare surfaces that are in contact with structural sealant in accordance with sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
 - 3. Seal joints watertight unless otherwise indicated.
 - 4. Install glazing to comply with requirements in Section 08 80 00 "Glazing."
- G. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.8 BRAKE METAL

- A. Material: Extruded Aluminum.
- B. Thickness: 0.090 inches (2.38mm) unless noted otherwise.
- C. Finish: Match storefront.
- D. Texture: Smooth.
- E. Profile: As indicated.

2.9 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - 1. Color: Black.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.
- E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- F. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
- G. Seal joints watertight unless otherwise indicated.
- H. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- I. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
- J. Install components plumb and true in alignment with established lines and grades.

3.4 INSTALLATION OF GLAZING

- A. Install glazing as specified in Section 08 80 00 "Glazing."

3.5 ERECTION TOLERANCES

- A. Install glazed aluminum curtain walls to comply with the following maximum tolerances:
 - 1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
 - 2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
 - 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
 - c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
 - 4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Test Area: Perform tests on one bay at least 30 feet (9.1 m), by one story.
- C. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls.
 - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested in accordance with AAMA 501.2 and shall not evidence water penetration.
 - a. Perform a minimum of three tests in areas as directed by Architect.
 - b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.
 - 2. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
 - a. Perform a minimum of two tests in areas as directed by Architect.
 - 3. Water Penetration: ASTM E1105 at a minimum uniform static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa), and shall not evidence water penetration.

- D. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION

SECTION 08 56 19

METAL STORM WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal storm windows.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- B. Shop Drawings:
 - 1. Elevation for each style window specified indicating its size, glazing type, muntin type and design.
 - 2. Manufacturer's head, jamb and sill details and section views for each window type specified.
- C. Schedules:
 - 1. Provide a window schedule indicating the type, size, color, and operation of each unit specified. Coordinate with window mark types found in the Contract Drawings.
- D. Samples for Initial Selection: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- E. Samples for Verification: For each finish product specified, two samples representing actual product, color, and patterns. Samples may be subsequently installed on the project.
- F. Test Reports: Submit certified independent testing agency reports indicating window units meet or exceed specified performance requirements.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: All windows and window hardware specified in this section will be supplied by a single manufacturer with a minimum of ten (10) years' experience.
- B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five (5) years demonstrated experience in installing windows of the same type and scope as specified.
- C. Provide test reports from AAMA accredited laboratory certifying that window units are found to be in compliance with AAMA/WDMA/CSA 101/I.S.2/A440-97 and performance standards listed above.
 - 1. Test reports shall be accompanied by the window manufacturer's letter of certification stating that the tested window meets or exceeds criteria for the appropriate AAMA/WDMA/CSA 101/I.S.2/A440 test.
- D. Code Compliance: Provide windows that comply with regulations of the code bodies having jurisdiction.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation in accordance with manufacturer's recommendations.
- B. Protect units against damage from the elements, construction activities and other hazards before, during, and after installation.

1.5 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Test Units:
1. Air, water and structural test unit shall conform to requirements set forth in AAMA/WDMA/CSA 101/I.S.2/A440. 2.28.
- B. Test Procedures and Performance:
1. Windows shall conform to AAMA/WDMA/CSA 101/I.S.2/A440 requirements for each window type.
 2. Air Infiltration Test:
 - a. With window sash and ventilators closed and locked, test unit in accordance with ASTM E 283 at static air pressure of 6.24 psf.
 - b. Air infiltration shall not exceed that specified for each Product.
 3. Water Resistance Test:
 - a. With window sash and ventilators closed and locked, test unit in accordance with ASTM E 331 and ASTM E 547 at static air pressure difference of 12 psf.
 - b. There shall be no uncontrolled water leakage.
 4. Uniform Load Deflection Test:
 - a. With window sash and ventilators closed and locked, test unit in accordance with ASTM E 330 at static air pressure (positive and negative) difference of 100% design pressure.
 - b. During testing, no member shall deflect more than 1/175 of its span.
 5. Uniform Load Structural Test:
 - a. With window sash and ventilators closed and locked, test unit in accordance with ASTM E 330 at static air pressure (positive and negative) difference 150% of design pressure.
 - b. At conclusion of test, there shall be no glass breakage; no permanent damage to fasteners, hardware parts, support arms, or actuating mechanisms; no other damage which would cause window to be inoperable.
 6. Condensation Resistance Test (CRF):
 - a. With window sash closed and locked, test unit in accordance with AAMA 1503.1.
 - b. Condensation Resistance Factor (CRF) shall not be less than that specified for each Product.
 7. Thermal Transmittance Test (Conductive U-Value):
 - a. With window sash closed and locked, test unit in accordance with AAMA 1503.1.
 - b. Conductive thermal transmittance (U-Value) shall not exceed that specified for each Product.
 8. Life Cycle Test:
 - a. Test window in accordance with AAMA 910.
 - b. At conclusion of test, there shall be no damage to fasteners, hardware parts, support arms, or actuating mechanisms; no other damage which would cause window to be inoperable. Subsequent air infiltration and water resistance tests shall not exceed specified requirements.
 9. Forced Entry Resistance Test: ASTM F 588, Type and Grade as indicated for each Product.
 10. Tornado Hazard Mitigating:
 - a. Test window in accordance with ICC 500-2020.
 - b. Window must be factory labeled and certified as ICC 500-2020 Compliant.
 - c. Furnish windows capable of providing protection from winds as specified in ICC-500 Tornado Hazard Map.
 - d. Furnish window that will resist 3-second 180 mph design wind speed and tornado missile speed of 100 mph (15-lb 2X4).
 - e. A "Pass" test as identified in ICC-500 Chapter 8. Missile did not perforate the glazing. The glazing remained attached to the glazing frame. Glass fragments or shards remained within the glazing unit.
 - f. Anchors, clips, stops and other accessories shall be provided to comply with AAMA 101.1.S.2 and AAMA 907. Provide units and anchorage mechanism with sufficient strength to withstand required design pressure and strength for specified load conditions.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Survivalite Impact Systems.
 - 2. Winco Window.
- B. Basis-of-Design Product: Survivalite Impact Systems; Citadel Products 5000 Series Window.

2.3 MATERIALS

- A. Aluminum:
 - 1. Frame: Extruded aluminum, 6063-T6 alloy and temper, tensile strength of 25,000 psi.

2.4 THERMAL FIXED ICC 500-2014 WINDOWS

- A. Performance: AAMA/WDMA/CSA 101/I.S.2/A440.
 - 1. Architectural Window: AW-80.
 - 2. FEMA 361/ICC 500-2020.
 - 3. Water Resistance, ASTM E 331: 20 psf.
 - 4. Air Infiltration, ASTM E 283 at static air pressure of 6.1 psf.
 - 5. Impact sample with 15 lb 2X4 162" long at 100 mph
 - 6. Forced Entry Resistance, ASTM E 330-14a:
 - a. Preload: +/- 80 psf.
 - b. Structural Load: +165; -195 psf.
 - 7. Thermal Performance ("U" Value), AAMA 1503.1: As required by applicable building code.
- B. Frame: Thermally broken.
 - 1. Wall Thickness: 0.125 inches (3.2 mm).
 - 2. Depth: 3-1/4 inches (89 mm).
 - 3. Corners: Closely fit and mechanically fastened with screws. Must be sealed using AAMA approved sealants in a multi-step process to provide sealant redundancy.
 - 4. Leg: Provide equal leg frame.
- C. Thermal Barrier.
 - 1. Poured-in-place structural thermal barrier shall transfer during bending and provide composite action between frame components.
 - 2. Thermal barrier pocket on aluminum extrusions shall be Azo-Braded to create a mechanical lock to improve the adhesion properties between the polyurethane polymer and the surface of the thermal barrier pocket.
 - 3. Window manufacturer must provide a warranty from the manufacturer of the polyurethane thermal barrier that warrants against product failure as a result of thermal shrinkage beyond 1/8 inch (3.2 mm) from each end and fracturing of the polyurethane for a period not to exceed ten years from the date of window manufacture.
 - 4. Thermal barriers made of crimped in place polyamide strips are not acceptable unless all strips are covered and tooled with Dow 795 silicone caulking to climate water migration.

2.5 TRIM AND PANS

- A. Provide trim and pans as indicated on Drawings.
- B. Subframe and Closure Plate: Manufacturer's standard.
- C. Sill Starter.
 - 1. Sills: As indicated.
 - 2. Sub-Sill: As indicated.
 - 3. Sill Extension: As indicated.
 - 4. PVC Comp. Channel (Frame Filler): As indicated.
- D. Strap Anchor: Manufacturer's standard.
- E. Snap Cover: Manufacturer's standard.
- F. Base Clip: Manufacturer's standard.

- G. Blat Tested Trim:
 - 1. Blast Receptor: Blast receptor with exterior installed closure plate.
 - 2. Blast Snap Trim: Size as indicated.

2.6 MULLIONS AND GRIDS

- A. Mullion:
 - 1. Blast Resistant Mullion: Manufacturer's standard, in accordance with UFC 4-010-01.
 - a. Maximum Deflection: L/60.
 - b. Static Pressure: 1 psi (0.07 kg/cm).
 - 2. Provide mullions as indicated on Drawings.
- B. Window Depth: As indicated.

2.7 FINISH

- A. 70 percent Kynar in accordance with AA-M12-C42-R1X, AAMA 2605-98.
 - 1. Color: As selected by Architect from manufacturer's full range.

2.8 GLAZING

- A. Refer to Section 08 80 00 "Glazing" for glass installation.
- B. Glass Type: Impact Resistant, as follows and as selected by Architect:
 - 1. Laminated Glass for Large Missile Impact Windows: 1/4-inch heat strengthened outer lite with 0.090 inch Saflex interlayer and 1/4-inch heat strengthened inner lite.
 - 2. Total Thickness: 1-1/8 inch.
- C. Glazing Bead, Tornado Resistant Windows:
 - 1. Glazing Bead: 1-11/16-inch (43mm) with screwed in glazing bead.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and conditions are ready to receive work of this Section.
- B. Notify Architect of any existing conditions which will adversely affect execution.
- C. Beginning of execution will constitute acceptance of existing conditions.

3.2 PREPARATION

- A. Prepare substrate surfaces as recommended by manufacturer.

3.3 INSTALLATION

- A. Install using skilled workers in accordance with manufacturer's published instructions and recommendations.

3.4 PROTECTION

- A. Protect installed products until completion of Project.
- B. Final operating adjustment shall be made after glazing work is complete. Operating sash and ventilator shall operate smoothly and shall be weathertight when in locked position.

3.5 ADJUSTING

- A. Adjust and fit items to be flush with adjacent construction.
- B. Fasten or adhere for tight connections and joints.

END OF SECTION

SECTION 08 62 23.13

TUBULAR DAYLIGHTING DEVICES FOR ICC 500 TORNADO SHELTER COMPLIANCE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Tubular daylighting devices and accessories.

1.2 REFERENCES

- A. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- B. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- C. ASTM A 463/A 463M - Standard Specification for Steel Sheet, Aluminum Coated, by the Hot Dip Process.
- D. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc Coated (Galvanized), by the Hot Dip Process.
- E. ASTM A 792/A 792M - Standard Specification for Steel Sheet, 55 percent Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- F. ASTM E 108 - Standard Test Methods for Fire Tests of Roof Coverings.
- G. ASTM E 283 - Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- H. ASTM E 308 - Standard Practice for Computing the Colors of Objects by Using the CIE System.
- I. ASTM E 330 - Structural Performance of Exterior Windows, Curtain Walls and Doors.
- J. ASTM E 547 - Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain walls by Cyclic Air Pressure Difference.
- K. ASTM E 1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
- L. ASTM E 1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricane.
- M. ASTM D 635 - Test Method for Rate of Burning and/or Extent of Time of Burning of Self-Supporting Plastics in a Horizontal Position.
- N. ASTM D 1929 - Test Method for Ignition Properties of Plastics.
- O. ASTM D 2843 - Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics.
- P. ASTM F 1642 - Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loading.
- Q. ASTM F 2912 - Standard Specification for Glazing and Glazing Systems Subject to Airblast Loading.

- R. AAMA/WDMA/CSA 101/I.S.2/A440 - Standard/Specification for Windows, Doors, and Unit Skylights; 2011.
- S. FEMA P-361 - Safe Rooms for Tornadoes and Hurricanes.
- T. ICC 500 - Standard for the Design and Construction of Storm Shelters.
- U. ICC-ES AC-16 - Acceptance Criteria for Plastic Skylights; 2008.
- V. IBC Section 1710 - Load Test Procedure for Wind Load Testing on Rooftop Daylight Collecting System - Structural Performance Testing - Devised by ATI PE; 2012.
- W. IBC Section 2606.7.2 - Installation - Diffuser Fall Out Test (Devised by PE); 2012.
- X. OSHA 29 CFR - 1910.23 (e)(8) (Guarding Requirements for Skylights); 1926 Subpart M (Fall Protection); 1926.501(b)(4)(i); 1926.501(i)(2); 1926.501(b)(4)(ii).
- Y. California State OSHA Fall Protection Code of Regulations, Title 8, Section 3212 (e)(1).

1.3 PERFORMANCE REQUIREMENTS

- A. SOLAMASTER 750 DS-O / 750 DS-C (OPEN/CLOSED CEILING)
 - 1. AAMA/WDMA/CSA 101/IS2/A440, Class CW-PG70, size tested 21 inch (530 mm) diameter, Type TDDOC and Type TDDCC.
 - a. Air Infiltration Test:
 - 1) Air infiltration will not exceed 0.30 cfm/sf aperture with a pressure delta of 1.57 psf across the tube when tested in accordance with ASTM E 283.
 - b. Water Resistance Test:
 - 1) Passes water resistance; no uncontrolled water leakage with a pressure differential of 10.7 psf (512 Pa) or 15 percent of the design load (whichever is greater) and a water spray rate of 5 gallons/hour/sf for 24 minutes when tested in accordance with ASTM E 547 and ASTM E 331.
 - c. Uniform Load Test: All units tested with a safety factor of (3) for positive pressure and (2) for negative pressure, acting normal to plane of roof in accordance with ASTM E 330.
 - 1) No breakage, permanent damage to fasteners, hardware parts, or damage to make daylighting system inoperable or cause excessive permanent deflection of any section when tested at a Positive Load of 150 psf (7.18 kPa) or Negative Load of 70 psf (3.35 kPa).
 - 2. Fire Testing:
 - a. Fire Rated Roof Assemblies:
 - 1) When used with the Dome Edge Protection Band, all domes meet fire rating requirements as described in the International Building Code for Class A, B, and C roof assemblies.
 - b. When used with the Dome Edge Protection Band, all domes meet fire rating requirements as described in the International Building Code.
 - c. Self-Ignition Temperature - Greater than 650 degrees F per ASTM D-1929.
 - d. Smoke Density: Rating no greater than 450 per ASTM E 84 in way intended for use. Classification C.
 - e. Rate of Burn and/or Extent: Maximum Burning Rate: 2.5 inches/min (62 mm/min) Classification CC-2 per ASTM D 635.
 - f. Rate of Burn and/or Extent: Maximum Burn Extent: 1 inch (25 mm) Classification CC-1 per ASTM D 635.
 - 3. FEMA P-361 / ICC 500 Compliance (Tested to comply with highest wind speed Safe Room design of 250 mph).
 - a. Missile Impact: Passes: 15 pound, 13 foot 2 by 4 with a velocity of 98 fps when tested in accordance with ASTM E 1886.
 - b. Uniform Load Test: No failure when tested at a Positive Load of 120.3 psf and a Negative Load of 120.3 psf when tested in accordance with ASTM E 330

- c. Design Pressure: No failure when tested at a Positive Pressure of 100.3 psf and a Negative Pressure of 100.3 psf when tested in accordance with ASTM E 1886 (Air Pressure Cycling)
- 4. Fall Protection Performance:
 - a. Passes fall protection test: No penetration of dome or curb cap when subject to 400 lb (160 Kg)/42 inch (1066 mm) impact drop test when tested in accordance with OSHA 29 CFR 1926.506(c) Safety Net Systems.
 - b. Passes fall protection test: California State OSHA Fall Protection Code of Regulations, Title 8, Section 3212 (e)(1) Skylight Screens.

1.4 SUBMITTALS

- A. Submit under provisions of Division 01.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Data sheets showing roof dome assembly, flashing base, reflective tubes, diffuser assembly, and accessories.
 - 4. Installation requirements.
- C. Shop Drawings. Submit shop drawings showing layout, profiles and product components, including rough opening and framing dimensions, anchorage, roof flashings and accessories.
- D. Electrical wiring diagrams and recommendations for power and control wiring.
- E. Verification Samples: As requested by Architect.
- F. Test Reports: Independent testing agency or evaluation service reports verifying compliance with specified performance requirements.
- G. Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features:

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of twenty years experience in the top lighting industry. Secondary products shall be acceptable to the primary manufacturer.
- B. Installer Qualifications: All products shall be installed by a single installer with a minimum of five years demonstrated experience, with adequate equipment, skilled workers, and practical experience to meet the project schedule.
- C. Skylights shall conform with authorities having jurisdiction and be designed to meet design criteria of the project location and the following:
 - 1. Skylights must be certified by NFRC.
 - 2. TDDs MUST be compliant with ICC 500/FEMA P-361 testing. Test results from NSSA approved test agency must show proof of compliance.
 - 3. Skylights must be Tested and labeled in accordance with AAMA/WDMA/CSA 101/I.S.2/A440.
 - 4. Meet or exceed OSHA 200 pound (90 kg) Drop Tests expressed in 29 CFR 1910.23(e)(8)
 - 5. Skylights shall provide minimum 69 psf (3.30 kPa) design load.

- D. Pre-Installation Meeting: Contractor shall convene a pre-installation meeting on the project site minimum one week before beginning work of this Section. The meeting shall include the Architect or Owner's Representative and representatives of all related trades to:
 - 1. Coordinate between the at least the following trades.
 - a. HVAC, plumbing and mechanical to ensure TDD pathways are clear to the delivery zone
 - b. Electrical to wire components and program lighting controls.
 - c. Roofing to install curbs, flashing and cut hole in roof deck for TDDs
 - 2. Verify project requirements and site logistics.
 - 3. Assess integrity of the roofing system and building structure.
 - 4. Review manufacturer's installation instructions and warranty requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original containers, dry, undamaged, seals and labels intact.
- B. Store products in manufacturer's unopened packaging until ready for installation.

1.7 PROJECT CONDITIONS

- A. Coordinate delivery schedule with the Contractor and project schedule to minimize on site storage.
- B. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- C. Store materials in a dry area, protected from freezing, staining, contamination or damage.

1.8 WARRANTY

- A. Daylighting Device: Manufacturer's standard warranty for 10 years.
- B. Electrical Parts: Manufacturer's standard warranty for 5 years, unless otherwise indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Solatube International, Inc., which is located at: Solatube International 2210 Oak Ridge Way; Vista, CA 92081-8341; Toll Free Tel: 888-765-2882; Tel: (760) 477-1120; Fax: (760) 597-4488; Email: [request info \(commsales@solatube.com\)](mailto:request info (commsales@solatube.com)); Web: <http://www.solatube.com>
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.
- C. General Contractor will bear responsibility for costs associated with substitution review including but not limited to testing, performance data verification and additional material and labor required to bring substituted product up to performance requirements or change out of product to TDD basis of design should submitted substitution not meet performance once installed. This also includes the cost to cover any additional material should the substituted product submittal not include the full amount of tubing or correct accessories to satisfy the tube runs and electrical requirements of this RFP.
- D. All substitutions must provide independent, 3rd party verified testing documentation for ICC 500/FEMA P-361 safe room testing for zone 4. This includes verified pass of the missile impact test for zone 4 as well as test pressures at a minimum of 300 +/- psf. No substitution for the tornado shelter will be allowed without proof of testing and compliance with ICC 500 and FEMA P-361 by National Storm Shelter Association approved test agent

2.2 TUBULAR DAYLIGHTING DEVICES

- A. Tubular Daylighting Devices General for storm shelter: Transparent roof-mounted skylight dome and self-flashing curb, reflective tube, and ceiling level diffuser assembly, transferring sunlight to interior spaces; complying with ICC AC-16 and ICC 500 storm shelter testing.
- B. SolaMaster Series: Solatube Model 750 DS, 21 inch (530 mm) Daylighting System:
1. Model:
 - a. Solatube Model 750 DS Metal RTS, Hard Ceiling. AAMA Type TDDCC.
 2. Capture Zone:
 - a. Roof Dome Assembly: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.
 - 1) Outer Dome Glazing: Type DA, 0.125 inch (3.2 mm) minimum thickness injection molded acrylic classified as CC2 material; UV inhibiting (100 percent UV C, 100 percent UV B and 98.5 percent UV A), impact modified acrylic blend.
 - a) Raybender 3000: Variable prism optic molded into outer dome to capture low angle sunlight and limit high angle sunlight.
 - 2) Acrylic Dome Plus Inner Dome Glazing: Type DPI, Inner Dome is 0.115 inch (3 mm) minimum thickness polycarbonate classified as CC1 material.
 - b. Tube Ring: 0.090 inch (2.3 mm) nominal thickness injection molded high impact PVC. Prevents thermal bridging between base flashing and tubing and channel condensed moisture. Attached to base of dome ring with butyl glazing rope 0.24 inch (6 mm) diameter; to minimize air infiltration.
 - c. Dome Seal: Adhesive backed weatherstrip, 0.63 inch (16 mm) tall by 0.28 inch (7 mm) wide.
 3. Flashings:
 - a. Roof Flashing Base:
 - 1) One Piece: One piece, seamless, leak-proof flashing functioning as base support for dome and top of tube. Sheet steel, corrosion resistant conforming to ASTM A 653/A 653M or ASTM A 463/A 463M or ASTM A792/A 792M, 14 gauge thick.
 - a) Basis-of-Design Product: NTX Building Products; RPC-3 Roof Curb.
 - b) Base Style: Type FC, Curb cap, with inside dimensions of 25 inches by 25 inches to cover curb as specified in Section 07 62 00.
 - b. Flashing Options:
 - 1) Curb Cap Insulation: Type CCI, Nominal 1 inch thick thermal insulation pad to reduce thermal conduction between curb-cap and tubing and thermal convection between room air and curb-cap. Rated R-6 (OFxft2xhr/Btu) Insulation is Polyisocyanurate foam utilizing CFC, HCFC, & HFC free blowing agent. Type-1 Class-1 per ASTM C 1289; Passes UL 1715 (15-minute thermal barrier per IBC 2603.4); Attic ventilation may be required per IBC 1203.2(OFxft2xhr/Btu). For use with Flashing Type FC.
 4. Transfer Zone:
 - a. Extension Tubes: Aluminum sheet, thickness 0.018 inch (0.5 mm) conforming to ASTM B 209.
 - 1) Reflective Tubes:
 - a) Reflective extension tube, Type EXX and Type EL with total length of run as indicated on the Drawings.
 - b) Interior Finish: Spectralight Infinity with INFRAREduction Technology combining ultra-high Visible Light reflectance with Ultra-low Infrared (IR) reflectance.
 - 2) Tube Options
 - a) Wire Suspension Kit: Type E, Use the wire suspension kit when additional bracing to the structure is required.

5. Delivery Zone:
 - a. Diffuser Assemblies for Tubes Penetrating Ceilings: Ceiling mounted box transition from round tube to square ceiling assembly, supporting light transmitting surface at bottom termination of tube; square frame in size as required to fit standard suspended ceiling grids or hard ceilings.
 - 1) Polymeric Transition Box: Type TP, round-to-square transition box made of opaque polymeric material, classified as CC2, Class C, 0.110 inch thick.
 - 2) Lens: Type L2P, Polycarbonate lens. Visible Transmission shall be greater than 90 percent at 0.125 inch (2.5 mm) thick. Classified as CC1.
 - 3) Diffuser Seal: Open cell foam, acrylic adhesive backed, 0.75 in (19 mm) wide by 0.125 in (3.2 mm) thick to minimize condensation and bug, dirt and air infiltration per ASTM E 283.
 - 4) Diffuser Trim Ring: Injection molded acrylic. Nominal wall thickness 0.172 inches (4.4 mm).
 - 5) Diffuser Trim Ring for Lens Type L2P: Injection molded polycarbonate. Nominal wall thickness 0.172 inches (4.4 mm).

2.3 ACCESSORIES

- A. Fasteners: Same material as metals being fastened, non-magnetic steel, non-corrosive metal of type recommended by manufacturer, or injection molded nylon.
- B. Screws: As recommended by manufacturer.
 1. Nominal Screw Size: #10.
 2. Thickness: 0.075 inch.
- C. Anchors: As recommended by manufacturer.
 1. Wedge Type Anchors: Red Head; Trubolt Wedge Anchors.
 - a. Anchor Diameter: 3/8 inch.
 - b. Embedment Depth: 1-1/2 inches.
 - c. Finish: Hot-dipped galvanized.
 - d. Tension: 1,620 lbs.
 - e. Shear: 2,320 lbs.
- D. Suspension Wire: Steel, annealed, galvanized finish, size and type for application and ceiling system requirement.
- E. Sealant: Polyurethane or copolymer based elastomeric sealant as provided or recommended by manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Examine openings, substrates, structural support, anchorage, and conditions for compliance with requirements for installation tolerances and other conditions.
- C. If substrate and rough opening preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Coordinate requirements for power supply, conduit and wiring.

- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's printed instructions and with ICC 500 storm shelter TDD installation method as shown in manufacturer's installation instructions demonstrating ICC 500 compliance.
- B. Coordinate installation with substrates, air and vapor retarders, roof insulation, roofing membrane, and flashing to ensure that each element of the Work performs properly and that finished installation is weather tight.
 - 1. Install flashing to produce weatherproof seal with curb and overlap with roofing system termination at top of curb.
 - 2. Provide thermal isolation when components penetrate or disrupt building insulation. Pack fibrous insulation in rough opening to maintain continuity of thermal barriers.
 - 3. Coordinate attachment and seal of perimeter air and vapor barrier material.
- C. Where metal surfaces of tubular unit skylights will contact incompatible metal or corrosive substrates, including preservative-treated wood, provide permanent separation as recommended by manufacturer
- D. Align device free of warp or twist, maintain dimensional tolerances.
- E. After installation of first unit, field test to determine adequacy of installation. Conduct water test in presence of Owner, Architect, or Contractor, or their designated representative. Correct if needed before proceeding with installation of subsequent units.
- F. Inspect installation to verify secure and proper mounting. Test each fixture to verify operation, control functions, and performance. Correct deficiencies.

3.4 CLEANING

- A. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes commercial door hardware for the following:
1. Swinging doors.
 2. Sliding doors.
 3. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
1. Mechanical door hardware.
 2. Electromechanical door hardware.
 3. Cylinders specified for doors in other sections.
- C. Related Sections:
1. Division 08 Section "Hollow Metal Doors and Frames".
 2. Division 08 Section "Flush Wood Doors".
 3. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
 4. Division 28 Section "Access Control Hardware Devices".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 2. FEMA P-361 2015/2021 - Design and Construction Guidance for Community Safe Rooms.
 3. ICC 500-2014/2020, ICC/NSSA Standard for the Design and Construction of Storm Shelters.
 4. ICC/IBC - International Building Code.
 5. NFPA 70 - National Electrical Code.
 6. NFPA 80 - Fire Doors and Windows.
 7. NFPA 101 - Life Safety Code.
 8. NFPA 105 - Installation of Smoke Door Assemblies.
 9. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
1. ANSI/BHMA Certified Product Standards - A156 Series.
 2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
 3. ANSI/UL 294 - Access Control System Units.
 4. UL 305 - Panic Hardware.
 5. ANSI/UL 437- Key Locks.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
 - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.
 - c. Wiring instructions for each electronic component scheduled herein.
 2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Proof of Certification: Provide copy of manufacturer(s) official certification or accreditation document indicating proof of status as a qualified and authorized provider of the primary Integrated Wiegand Access Control Products.
- E. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

F. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

1.3 CLOSEOUT SUBMITTALS

- A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1. Maintenance manual must be provided for tornado/hurricane storm shelter impact protective systems.

- B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

- B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

- E. Integrated Wireless, and IP-Enabled Access Control Products Supplier Qualifications: Integrated access control products and accessories are required to be supplied and installed through current members of the ASSA ABLOY "Authorized Channel Partner" (ACP) and "Certified Integrator" (CI) programs. Suppliers are to be factory trained, certified prior to project bid, and a direct purchaser of the specified product. Installers are to be factory trained, certified prior to project bid, and are responsible for commissioning, servicing, and warranting the installed equipment specified for the project.

- F. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

- G. Storm Shelter Openings: Provide complete door systems for hurricane or tornado resistant storm shelters and other areas of refuge complying and tested according to ICC 500 (2014/2020), ICC/NSSA Standard for the Design and Construction of Storm Shelters.
 - H. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.
 - I. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
 - 1. Function of building, purpose of each area and degree of security required.
 - 2. Plans for existing and future key system expansion.
 - 3. Requirements for key control storage and software.
 - 4. Installation of permanent keys, cylinder cores and software.
 - 5. Address and requirements for delivery of keys.
 - J. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
 - 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 - 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 - 3. Review sequence of operation narratives for each unique access controlled opening.
 - 4. Review and finalize construction schedule and verify availability of materials.
 - 5. Review the required inspecting, testing, commissioning, and demonstration procedures
 - K. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.
- 1.5 DELIVERY, STORAGE AND HANDLING
- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
 - B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
 - C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".
- 1.6 COORDINATION
- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.
- C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Storm Shelter Openings: Furnish a complete set of operational and maintenance instructions as needed for Owner's continued adjustment, maintenance, and repairs of door hardware as required by ICC 500 (2020), ICC/NSSA Standard for the Design and Construction of Storm Shelters.

PART 2 - PRODUCTS

2.1 BUTT HINGES

- A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
 - 1. Quantity: Provide the following hinge quantity:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
 4. Hinge Options: Comply with the following:
 - a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.
 5. Manufacturers:
 - a. McKinney (MK) - TA/T4A Series, 5-knuckle.
- B. Hinges at Storm Shelter Assemblies: At a minimum, provide heavy weight hinges with stainless steel screws used in accordance with and specified as part of a Severe Storm Shelter Opening meeting ICC 500 and FEMA 361.
1. Quantity: Provide the following hinge quantity:
 - a. Three Hinges: For shutters with heights 36 to 60 inches, and doors at height of 80 inches.
 - b. Four Hinges: For shutters with heights > 60 inches to 80 inches, and doors with heights greater than 84 inches.
 2. Quantity: Provide the following hinge quantity:
 - a. Three Hinges: For shutters with heights 36 to 60 inches, and doors at height of 80 inches.
 - b. Four Hinges: For shutters with heights > 60 inches to 80 inches, and doors with heights greater than 84 inches.
 - c. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - d. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - e. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
 3. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
 4. Hinge Weight and Base Material: At a minimum, provide heavy weight hinges with stainless steel screws used in accordance with and specified as part of a certified Storm Shelter Opening meeting ICC 500.
 5. Manufacturers:
 - a. McKinney (MK) - SP3386/SP3786.

2.2 CONTINUOUS HINGES

- A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:
 - a. Pemko (PE).

2.3 POWER TRANSFER DEVICES

- A. Electrified Quick Connect Continuous Geared Transfer Hinges: Provide electrified transfer continuous geared hinges with a removable service panel cutout accessible without de-mounting door from the frame. Furnish with Molex™ standardized plug connectors with sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:
 - a. Pemko (PE) - SER-QC (# wires) Option.

- B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:
 - a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
 - b. McKinney (MK) - Connector Hand Tool: QC-R003.
2. Manufacturers:
 - a. McKinney (MK) - QC-C Series.

- C. Storm Shelter Compliance: Power transfer devices to be U.L. listed for windstorm components.

- D. Provide mortar guard enclosure on steel frames installed at masonry openings for each electrical hinge specified.

2.4 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.

4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
5. Manufacturers:
 - a. Rockwood (RO).
- B. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
 1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
 2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
 3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
 4. Pulls, where applicable, shall be provided with a 10" clearance from the finished floor on the push side to accommodate wheelchair accessibility.
 5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
 6. Manufacturers:
 - a. Rockwood (RO).

2.5 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
 1. Threaded mortise cylinders with rings and cams to suit hardware application.
 2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
 4. Tubular deadlocks and other auxiliary locks.
 5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 6. Keyway: Match Facility Restricted Keyway.
- C. Large Format Interchangeable Cores: Provide removable cores (LFIC) as specified, core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.
- D. High Security Cylinders: ANSI/BHMA A156.5, Grade 1 Certified Products Directory (CPD) listed cylinders certified to UL437, including pick and drill resistance. Pick resistance to incorporate two or more independent locking mechanisms including a pin tumbler device with five or six pin chambers, mushroom-shaped driver pins, and sidebar locking mechanism operated independently from the six top pin tumbler device. Drill resistance to incorporate cylinder housing with fixed case-hardened inserts protecting the pin tumbler shear line, cylinder plugs with case-hardened inserts protecting both the pin tumbler shear line and the side bar, mushroom-shaped stainless steel driver pins, and stainless steel side pins. Cylinders to be factory keyed.
 1. New high security key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.
 2. Manufacturers:

- a. Corbin Russwin (RU) - Pyramid PHS.
 - b. No Substitution.
 - E. Keying System: Each type of lock and cylinders to be factory keyed.
 1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
 3. Existing System: Field verify and key cylinders to match Owner's existing system.
 - F. Key Quantity: Provide the following minimum number of keys:
 1. Change Keys per Cylinder: Two (2)
 2. Master Keys (per Master Key Level/Group): Five (5).
 3. Construction Keys (where required): Ten (10).
 4. Construction Control Keys (where required): Two (2).
 5. Permanent Control Keys (where required): Two (2).
 - G. Construction Keying: Provide temporary keyed construction cores.
 - H. Key Registration List (Bitting List):
 1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
 2. Provide transcript list in writing or electronic file as directed by the Owner.
- 2.6 KEY CONTROL
- A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
 1. Manufacturers:
 - a. Lund Equipment (LU).
 - b. MMF Industries (MM).
 - c. Telkee (TK).
- 2.7 MORTISE LOCKS AND LATCHING DEVICES
- A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.
 1. Provide locksets with functions and features as follows:
 - a. Heavy duty 12-gauge wrought steel case.
 - b. Stainless steel 3/4" one-piece anti-friction reversible latchbolt with a one-piece hardened stainless steel 1" projection deadbolt.
 - c. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
 - d. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.

- e. Meets UL Certification Directory ZHLL.R21744 for products used in windstorm rated assemblies.
- f. Extended cycle test: Locks to have been cycle tested in ordinance with ANSI/BHMA 156.13 requirements to 14.5 million cycles or greater.
- g. Status indicators inside, outside, or on both sides of doors as specified; available with wording for "locked/unlocked", "vacant/occupied" or custom wording options. Indicator to be located above the cylinder with the inside thumb-turn not blocking the visibility of the indicator status.
- h. Ten-year limited warranty for mechanical functions.

2. Manufacturers:

- a. Corbin Russwin Hardware (RU) - ML2000 Series.
- b. No Substitution.

2.8 MULTI-POINT LOCKS AND LATCHING DEVICES

- A. Multi-Point Locksets, Storm Shelter: Provide ANSI/BHMA A156.37, Series 1000, Operational Grade 1 and Security Grade 1 Certified Products Directory (CPD) listed multi-point locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Provide locksets with functions and features as follows:

- a. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
- b. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
- c. Meets Florida Building Code FL2998 and UL Certification Directory ZHEM.R21744 for latching hardware for hurricane requirements.
- d. Approved for usage as part of a complete ICC 500 (2014/2020) and FEMA P-361 (2015/2021) door, frame, and hardware assemblies for storm shelter components.
- e. Lever torque to retract all bolts less than 28 in.lb.
- f. Cycle tested to 1,000,000 cycles.
- g. Seven-year limited warranty for mechanical functions.

2. Manufacturers:

- a. Corbin Russwin Hardware (RU) - FE6600 Series.

2.1 INTEGRATED WIRED OUTPUT LOCKING DEVICES - MULTI-CLASS READER

- A. Integrated Wired Output Multi-Class Mortise Locks: Wiegand or Open Supervised Device Protocol (OSDP) output ANSI A156.13, Grade 1, mortise lockset with integrated card reader with or without keypad option, request-to-exit signaling, door position status switch, and latchbolt monitoring in one complete unit. Hard wired, solenoid driven locking/unlocking control of the lever handle trim, 3/4" deadlocking anti-friction latch, and 1" case-hardened steel deadbolt. Lock is U.L listed and labeled for use on up to 3 hour fire rated openings. Available with or without keyed high security cylinder override.

- 1. Open architecture, hard wired platform supports centralized control of locking units with new or existing Wiegand or OSDP compatible access control systems. Latchbolt monitoring and door position switch act in conjunction to report door-in-frame (DPS) and door latched (door closed and latched) conditions.
- 2. Integrated reader supports the following credentials:

- a. 125kHz proximity credentials: HID, AWID, Indala, and EM4102.
- b. 13.56 MHz proximity credentials: HID Secure Identity Object™ (SIO) on iCLASS Seos, HID iCLASS, HID iCLASS SE/SR, MIFARE Classic, DESFire EV1 and EV2.

- c. 2.4 GHz credentials: Secure Identity Object™ (SIO) on Mobile IDs (Bluetooth Smart)
 - d. ISO14443A/B (PIV-compatible Transparent FASC-N read) available with pivCLASS variant
 - e. NFC-enabled mobile phones
 - f. PIN code only or PIN + credential with keypad option.
3. 12VDC external power supply required for reader and lock, with optional 24VDC lock solenoid. Fail safe or fail secure options.
 4. Energy Efficient Design: Provide lock bodies which have a holding current draw of 500mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.
 5. Support end-of-line resistors contained within the lock case.
 6. Installation requires only one cable run from the lock to the access control panel without requirements for additional proprietary lock panel interface boards or modules.
 7. Installation to include manufacturer's access control panel interface board or module where required for Wiegand or OSDP output protocol.
 8. Manufacturers:
 - a. Corbin Russwin (RU) - ML2000 SN Series.
 - b. No Substitution.

2.2 DEADLOCKS AND LATCHES

- A. Mortise Deadlocks, Small Case: ANSI/BHMA A156.36, Grade 1, small case mortise type deadlocks constructed of heavy gauge wrought corrosion resistant steel. Steel or stainless steel bolts with a 1" throw and hardened steel roller pins. Deadlocks to be products of the same source manufacturer and keyway as other specified locksets.
 1. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - DL4000 Series.
 - b. No Substitution.

2.3 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
 4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.
- B. Standards: Comply with the following:
 1. Strikes for Mortise Locks and Latches: BHMA A156.13.
 2. Strikes for Bored Locks and Latches: BHMA A156.2.
 3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
 4. Dustproof Strikes: BHMA A156.16.

2.4 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
1. Exit devices shall have a five-year warranty.
 2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
 3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
 4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
 5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
 6. Flush End Caps: Provide flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.
 7. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
 - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
 - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
 8. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
 9. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
 10. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 11. Rail Sizing: Provide exit device rails factory sized for proper door width application.
 12. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.
1. Electromechanical exit devices shall have the following functions and features:
 - a. Universal Molex plug-in connectors that have standardized color-coded wiring and are field configurable in fail safe or fail secure and operate from 12vdc to 24vdc regulated.
 - b. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
 - c. Options to be available for request-to-exit or enter signaling, latchbolt and touchbar monitoring.
 - d. Field configurable electrified trim to fail-safe or fail-secure that operates from 12-24VDC.
 - e. Five-year limited warranty for electromechanical features.
 2. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
 - b. No Substitution.

- C. Security Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed rim panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be constructed of high grade, heat treated, corrosion resistant nickel steel alloy, and have a full 3/4" throw projection with slide action positive deadlocking.
 - 1. Static Load Force Resistance: Minimum 3000 lbs. certified independent tested.
 - 2. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - ED4000S / ED5000S Series.
 - b. No Substitution.

- D. Multi-Point Exit Devices (Storm Shelter Openings): Multi-point exit devices specifically engineered for out-swinging door applications on tornado or hurricane resistant storm shelter openings. Extra heavy duty steel component construction with each of the latching points automatically activated when the device is locked. The multi-point exit device is approved for usage as part of a complete ICC 500 (2014/2020) and FEMA P-361 (2015/2021) door, frame and hardware assembly.
 - 1. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - FE5400S Series.

- E. Steel Removable Mullions: ANSI/BHMA A156.3 steel removable mullions with options for fire rating, locking, through-wire electrification and hurricane compliance as specified.
 - 1. Provide mullions with functions and features as follows:
 - a. At openings designed for severe wind load conditions due to hurricanes or tornadoes, provide manufacturer's certified mullion and accessories to meet applicable state and local windstorm codes.
 - b. Provide keyed removable feature where specified in the Hardware Sets.
 - c. Provide stabilizers and mounting brackets as required.
 - 2. Manufacturers:
 - a. Same as exit device manufacturer.

2.5 INTEGRATED WIRED OUTPUT EXIT DEVICES - MULTI-CLASS READER

- A. Integrated Wired Output Multi-Class Exit Hardware: Wiegand output ANSI 156.3 Grade 1 rim, mortise, and vertical rod exit device hardware with integrated card reader with or without keypad option, latchbolt and touchbar monitoring, and request-to-exit signaling, in one complete unit. Hard wired, solenoid driven locking/unlocking control of the lever handle exit trim with 3/4" throw latch bolt. U.L listed and labeled for either panic or "fire exit hardware" for use on up to 3 hour fire rated openings. Available with or without keyed high security cylinder override.
 - 1. Open architecture, hard wired platform supports centralized control of locking units with new or existing Wiegand or OSDP compatible access control systems. Inside push bar (request-to-exit) signaling and door position (open/closed status) monitoring (via separately connected DPS).
 - 2. Integrated reader supports the following credentials:
 - a. 125kHz proximity credentials: HID, AWID, Indala, and EM4102.
 - b. 13.56 MHz proximity credentials: HID Secure Identity Object™ (SIO) on iCLASS Seos, HID iCLASS, HID iCLASS SE/SR, MIFARE Classic, DESFire EV1 and EV2.
 - c. 2.4 GHz credentials: Secure Identity Object™ (SIO) on Mobile IDs (Bluetooth Smart)
 - d. ISO14443A/B (PIV-compatible Transparent FASC-N read) available with pivCLASS variant
 - e. NFC-enabled mobile phones

- f. PIN code only or PIN + credential with keypad option
3. 12VDC external power supply required for reader. 24VDC required for solenoid operated exit trim. Fail safe or fail secure options.
 4. Installation requires only one cable run from the exit hardware to the access control panel without requirements for additional proprietary lock panel interface boards or modules.
 5. Competitor Alternates Allowed Option: Installation to include manufacturer's access control panel interface board or module where required for Wiegand or OSDP output protocol.
 6. Manufacturers:
 - a. Corbin Russwin (RU) - ED5000 SN Series.
 - b. No Substitution.

2.6 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
 1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
 2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
 3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
 4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
 7. Storm Shelter Compliance: Door closers to be U.L. listed for windstorm assemblies where applicable. Provide the appropriate storm shelter products that have been independently third party tested, certified, and labeled to meet state and local windstorm building codes applicable to project.
- B. Door Closers, Surface Mounted (Large Body Cast Iron): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control.
 1. Large body cast iron surface mounted door closers shall have a 30-year warranty.
 2. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - DC8000 Series.
- C. Door Closers, Surface Mounted (Commercial Duty): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, institutional grade door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.
 1. Manufacturers:

- a. Corbin Russwin Hardware (RU) - DC6000 Series.
- b. No Substitution.

2.7 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, 050-inch thick.
5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:
 - a. Rockwood (RO).

2.8 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:
 - a. Rockwood (RO).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:
 - a. Norton Rixson (RF).
 - b. Sargent Manufacturing (SA).

2.9 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Hurricane and Storm Shelter Compliance: Devices to be U.L. listed for windstorm assemblies where applicable. Provide the appropriate hurricane or storm shelter products that have been independently third party tested, certified, and labeled to meet state and local windstorm building codes applicable to project.
- G. Manufacturers:
 - 1. Pemko (PE).

2.10 ELECTRONIC ACCESSORIES

- A. Push-Button Switches: Industrial grade momentary or alternate contact, back-lighted push buttons with stainless-steel switch enclosures. 12/24 VDC bi-color illumination suitable for either flush or surface mounting.
 - 1. Manufacturers:
 - a. Alarm Controls (AK) - TS Series.
 - b. Securitron (SU) - PB Series.
- B. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.
 - 1. Manufacturers:
 - a. Securitron (SU) - DPS Series.
- C. Switching Power Supplies: Provide power supplies with either single or dual voltage configurations at 12 or 24VDC. Power supplies shall have battery backup function with an integrated battery charging circuit and shall provide capability for power distribution, direct lock control and Fire Alarm Interface (FAI) through add on modules. Power supplies shall be expandable up to 16 individually protected outputs. Output modules shall provide individually protected, continuous outputs and/or individually protected, relay controlled outputs.

1. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.
2. Manufacturers:
 - a. Securitron (SU) - AQD Series.

2.11 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.12 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
- E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.5 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.6 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.7 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.
 3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
 4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.
- B. Refer to attached document for Door Hardware Schedule.

END OF SECTION

DOOR HARDWARE SCHEDULE

A. Manufacturer's Abbreviations:

1. MK - McKinney
2. OT - Other
3. PE - Pemko
4. RO - Rockwood
5. RU - Corbin Russwin
6. RF - Rixson
7. SU - Securitron
8. AK - Alarm Controls

Hardware Sets

Set: 1.0

Doors: A100.2, A137.2, A150, B000.3, B120

Description: Exterior, Pair, AD&F, SN200 Rim Panic, Closer w/Stop, ELR

1	Continuous Hinge	CFMXXSLF-HD1-M		PE	
1	Continuous Hinge	CFMXXSLF-HD1 SER		PE	⚡
1	Key Removable Mullion	CR972BKM 7'2" M57 CT6R		RU	
1	Rim Exit Device, Exit Only	ED5200S EO M110 M54 M52 CT6R	630	RU	
1	Access Control Rim Exit Device, MELR	ED5200SN-SN200 K157ET BIPS B03 M110 M54 MELR CT6R	630	RU	⚡
1	Interchangeable Core - Exterior	CR8020 Keyed into Existing System	626	RU	
2	Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU	
2	Pull	RM202 Mtg-Type 12XHD	US32D	RO	
2	Conc Overhead Stop	1-x36	630	RF	
2	Surface Closer, PA	DC6210 A3 M85 M78	689	RU	
2	Drop Plate	597F58	689	RU	
1	Gasketing (mullion)	5110BL		PE	
1	Perimeter Gasketing	By Door and Frame Manufacturer		OT	
2	Sweep	345APK TKSP		PE	
1	Threshold	273x292AFGPK MSES25SS		PE	
1	ElectroLynx Harness	QC-CXXX Length as Required		MK	⚡
1	ElectroLynx Harness	QC-C1500P		MK	⚡
1	Position Switch	DPS		SU	⚡
1	Power Supply	AQD (Size and Relays as Required)		SU	⚡

Notes: Coordinate hardware with Aluminum Door and Frame manufacturer. Provide special templates, brackets, spacers, drop plates and fasteners as required. Confirm hardware finish with architect prior to ordering.

Access control locking device to be furnished by Authorized Channel Partner (ACP) and installed by Certified Integrator (CI).

Door normally closed and locked.

Entry by valid credential or manual key override.

Always free egress.

Upon activation of the fire alarm or loss of power, door remains locked.

Set: 2.0

Doors: A100.1, A137.1, B000.1, B000.2, B000.4, C001.1, C002.1

Description: Exterior, Pair, AD&F, Exit Only Rim Panic, Closer w/Stop, DPS

2	Continuous Hinge	CFMXXSLF-HD1-M		PE
1	Key Removable Mullion	CR972BKM 7'2" M57 CT6R		RU
2	Rim Exit Device, Exit Only	ED5200S EO M110 M54 M52 CT6R	630	RU
2	Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
2	Pull	RM202 Mtg-Type 12XHD	US32D	RO
2	Conc Overhead Stop	1-x36	630	RF
2	Surface Closer, PA	DC6210 A3 M85 M78	689	RU
2	Drop Plate	597F58	689	RU
1	Gasketing (mullion)	5110BL		PE
1	Perimeter Gasketing	By Door and Frame Manufacturer		OT
2	Sweep	345APK TKSP		PE
1	Threshold	273x292AFGPK MSES25SS		PE
2	Position Switch	DPS		SU ⚡

Notes: Coordinate hardware with Aluminum Door and Frame manufacturer. Provide special templates, brackets, spacers, drop plates and fasteners as required. Confirm hardware finish with architect prior to ordering.

Set: 3.0

Doors: A190.1, C001.2

Description: Exterior, Single, AD&F, SN200 Rim Panic, Closer w/Stop, ELR

1 Continuous Hinge	CFMXXSLF-HD1 SER		PE	⚡
1 Access Control Rim Exit Device, MELR	ED5200SN-SN200 K157ET BIPS B03 M110 M54 MELR CT6R	630	RU	⚡
1 Interchangeable Core - Exterior	CR8020 Keyed into Existing System	626	RU	
1 Pull	RM202 Mtg-Type 12XHD	US32D	RO	
1 Conc Overhead Stop	1-x36	630	RF	
1 Surface Closer, PA	DC6210 A3 M85 M78	689	RU	
1 Drop Plate	597F58	689	RU	
1 Perimeter Gasketing	By Door and Frame Manufacturer		OT	
1 Sweep	345APK TKSP		PE	
1 Threshold	273x292AFGPK MSES25SS		PE	
1 ElectroLynx Harness	QC-CXXX Length as Required		MK	⚡
1 ElectroLynx Harness	QC-C1500P		MK	⚡
1 Power Supply	AQD (Size and Relays as Required)		SU	⚡

Notes: Coordinate hardware with Aluminum Door and Frame manufacturer. Provide special templates, brackets, spacers, drop plates and fasteners as required. Confirm hardware finish with architect prior to ordering.

Access control locking device to be furnished by Authorized Channel Partner (ACP) and installed by Certified Integrator (CI).

Door normally closed and locked.

Entry by valid credential or manual key override.

Always free egress.

Upon activation of the fire alarm or loss of power, door remains locked.

Set: 3.1

Doors: A190.2

Description: Exterior, Single, AD&F, Exit Only Rim Panic, Closer w/Stop, DPS

1	Continuous Hinge	CFMXXSLF-HD1-M		PE
1	Rim Exit Device, Exit Only	ED5200S EO M110 M54 M52 CT6R	630	RU
1	Interchangeable Core - Exterior	CR8020 Keyed into Existing System	626	RU
1	Pull	RM202 Mtg-Type 12XHD	US32D	RO
1	Conc Overhead Stop	1-x36	630	RF
1	Surface Closer, PA	DC6210 A3 M85 M78	689	RU
1	Drop Plate	597F58	689	RU
1	Perimeter Gasketing	By Door and Frame Manufacturer		OT
1	Sweep	345APK TKSP		PE
1	Threshold	273x292AFGPK MSES25SS		PE
1	Position Switch	DPS		SU ⚡

Notes: Coordinate hardware with Aluminum Door and Frame manufacturer. Provide special templates, brackets, spacers, drop plates and fasteners as required. Confirm hardware finish with architect prior to ordering.

Set: 4.0

Doors: A100.3

Description: Vestibule, Pair, AD&F, SN200 Rim Panic, Closer w/Stop, ELR

1	Continuous Hinge	CFMXXSLF-HD1-M		PE	
1	Continuous Hinge	CFMXXSLF-HD1 SER		PE	⚡
1	Key Removable Mullion	CR972BKM 7'2" M57 CT6R		RU	
1	Rim Exit Device, Exit Only	ED5200S EO M110 M54 M52 CT6R	630	RU	
1	Access Control Rim Exit Device, MELR	ED5200SN-SN200 K157ET BIPS B03 M110 M54 MELR CT6R	630	RU	⚡
1	Interchangeable Core - Exterior	CR8020 Keyed into Existing System	626	RU	
2	Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU	
2	Pull	RM202 Mtg-Type 12XHD	US32D	RO	
2	Conc Overhead Stop	1-x36	630	RF	
2	Surface Closer, PA	DC6210 A3 M85 M78	689	RU	
2	Drop Plate	597F58	689	RU	
1	Gasketing (mullion)	5110BL		PE	
1	Perimeter Gasketing	By Door and Frame Manufacturer		OT	
1	ElectroLynx Harness	QC-CXXX Length as Required		MK	⚡
1	ElectroLynx Harness	QC-C1500P		MK	⚡
1	Position Switch	DPS		SU	⚡
1	Power Supply	AQD (Size and Relays as Required)		SU	⚡

Notes: Coordinate hardware with Aluminum Door and Frame manufacturer. Provide special templates, brackets, spacers, drop plates and fasteners as required. Confirm hardware finish with architect prior to ordering.

Access control locking device to be furnished by Authorized Channel Partner (ACP) and installed by Certified Integrator (CI).

Door normally closed and locked.

Entry by valid credential or manual key override.

Always free egress.

Upon activation of the fire alarm or loss of power, door remains locked.

Set: 5.0

Doors: A100.4

Description: Vestibule, Pair, AD&F, Exit Only Rim Panic, Closer w/Stop, DPS

2	Continuous Hinge	CFMXXSLF-HD1-M		PE
1	Key Removable Mullion	CR972BKM 7'2" M57 CT6R		RU
2	Rim Exit Device, Exit Only	ED5200S EO M110 M54 M52 CT6R	630	RU
2	Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
2	Pull	RM202 Mtg-Type 12XHD	US32D	RO
2	Conc Overhead Stop	1-x36	630	RF
2	Surface Closer, PA	DC6210 A3 M85 M78	689	RU
2	Drop Plate	597F58	689	RU
1	Gasketing (mullion)	5110BL		PE
1	Perimeter Gasketing	By Door and Frame Manufacturer		OT
2	Position Switch	DPS		SU ⚡

Notes: Coordinate hardware with Aluminum Door and Frame manufacturer. Provide special templates, brackets, spacers, drop plates and fasteners as required. Confirm hardware finish with architect prior to ordering.

Set: 6.0

Doors: A137.3, A137.4, C001.3

Description: Vestibule, Pair, AD&F, Push / Pull, Closer w/Stop

2	Continuous Hinge	CFMXXSLF-HD1-M		PE
2	Push Bar	ED5000DB EO	630	RU
2	Pull	RM202 Mtg-Type 12XHD	US32D	RO
2	Surface Closer, PA	DC6210 A3 M85 M78	689	RU
2	Drop Plate	597F58	689	RU
1	Perimeter Gasketing	By Door and Frame Manufacturer		OT

Notes: Coordinate hardware with Aluminum Door and Frame manufacturer. Provide special templates, brackets, spacers, drop plates and fasteners as required. Confirm hardware finish with architect prior to ordering.

Set: 7.0

Doors: A101.1

Description: Vestibule, Single, AD&F, SN200 Rim Panic, Closer w/Stop, ELR

1 Continuous Hinge	CFMXXSLF-HD1 SER		PE	⚡
1 Access Control Rim Exit Device, MELR	ED5200SN-SN200 K157ET BIPS B03 M110 M54 MELR CT6R	630	RU	⚡
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU	
1 Pull	RM202 Mtg-Type 12XHD	US32D	RO	
1 Conc Overhead Stop	1-x36	630	RF	
1 Surface Closer, PA	DC6210 A3 M85 M78	689	RU	
1 Drop Plate	597F58	689	RU	
1 Perimeter Gasketing	By Door and Frame Manufacturer		OT	
1 ElectroLynx Harness	QC-CXXX Length as Required		MK	⚡
1 ElectroLynx Harness	QC-C1500P		MK	⚡
1 Door Release	TS-18		AK	⚡
1 Power Supply	AQD (Size and Relays as Required)		SU	⚡

Notes: Coordinate hardware with Aluminum Door and Frame manufacturer. Provide special templates, brackets, spacers, drop plates and fasteners as required. Confirm hardware finish with architect prior to ordering.

Access control locking device to be furnished by Authorized Channel Partner (ACP) and installed by Certified Integrator (CI).

Door normally closed and locked.
 Entry by valid credential, remote release or manual key override.
 Always free egress.
 Upon activation of the fire alarm or loss of power, door remains locked.

Set: 8.0

Doors: C001.4

Description: Vestibule, Single, AD&F, Push / Pull, Closer w/Stop

1 Continuous Hinge	CFMXXSLF-HD1-M		PE	
1 Push Bar	ED5000DB EO	630	RU	
1 Pull	RM202 Mtg-Type 12XHD	US32D	RO	
1 Surface Closer, PA	DC6210 A3 M85 M78	689	RU	
1 Drop Plate	597F58	689	RU	
1 Perimeter Gasketing	By Door and Frame Manufacturer		OT	

Notes: Coordinate hardware with Aluminum Door and Frame manufacturer. Provide special templates, brackets, spacers, drop plates and fasteners as required. Confirm hardware finish with architect prior to ordering.

Set: 9.0

Doors: E211.3

Description: Exterior, Pair, HMD&F, SN200 Rim Panic, Closer w/Stop, ELR

5 Hinge, Full Mortise, Hvy Wt	T4A3386 NRP 4-1/2" x 4-1/2"	US32D	MK
1 Hinge, Full Mortise, Hvy Wt	T4A3386 QC 4-1/2" x 4-1/2"	US32D	MK ⚡
1 Key Removable Mullion	CR972BKM 7'2" M57 CT6R		RU
1 Rim Exit Device, Exit Only	ED5200S EO M110 M54 M52 CT6R	630	RU
1 Access Control Rim Exit Device, MELR	ED5200SN-SN200 K157ET BIPS B03 M110 M54 MELR CT6R	630	RU ⚡
1 Interchangeable Core - Exterior	CR8020 Keyed into Existing System	626	RU
2 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
2 Pull	RM202 Mtg-Type 12XHD	US32D	RO
2 Surface Closer	DC6210 A11	689	RU
1 Gasketing	2891APK TKSP		PE
1 Gasketing (mullion)	5110BL		PE
2 Sweep	345APK TKSP		PE
1 Threshold	273x292AFGPK MSES25SS		PE
1 ElectroLynx Harness	QC-CXXX Length as Required		MK ⚡
1 ElectroLynx Harness	QC-C1500P		MK ⚡
1 Position Switch	DPS		SU ⚡
1 Power Supply	AQD (Size and Relays as Required)		SU ⚡

Notes: Access control locking device to be furnished by Authorized Channel Partner (ACP) and installed by Certified Integrator (CI).

Door normally closed and locked.

Entry by valid credential or manual key override.

Always free egress.

Upon activation of the fire alarm or loss of power, door remains locked.

Set: 9.1

Doors: A147.1

Description: Exterior, Single, HMD&F, SN200 Rim Panic, Closer w/Stop, ELR

2 Hinge, Full Mortise, Hvy Wt	T4A3386 NRP 4-1/2" x 4-1/2"	US32D	MK
1 Hinge, Full Mortise, Hvy Wt	T4A3386 QC 4-1/2" x 4-1/2"	US32D	MK ⚡
1 Access Control Rim Exit Device, MELR	ED5200SN-SN200 K157ET BIPS B03 M110 M54 MELR CT6R	630	RU ⚡
1 Interchangeable Core - Exterior	CR8020 Keyed into Existing System	626	RU
1 Pull	RM202 Mtg-Type 12XHD	US32D	RO
1 Surface Closer	DC6210 A11	689	RU
1 Gasketing	2891APK TKSP		PE
1 Sweep	345APK TKSP		PE
1 Threshold	273x292AFGPK MSES25SS		PE
1 ElectroLynx Harness	QC-CXXX Length as Required		MK ⚡
1 ElectroLynx Harness	QC-C1500P		MK ⚡
1 Position Switch	DPS		SU ⚡
1 Power Supply	AQD (Size and Relays as Required)		SU ⚡

Notes: Access control locking device to be furnished by Authorized Channel Partner (ACP) and installed by Certified Integrator (CI).

Door normally closed and locked.

Entry by valid credential or manual key override.

Always free egress.

Upon activation of the fire alarm or loss of power, door remains locked.

Set: 9.2

Doors: Z101

Description: Exterior, Single, HMD&F, SN200 Lock, Closer w/Stop

2 Hinge, Full Mortise, Hvy Wt	T4A3386 NRP 4-1/2" x 4-1/2"	US32D	MK	
1 Hinge, Full Mortise, Hvy Wt	T4A3386 QC 4-1/2" x 4-1/2"	US32D	MK	⚡
1 Access Control Mort Lock, Fail Secure	ML20606 x SN200-SEC PSA BIPS B03 CT6R	626	RU	⚡
1 Interchangeable Core - Exterior	CR8020 Keyed into Existing System	626	RU	
1 Surface Closer	DC6210 A11	689	RU	
1 Gasketing	2891APK TKSP		PE	
1 Sweep	345APK TKSP		PE	
1 Threshold	273x292AFGPK MSES25SS		PE	
1 ElectroLynx Harness	QC-CXXX Length as Required		MK	⚡
1 ElectroLynx Harness	QC-C1500P		MK	⚡
1 Position Switch	DPS		SU	⚡
1 Power Supply	AQD (Size and Relays as Required)		SU	⚡

Notes: Access control locking device to be furnished by Authorized Channel Partner (ACP) and installed by Certified Integrator (CI).

Door normally closed and locked.

Entry by valid credential or manual key override.

Always free egress.

Upon activation of the fire alarm or loss of power, door remains locked.

Set: 10.0

Doors: D102

Description: Exterior, Pair, HMD&F, Nightlatch Rim Panic, Closer w/Stop, DPS

6 Hinge, Full Mortise, Hvy Wt	T4A3386 NRP 4-1/2" x 4-1/2"	US32D	MK	
1 Key Removable Mullion	CR972BKM 7'2" M57 CT6R		RU	
1 Rim Exit Device, Nightlatch	ED5200S K157ET M110 M54 M52 CT6R	630	RU	
1 Rim Exit Device, Exit Only	ED5200S EO M110 M54 M52 CT6R	630	RU	
1 Interchangeable Core - Exterior	CR8020 Keyed into Existing System	626	RU	
3 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU	
2 Pull	RM202 Mtg-Type 12XHD	US32D	RO	
2 Surface Closer	DC6210 A11	689	RU	
1 Gasketing	2891APK TKSP		PE	
1 Rain Guard	346A TKSP		PE	
1 Gasketing (mullion)	5110BL		PE	
2 Sweep	315CN TKSP		PE	
1 Threshold	273x292AFGPK MSES25SS		PE	
2 Position Switch	DPS		SU	⚡

Set: 11.0

Doors: A148, A149

Description: Exterior, Single, HMD&F, Nightlatch Rim Panic, Closer w/Stop, DPS

3 Hinge, Full Mortise, Hvy Wt	T4A3386 5" x 4-1/2" (NRP as Required)	US32D	MK
1 Rim Exit Device, Nightlatch	ED5200S K157ET M110 M54 M52 CT6R	630	RU
1 Interchangeable Core - Exterior	CR8020 Keyed into Existing System	626	RU
1 Pull	RM202 Mtg-Type 12XHD	US32D	RO
1 Surface Closer	DC6210 A11	689	RU
1 Gasketing	2891AS TKSP		PE
1 Rain Guard	346C TKSP		PE
1 Sweep	315CN TKSP		PE
1 Threshold	273x292AFGPK MSES25SS		PE
1 Position Switch	DPS		SU ⚡

Set: 12.0

Doors: A223

Description: Interior, Pair, AD&F, Manual FB, Office Lock, Closer

2 Continuous Hinge	CFMXXSLF-HD1-M		PE
2 Manual Flush Bolt	555 Length as Required	US26D	RO
1 Dust Proof Strike	570	US26D	RO
1 Entrance Lock	ML2054 PSA CT6R	626	RU
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Surface Closer, PA	DC6210 A3 M85 M78	689	RU
1 Drop Plate	597F58	689	RU
2 Door Stop	406 / 409 / 441	US32D	RO
1 Perimeter Gasketing	By Door and Frame Manufacturer		OT

Notes: Coordinate hardware with Aluminum Door and Frame manufacturer. Provide special templates, brackets, spacers, drop plates and fasteners as required. Confirm hardware finish with architect prior to ordering.

Set: 13.0

Doors: A101.2, A261

Description: Interior, Single, AD&F. SN200 Lock, Closer

1	Continuous Hinge	CFMXXSLF-HD1 SER		PE	⚡
1	Access Control Mort Lock, Fail Secure	ML20606 x SN200-SEC PSA BIPS B03 CT6R	626	RU	⚡
1	Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU	
1	Surface Closer, PA	DC6210 A3 M85 M78	689	RU	
1	Drop Plate	597F58	689	RU	
1	Perimeter Gasketing	By Door and Frame Manufacturer		OT	
1	ElectroLynx Harness	QC-CXXX Length as Required		MK	⚡
1	ElectroLynx Harness	QC-C1500P		MK	⚡
1	Door Release	TS-18		AK	⚡
1	Power Supply	AQD (Size and Relays as Required)		SU	⚡

Notes: Access control locking device to be furnished by Authorized Channel Partner (ACP) and installed by Certified Integrator (CI).

Door normally closed and locked.

Entry by valid credential, remote release or manual key override.

Always free egress.

Upon activation of the fire alarm or loss of power, door remains locked.

Set: 14.0

Doors: A138.1, A138.2, A201, A203, A204, A205, A229.1, A230.1, B214

Description: Interior, Single, AD&F, Office Lock, Closer

1	Continuous Hinge	CFMXXSLF-HD1-M		PE	
1	Entrance Lock	ML2054 PSA CT6R	626	RU	
1	Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU	
1	Surface Closer, PA / RA	DC6210 - A3 or A10	689	RU	
1	Door Stop	406 / 409 / 441	US32D	RO	
1	Perimeter Gasketing	By Door and Frame Manufacturer		OT	

Notes: Coordinate hardware with Aluminum Door and Frame manufacturer. Provide special templates, brackets, spacers, drop plates and fasteners as required. Confirm hardware finish with architect prior to ordering.

Set: 14.1

Doors: A135.2

Description: Interior, Single, AD&F, Office Lock, Closer

1	Continuous Hinge	CFMXXSLF-HD1-M		PE
1	Entrance Lock	ML2054 PSA CT6R	626	RU
1	Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1	Surface Closer	DC6210 A11	689	RU
1	Perimeter Gasketing	By Door and Frame Manufacturer		OT

Notes: Coordinate hardware with Aluminum Door and Frame manufacturer. Provide special templates, brackets, spacers, drop plates and fasteners as required. Confirm hardware finish with architect prior to ordering.

Set: 15.0

Description: FEMA - Interior, Pair, Classroom Panic, Closer

8	Hinge, Hvy Wt	SP3786 NRP 5" x 4-1/2"	US26D	MK
1	Mullion	CRFE707A M95		RU
2	Fire Rated Multi-Point ED, Classroom	FE5400SA PR955ET CT6R	630	RU
2	Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
2	Surface Closer, PA	DC8210 A3 M54	689	RU
2	Latch Cover Kick Plate	BFLG1050 10"	US32D	RO
2	Door Stop	406 / 409 / 441	US32D	RO
1	Gasketing (mullion)	5110BL		PE
1	Gasketing	S773BL		PE
1	Threshold	2715A MSES25SS		PE

Notes: FEMA P361 2021 / ICC500-2014 / ICC500-2020 - CERTIFIED BY THIRD PARTY. HARDWARE TO BE FURNISHED AS APPROVED BY DOOR AND FRAME MANUFACTURER.

Set: 16.0

Doors: B010-S, B011-S, B012-S, B019-S

Description: FEMA - Interior, Pair, Classroom Panic, Closer, Mag HO

8 Hinge, Hvy Wt	SP3786 NRP 5" x 4-1/2"	US26D	MK
1 Mullion	CRFE707A M95		RU
2 Fire Rated Multi-Point ED, Classroom	FE5400SA PR955ET CT6R	630	RU
2 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
2 Surface Closer, PA, Unitrol	DC8210 A11 M54	689	RU
2 Latch Cover Kick Plate	BFLG1050 10"	US32D	RO
2 Electromagnetic Holder	99xM	689	RF ⚡
1 Gasketing (mullion)	5110BL		PE
1 Gasketing	S773BL		PE
1 Threshold	2715A MSES25SS		PE

Notes: FEMA P361 2021 / ICC500-2014 / ICC500-2020 - CERTIFIED BY THIRD PARTY. HARDWARE TO BE FURNISHED AS APPROVED BY DOOR AND FRAME MANUFACTURER.

Set: 17.0

Doors: A146.3

Description: Interior, Pair, Manual FB, Storeroom Lock

6 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
2 Manual Flush Bolt	555 Length as Required	US26D	RO
1 Dust Proof Strike	570	US26D	RO
1 Storeroom Lock	ML2057 PSA CT6R	626	RU
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Surf Overhead Stop	9-x36	652	RF
2 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	406 / 409 / 441	US32D	RO
2 Silencer	608-RKW		RO

Set: 18.0

Doors: A216

Description: Interior, Pair, Manual FB, Office Lock, Closer

6 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
2 Manual Flush Bolt	555 Length as Required	US26D	RO
1 Dust Proof Strike	570	US26D	RO
1 Entrance Lock	ML2054 PSA CT6R	626	RU
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Surface Closer, PA / RA	DC6210 - A3 or A10	689	RU
2 Kick Plate	K1050 10" High CSK BEV	US32D	RO
2 Door Stop	406 / 409 / 441	US32D	RO
2 Silencer	608-RKW		RO

Set: 19.0

Doors: B016

Description: Interior, Pair, Storeroom Rim Panic, Closer w/Stop

6 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Key Removable Mullion	CR972BKM 7'2" M57 CT6R		RU
1 Rim Exit Device, Storeroom	ED5200S(A) PR959ET M110 M54 CT6R	630	RU
1 Rim Exit Device, Exit Only	ED5200S(A) EO M110 M54	630	RU
2 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Surface Closer	DC6210 A11	689	RU
1 Surface Closer, PA / RA	DC6210 - A3 or A10	689	RU
2 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	406 / 409 / 441	US32D	RO
1 Astragal	S772BL		PE
1 Gasketing (mullion)	5110BL		PE
1 Gasketing	S88BL		PE

Set: 20.0

Doors: E213, F111

Description: Interior, Pair, Classroom Rim Panic, Closer

6 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Key Removable Mullion	CR972BKM 7'2" M57 CT6R		RU
2 Rim Exit Device, Classroom	ED5200S(A) PR955ET M110 M54	630	RU
3 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
2 Surface Closer, PA / RA	DC6210 - A3 or A10	689	RU
2 Kick Plate	K1050 10" High CSK BEV	US32D	RO
2 Door Stop	406 / 409 / 441	US32D	RO
2 Silencer	608-RKW		RO

Set: 21.0

Doors: A143.1

Description: Interior, Pair, Passage Rim Panic, Closer

6 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
2 Surface Vert Rod Exit, Passage	ED5470(B) PR910ET M110 M54	630	RU
2 Surface Closer, PA / RA	DC6210 - A3 or A10	689	RU
2 Kick Plate	K1050 10" High CSK BEV	US32D	RO
2 Door Stop	406 / 409 / 441	US32D	RO
2 Silencer	608-RKW		RO

Set: 22.0

Doors: E211.1, E211.2

Description: Interior, Pair, Passage Rim Panic, Closer, STC

6 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
2 Surface Vert Rod Exit, Passage	ED5470(B) PR910ET M110 M54	630	RU
2 Surface Closer, PA / RA	DC6210 - A3 or A10	689	RU
2 Kick Plate	K1050 10" High CSK BEV	US32D	RO
2 Door Stop	406 / 409 / 441	US32D	RO
1 STC Gasketing / Threshold	By Door and Frame Manufacturer		OT

Notes: All hardware (hinges, locksets, backsets, closer arms, seals, thickness, etc.) to be coordinated with STC assembly manufacturer.

Set: 23.0

Doors: B010, B011

Description: Interior, Pair, Passage Rim Panic, Closer w/Stop

6 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
2 Surface Vert Rod Exit, Passage	ED5470(B) PR910ET M110 M54	630	RU
1 Surface Closer	DC6210 A11	689	RU
1 Surface Closer, PA / RA	DC6210 - A3 or A10	689	RU
2 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	406 / 409 / 441	US32D	RO
2 Silencer	608-RKW		RO

Set: 24.0

Doors: A143.2, D101, E225.2

Description: Interior, Pair, Classroom Security Rim Panic, Closer

6 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Key Removable Mullion	CR972BKM 7'2" M57 CT6R		RU
2 Rim Exit Device, Classroom Intruder	ED5202S(A) PR955ET M110 M54 CT6R	630	RU
5 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
2 Surface Closer, PA / RA	DC6210 - A3 or A10	689	RU
2 Kick Plate	K1050 10" High CSK BEV	US32D	RO
2 Door Stop	406 / 409 / 441	US32D	RO
2 Silencer	608-RKW		RO

Set: 25.0

Doors: E210, E219

Description: Interior, Pair, Classroom Security Rim Panic, Closer, Seals

6 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Key Removable Mullion	CR972BKM 7'2" M57 CT6R		RU
2 Rim Exit Device, Classroom Intruder	ED5202S(A) PR955ET M110 M54 CT6R	630	RU
5 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
2 Surface Closer, PA / RA	DC6210 - A3 or A10	689	RU
2 Kick Plate	K1050 10" High CSK BEV	US32D	RO
2 Door Stop	406 / 409 / 441	US32D	RO
1 Gasketing (mullion)	5110BL		PE
2 Acoustic Seal Set	PEMKOSTCSET-1A	BL	PE

Set: 26.0

Doors: E214

Description: Interior, Pair, Manual FB, Classroom Lock, STC

6 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
2 Manual Flush Bolt	555 Length as Required	US26D	RO
1 Dust Proof Strike	570	US26D	RO
1 Classroom Lock	ML2055 PSA CT6R	626	RU
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
2 Kick Plate	K1050 10" High CSK BEV	US32D	RO
2 Door Stop	406 / 409 / 441	US32D	RO
1 STC Gasketing / Threshold	By Door and Frame Manufacturer		OT

Notes: All hardware (hinges, locksets, backsets, closer arms, seals, thickness, etc.) to be coordinated with STC assembly manufacturer.

Set: 27.0

Doors: A160.1, A160.2, A170.1, A170.2

Description: Interior, Single, SN200 Lock, Closer

2 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Hinge, Full Mortise	TA2714 QC 4-1/2" x 4-1/2"	US26D	MK ⚡
1 Access Control Mort Lock, Fail Secure	ML20606 x SN200-SEC PSA BIPS B03 CT6R	626	RU ⚡
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Surface Closer, PA / RA	DC6210 - A3 or A10	689	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	406 / 409 / 441	US32D	RO
3 Silencer	608-RKW		RO
1 ElectroLynx Harness	QC-CXXX Length as Required		MK ⚡
1 ElectroLynx Harness	QC-C1500P		MK ⚡
1 Power Supply	AQD (Size and Relays as Required)		SU ⚡

Notes: Access control locking device to be furnished by Authorized Channel Partner (ACP) and installed by Certified Integrator (CI).

Door normally closed and locked.

Entry by valid credential or manual key override.

Always free egress.

Upon activation of the fire alarm or loss of power, door remains locked.

Set: 28.0

Doors: A146.1, B020

Description: Interior, Single, Storeroom Lock, Closer

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Storeroom Lock	ML2057 PSA CT6R	626	RU
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Surface Closer, PA / RA	DC6210 - A3 or A10	689	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	406 / 409 / 441	US32D	RO
1 Gasketing	S88BL		PE

Set: 29.0

Doors: B013-S

Description: FEMA - Interior, Single, Storeroom, Closer w/Stop

4 Hinge, Hvy Wt	SP3786 NRP 5" x 4-1/2"	US26D	MK
1 Multi-Point Lock	FE6665 PSA AUX188 CT6R	626	RU
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Surface Closer, PA, Unitrol	DC8210 A11 M54	689	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Astragal	S772BL		PE
1 Threshold	2715A MSES25SS		PE

Set: 30.0

Doors: H104

Description: Interior, Single, Office Lock, Closer w/Stop

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Entrance Lock	ML2054 PSA CT6R	626	RU
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Surface Closer	DC6210 A11	689	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Gasketing	S88BL		PE

Set: 31.0

Doors: A112, A227

Description: Interior, Single, Storeroom Rim Panic, Closer

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Rim Exit Device, Storeroom	ED5200S(A) PR959ET M110 M54 CT6R	630	RU
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Surface Closer, PA / RA	DC6210 - A3 or A10	689	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	406 / 409 / 441	US32D	RO
1 Gasketing	S88BL		PE

Set: 32.0

Doors: B109, B209

Description: Interior, Single, Storeroom Rim Panic, Closer w/Stop

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Rim Exit Device, Storeroom	ED5200S(A) PR959ET M110 M54 CT6R	630	RU
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Surface Closer	DC6210 A11	689	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Gasketing	S88BL		PE

Set: 33.0

Doors: E108

Description: Interior, Single, Classroom Lock, Closer

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Storeroom Lock	ML2057 PSA CT6R	626	RU
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Surface Closer, PA / RA	DC6210 - A3 or A10	689	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	406 / 409 / 441	US32D	RO
1 Gasketing	S88BL		PE

Set: 34.0

Doors: A134, A217, A219, A228, B004, B015, B105, B110, B205, E104, E116, E202.1, E221, F105, F110

Description: Interior, Single, Storeroom Lock, Closer

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Storeroom Lock	ML2057 PSA CT6R	626	RU
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Surface Closer, PA / RA	DC6210 - A3 or A10	689	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	406 / 409 / 441	US32D	RO
3 Silencer	608-RKW		RO

Set: 34.1

Doors: B014

Description: Interior, Single, Storeroom Lock, Closer w/Stop

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Storeroom Lock	ML2057 PSA CT6R	626	RU
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Surface Closer	DC6210 A11	689	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
3 Silencer	608-RKW		RO

Set: 35.0

Doors: A140, A226, B012.1, B013.1

Description: Interior, Single, Storeroom Lock, Closer

3 Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2" (NRP as Required)	US26D	MK
1 Storeroom Lock	ML2057 PSA CT6R	626	RU
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Surface Closer, PA / RA	DC6210 - A3 or A10	689	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	406 / 409 / 441	US32D	RO
3 Silencer	608-RKW		RO

Set: 35.1

Doors: B210

Description: Interior, Single, Storeroom Lock, Closer w/Stop

3 Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2" (NRP as Required)	US26D	MK
1 Storeroom Lock	ML2057 PSA CT6R	626	RU
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Surface Closer	DC6210 A11	689	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
3 Silencer	608-RKW		RO

Set: 36.0

Doors: A104, A117, A120, A122, A123.1, A123.2, B008, E102, E103, E227, H108, H114.1, H114.2

Description: Interior, Single, Storeroom Lock

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Storeroom Lock	ML2057 PSA CT6R	626	RU
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	406 / 409 / 441	US32D	RO
3 Silencer	608-RKW		RO

Set: 37.0

Doors: A103.1, A124.1, A124.2, A124.3, A131, A135.1, B001.1, B009, E115, E220

Description: Interior, Single, Office Lock, Closer

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Entrance Lock	ML2054 PSA CT6R	626	RU
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Surface Closer, PA / RA	DC6210 - A3 or A10	689	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	406 / 409 / 441	US32D	RO
3 Silencer	608-RKW		RO

Set: 38.0

Doors: A103.2, A105.1, A106.2, A107.1, A107.2, A110, A113, A115, A116, A118.1, A119, A121, A125, A126, A127, A128, A133, A136, A202.1, A202.2, A229.2, E101, E126, E127, E228

Description: Interior, Single, Office Lock

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Entrance Lock	ML2054 PSA CT6R	626	RU
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	406 / 409 / 441	US32D	RO
3 Silencer	608-RKW		RO

Set: 39.0

Doors: E212

Description: Interior, Single, Office Lock, STC

3 Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2" (NRP as Required)	US26D	MK
1 Entrance Lock	ML2054 PSA CT6R	626	RU
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	406 / 409 / 441	US32D	RO
1 STC Gasketing / Threshold	By Door and Frame Manufacturer		OT

Notes: All hardware (hinges, locksets, backsets, closer arms, seals, thickness, etc.) to be coordinated with STC assembly manufacturer.

Set: 40.0

Doors: B103.1, B103.2, B107.1, B107.2, B108.1, B108.2, B113.1, B113.2, B203.1, B203.2, B207.1, B207.2, B208.1, B208.2, B213.1, B213.2, E106.1, E106.2

Description: Interior, Single, Classroom Intruder Lock, Closer

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Rim Exit Device, Classroom Intruder	ED5202S(A) PR955ET M110 M54 CT6R	630	RU
2 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Surface Closer, PA / RA	DC6210 - A3 or A10	689	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	406 / 409 / 441	US32D	RO
3 Silencer	608-RKW		RO

Set: 41.0

Doors: A218.2, A220.2, E119.2, E121.2

Description: Interior, Single, Communicating Lock

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Store Door Lock	ML2022 PSA CT6R	626	RU
2 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	406 / 409 / 441	US32D	RO
3 Silencer	608-RKW		RO

Set: 42.0

Doors: B106.1, B106.2, B112.1, B112.2, B206.1, B206.2, B212.1, B212.2

Description: Interior, Single, Classroom Lock

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Storeroom Lock	ML2057 PSA CT6R	626	RU
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	406 / 409 / 441	US32D	RO
1 Gasketing	S88BL		PE

Set: 43.0

Doors: E215, E216, E217, E218

Description: Interior, Single, Classroom Lock, STC

3 Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2" (NRP as Required)	US26D	MK
1 Storeroom Lock	ML2057 PSA CT6R	626	RU
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	406 / 409 / 441	US32D	RO
1 STC Gasketing / Threshold	By Door and Frame Manufacturer		OT

Notes: All hardware (hinges, locksets, backsets, closer arms, seals, thickness, etc.) to be coordinated with STC assembly manufacturer.

Set: 44.0

Doors: A141, A144.1, A144.2, A145, A206, A207, A208, A209, A210, A211, A212, A213, A214, A215, A218.1, A220.1, E107.1, E107.2, E107.3, E107.4, E111.1, E111.2, E117, E119, E121.1, E123, E125, E229, F101, F102, H111, H113, H117, E225.1

Description: Interior, Single, Classroom Intruder Lock, Closer

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Classroom Intruder Lock	ML2072 PSA CT6R	626	RU
2 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Surface Closer, PA / RA	DC6210 - A3 or A10	689	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	406 / 409 / 441	US32D	RO
1 Gasketing	S88BL		PE

Set: 45.0

Doors: A139

Description: Interior, Single, Passage Latch

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Passage Latch	ML2010 PSA CT6R	626	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	406 / 409 / 441	US32D	RO
3 Silencer	608-RKW		RO

Set: 46.0

Doors: A102, A108, A109, A114, A129, A130, A224, A225, B005, B104, B111, B204, B211, E105, E222, H115, H116

Description: Interior, Single, Privacy Lock, Closer

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Privacy Lock	ML2030 PSA V50	626	RU
1 Surface Closer, PA / RA	DC6210 - A3 or A10	689	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	406 / 409 / 441	US32D	RO
1 Gasketing	S88BL		PE

Set: 47.0

Doors: A132, A142, E120, E122, F107, F109

Description: Interior, Single, Privacy Lock

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Privacy Lock	ML2030 PSA V50	626	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	406 / 409 / 441	US32D	RO
1 Gasketing	S88BL		PE

Set: 48.0

Doors: B002, B007, B017, B018, F106, F108

Description: Interior, Single, Push / Pull, Classroom Deadbolt, Closer

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2" (NRP as Required)	US26D	MK
1 Classroom Deadbolt	DL4117 CT6R	626	RU
1 Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU
1 Pull Plate	111x70C	US32D	RO
1 Push Plate	70C-RKW	US32D	RO
1 Surface Closer, PA / RA	DC6210 - A3 or A10	689	RU
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	406 / 409 / 441	US32D	RO
3 Silencer	608-RKW		RO

Set: 49.0

Doors: A146.2, A147, A230.2, B000.5, B001.2, C003.1, C003.2, C004, C101, E107.5, E107.6, G001, G002, G003, G004, G005, G006, G007, G008

Description: By Others

1 All Hardware	By Door and Frame Manufacturer	OT
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Set: 50.0

Doors: F111a, F111b

Description: Existing Opening - Hinges Only

3 Hinges / Wide Throw Hinges	Field Verify	OT
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Notes: Existing opening to be field verified. Provide hinges and closers as required to allow doors to swing 180 degrees.

Set: EP1

Description: Exterior, Pair, AD&F, SN200 Rim Panic, Closer w/Stop, ELR

1	Continuous Hinge	CFMXXSLF-HD1-M		PE	
1	Continuous Hinge	CFMXXSLF-HD1 SER		PE	⚡
1	Key Removable Mullion	CR972BKM 7'2" M57 CT6R		RU	
1	Rim Exit Device, Exit Only	ED5200S EO M110 M54 M52 CT6R	630	RU	
1	Access Control Rim Exit Device, MELR	ED5200SN-SN200 K157ET BIPS B03 M110 M54 MELR CT6R	630	RU	⚡
1	Interchangeable Core - Exterior	CR8020 Keyed into Existing System	626	RU	
2	Interchangeable Core - Interior	CR8000 Keyed into Existing System	626	RU	
2	Pull	RM202 Mtg-Type 12XHD	US32D	RO	
2	Conc Overhead Stop	1-x36	630	RF	
2	Surface Closer, PA	DC6210 A3 M85 M78	689	RU	
2	Drop Plate	597F58	689	RU	
1	Gasketing (mullion)	5110BL		PE	
1	Perimeter Gasketing	By Door and Frame Manufacturer		OT	
2	Sweep	345APK TKSP		PE	
1	Threshold	273x292AFGPK MSES25SS		PE	
1	ElectroLynx Harness	QC-CXXX Length as Required		MK	⚡
1	ElectroLynx Harness	QC-C1500P		MK	⚡
1	Position Switch	DPS		SU	⚡
1	Power Supply	AQD (Size and Relays as Required)		SU	⚡

Notes: Coordinate hardware with Aluminum Door and Frame manufacturer. Provide special templates, brackets, spacers, drop plates and fasteners as required. Confirm hardware finish with architect prior to ordering.

Access control locking device to be furnished by Authorized Channel Partner (ACP) and installed by Certified Integrator (CI).

Door normally closed and locked.
 Entry by valid credential or manual key override.
 Always free egress.
 Upon activation of the fire alarm or loss of power, door remains locked.

Set: EP2

Description: Existing

1	All Hardware	Existing to be Re-Used		OT	
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END OF DOCUMENT

SECTION 08 80 00

GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Glass for windows, doors, interior borrowed lites, storefront framing, and glazed curtain walls.
 - 2. Fire-rated glass.
 - 3. Glazing sealants and accessories.

1.2 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.3 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review temporary protection requirements for glazing during and after installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.
 - 1. Tinted glass.
 - 2. Coated glass.
 - 3. Insulating glass.
- C. Product Test Listings: From UL indicating fire-rated glass complies with requirements, based on comprehensive testing of current product.
- D. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch (300-mm) lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
- E. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- F. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturers of insulating-glass units with sputter-coated, low-E coatings.
- B. Product Certificates: For glass.
- C. Preconstruction adhesion and compatibility test report.
- D. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- E. Fire Protective Rated Glass Each lite shall bear permanent, nonremovable label of UL certifying it for use in tested and rated fire protective assemblies.
- F. Fire Protective Glazing Products for Door Assemblies: Products identical to those tested per ASTM E2074-00, classified and labeled by UL acceptable to authorities having jurisdiction.
- G. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Install glazing in mockups specified in Section 08 41 13 "Aluminum-Framed Entrances and Storefronts" to match glazing systems required for Project, including glazing methods.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
 - 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
 - 2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 - 3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
 - 4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
 - 5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

1.11 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

- B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cardinal Glass Industries.
 - 2. Guardian Industries Corp.
 - 3. Oldcastle BuildingEnvelope.
 - 4. McGroly Glass.
 - 5. Pilkington North America.
 - 6. Vitro.
- B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
 - 1. Obtain tinted glass from single source from single manufacturer.
- C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design glazing.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
 - 1. Design Wind Pressures: As indicated on Drawings.
 - 2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
 - 3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
 - 2. For laminated-glass lites, properties are based on products of construction indicated.
 - 3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 - 4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).

5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.
- F. Clear and wireless glass ceramic and tempered or annealed float glass material; listed for use in fire-rated or fire/impact safety-rated insulated glass units in locations with fire rating requirements ranging from 20 to 3 hours with required hose stream test.
- G. Passes positive pressure test standards UL 10C.
- H. Labeling: Permanently label each piece of glass with the manufacturer's fire-rated glass logo, UL logo and fire rating in sizes up to 3,325 sq. in., and with the manufacturer's fire-rated glass label only for sizes that exceed the listing (as approved by the local authority having jurisdiction).
- I. Fire Rating: Fire rating classified and labeled by UL for fire rating scheduled at opening locations on drawings, when tested in accordance with ASTM E2010-01, NPFA 252 and NFPA 25, and UL 9 and UL 10B.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness of Interior Glazing:
 1. 6 mm for glazing up to 60 inches in any direction.
 2. 9.5 mm for glazing greater than 60 inches but not greater than 96 inches in any direction.
 3. 13 mm for glazing greater than 96 inches in any direction.
- E. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
 1. Minimum Glass Thickness for Exterior Lites: 6 mm.
 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- F. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.
- B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- C. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- D. Ceramic-Coated Spandrel Glass: ASTM C 1048, Type I, Condition B, Quality-Q3.

2.5 LAMINATED GLASS

- A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 - 1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
 - 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 - 3. Interlayer Color: Clear unless otherwise indicated.

2.6 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
 - 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
 - 2. Perimeter Spacer: Manufacturer's standard spacer material and construction.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Technoform Glass Insulation NA, Inc.
 - 2) Thermix; a brand of Ensinger USA.
 - 3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.7 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 790.
 - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. Bondaflex Sil 290.
 - d. Pecora Corporation; 890NST.
 - e. Sikasil WS-290.
 - f. Tremco Incorporated; Spectrem 1
- C. Silicone Sealant (Not to be used with FireLite NT unless used as a cap bead/seal): One-part neutral curing silicone, medium modulus sealant, Type S; Grade NS; Class 25 with additional movement capability of 50 percent in both extension and compression (total 100 percent); Uses (Exposure) NT*; Uses (Substrates) G, A, and O as applicable.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corp.; Dow Corning 795.
 - b. General Electric Co.; Silglaze-II 2800.
 - c. Tremco, Inc.; Spectrem 2.

2.8 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 - 1. AAMA 804.3 tape, where indicated.
 - 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

- B. Glazing Tape for Fire-Rated Glass: Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent. Glass panels that exceed 1,393 sq. inches for 90-minute ratings must be glazed with fire-rated glazing tape supplied by manufacturer.

2.9 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Setting Blocks for Fire-Rated Glass: Neoprene, EPDM, or silicone; tested for compatibility with glazing compound; of 70 to 90 Shore A hardness.
- E. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- F. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- G. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.10 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 - 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Fire-Rated Glass:
 - 1. Comply with referenced FGMA standards and instructions of manufacturers of glass, glazing sealants, and glazing compounds for fire-rated glass.
 - 2. For fire-rated glass, place setting blocks located at quarter points of glass with edge block no more than 6 inches from corners.
 - 3. Glaze vertically into labeled fire-rated metal frames with same fire rating as glass and push against tape for full contact at perimeter of pane or unit.
 - 4. Place glazing tape on free perimeter of glazing in same manner described above.
 - 5. Install removable stop and secure without displacement of tape.
 - 6. Install in vision panels in fire-rated doors to requirements of NFPA 80.
 - 7. Install so that appropriate UL markings remain permanently visible.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.

- G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 MONOLITHIC GLASS SCHEDULE

- A. Clear fully tempered float glass.
 - 1. Minimum Thickness: 6 mm.
 - 2. Safety glazing required.

3.9 LAMINATED GLASS SCHEDULE

- A. Clear laminated glass with two plies of heat-strengthened or fully tempered float glass, as indicated or required by code.
 - 1. Minimum Thickness of Each Glass Ply: 6 mm.
 - 2. Interlayer Thickness: 0.030 inch (0.76 mm).
 - 3. Safety glazing required.

3.10 INSULATING GLASS SCHEDULE

- A. Low-E-coated, tinted insulating glass.
1. Basis-of-Design Product: Vitro Architectural Glass; Solarban 90 Optigray + Clear.
 2. Overall Unit Thickness: 1 inch (25 mm).
 3. Minimum Thickness of Each Glass Lite: 6 mm.
 4. Outdoor Lite: Tinted heat-strengthened or fully tempered float glass, as indicated or required by code.
 5. Tint Color: As selected by Architect from manufacturer's full range.
 6. Interspace Content: Air.
 7. Indoor Lite: Clear heat-strengthened or fully tempered float glass, as indicated or required by code.
 8. Low-E Coating: Sputtered on second surface.
 9. Winter Nighttime U-Factor: 0.29 maximum.
 10. Visible Light Transmittance: 36 percent minimum.
 11. Solar Heat Gain Coefficient: 0.20 maximum.
 12. Safety glazing required.
- B. Ceramic-coated, low-E, insulating spandrel glass.
1. Coating Color: As selected by Architect from manufacturer's full range.
 2. Overall Unit Thickness: 1 inch (25 mm).
 3. Minimum Thickness of Each Glass Lite: 6 mm.
 4. Outdoor Lite: Heat-strengthened or fully tempered float glass, as indicated or required by code.
 5. Interspace Content: Air.
 6. Indoor Lite: Heat-strengthened or fully tempered float glass, as indicated or required by code.
 7. Low-E Coating: Sputtered on second surface.
 8. Opaque Coating Location: Fourth surface.

3.11 FIRE-RATED GLASS

- A. Fire-Rated Glass: Sealed Insulating Glass Units: ASTM E 774.
1. Basis-of-Design Product: Technical Glass Products; FireLite.
 2. Nominal Thickness: 1 inch.
 3. Glass - Vision Units: Two lites, one fire-rated and one tempered safety or annealed glass, as scheduled:
 - a. Exterior Lite: Clear float.
 - b. Interior Lite: Clear FireLite with Standard surface finish.
 4. Air Space Width: Nominal 1/2 inch measured perpendicularly from surfaces of glass lites at unit's edge.
 5. Sealing System: Dual seal, 10 year limited warranty.
 6. Spacer Specifications: Manufacturer's standard stainless steel.
 7. Desiccant: Manufacturer's standard desiccant.
 8. Corner Construction: Manufacturer's standard corner construction
 9. Approximate Visible Transmission: 88 percent.
 10. Approximate Visible Reflection: 9 percent.
 11. Hardness (Vicker's Scale): 700.
 12. Fire-Rating: 20 minutes to 90 minutes.
 13. Impact Safety Resistance: None.
 14. Positive Pressure Test: UL 10C; passes.

END OF SECTION

SECTION 08 83 00

MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the following types of silvered flat glass mirrors:
 - 1. Tempered glass mirrors qualifying as safety glazing in fitness rooms or required by building code.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.
- B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1.4 PRECONSTRUCTION TESTING

- A. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing.
 - 1. Testing is not required if data are submitted based on previous testing of mirror mastic products and mirror backing matching those submitted.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Binswanger Mirror; a division of Vitro America, Inc.
 - 2. Gardner Glass, Inc.
 - 3. Glasswerks LA, Inc.
 - 4. Guardian Industries Corp..

5. Virginia Mirror Company, Inc.
 6. Walker Glass Co., Ltd.
- B. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.
- C. Source Limitations for Mirror Accessories: Obtain mirror glazing accessories from single source.
- 2.2 SILVERED FLAT GLASS MIRRORS
- A. Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.
- B. Tempered Glass Mirrors: Mirror Glazing Quality for blemish requirements and complying with ASTM C 1048 for Kind FT, Condition A, tempered float glass before silver coating is applied; clear.
1. Nominal Thickness: 6.0 mm .
- 2.3 MISCELLANEOUS MATERIALS
- A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
- C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Palmer Products Corporation.
 - b. Pecora Corporation.
- 2.4 MIRROR HARDWARE
- A. Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.
1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch (9.5 and 22 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Andscot Company, Inc.
 - 2) Laurence, C. R. Co., Inc.
 - 3) Stylmark, Inc.
 2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch (16 and 25 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Andscot Company, Inc.
 - 2) Laurence, C. R. Co., Inc.
 - 3) Stylmark, Inc.
 3. Finish: As selected by Architect from manufacturer's full range.
- B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
- C. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield, expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.
- 2.5 FABRICATION
- A. Fabricate mirrors in the shop to greatest extent possible.
- B. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.
- C. Mirror Edge Treatment: Flat polished.
1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.

2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.
- B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.
- C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

- A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

- A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
 1. GANA Publications: "Glazing Manual" and "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."
- B. Provide a minimum airspace of 1/8 inch (3 mm) between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
- C. Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
 1. Aluminum J-Channels: Provide setting blocks 1/8 inch (3 mm) thick by 4 inches (100 mm) long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch (6.4 mm) wide by 3/8 inch (9.5 mm) long at bottom channel.
 2. Install mastic as follows:
 - a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
 - b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
 - c. After mastic is applied, align mirrors and press into place while maintaining a minimum airspace of 1/8 inch (3 mm) between back of mirrors and mounting surface.

3.4 CLEANING AND PROTECTION

- A. Protect mirrors from breakage and contaminating substances resulting from construction operations.
- B. Do not permit edges of mirrors to be exposed to standing water.
- C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.
- D. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer.

END OF SECTION

SECTION 08 87 00
GLAZING SURFACE FILMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes film products applied to glass surfaces.

1.2 DEFINITIONS

- A. Dual Reflective Films: Films where interior visible light reflectance is less than the exterior visible light reflectance. The lower interior reflectance provides improved visibility from the interior to the outdoors without affecting the film's solar performance.
- B. Emissivity: The ability of a surface to absorb far-infrared heat and to reflect it. The lower the emissivity, the lower the far-infrared heat absorption and the greater the far-infrared heat reflectance.
- C. Far-Infrared Heat: Heat radiated from objects at temperatures below 1300 deg F such as heat radiated from: room objects, objects heated by the sun, or a home heating system. Far-infrared heat is different from near-infrared heat that is heat radiated from objects at highly elevated temperatures such as the sun.
- D. Low Emissivity (Low-E) Films: Films with improved far-infrared heat reflection, with the ability to reduce winter heat loss through windows. The reflection of far-infrared heat also reduces the need for summer cooling by reducing the transmission of far-infrared heat from outdoor objects through windows into the interior of a home or building.
- E. Low Reflectance Films: Films whose visible light reflectance values are very close to that of ordinary glass.
- F. Neutral Solar Films: Films that allow visible light to pass without distortion of color and that have equal visible light transmission properties at all wavelengths in the visible range from 380 to 780 nanometers.
- G. Light to Solar Heat Gain Ratio: Ratio of visible light transmission to Solar Heat Gain Coefficient for a glazing system.
- H. Solar Heat Gain Coefficient: The fraction of incident solar radiation that actually passes through that window, including solar energy that is both directly transmitted and that which is absorbed and subsequently released inwardly by re-radiation and conduction.
1. SHGC is expressed as a number between 0 and 1. The lower a window's solar heat gain coefficient, the less solar heat it transmits.
 2. This number is the mathematical complement of the TSER value: The sum of the TSER (Total Solar Energy Rejection, in decimal form) of a glazing system and its SHGC value is 1; therefore, $1 - TSER = SHGC$
- I. Spectrally Selective Solar Films: Films that reduce solar heat gain mainly by reducing the transmission of near-infrared solar radiation with minimal reduction of visible light transmission. Films with a Light to Solar Heat Gain Ratio of above 1.00 are spectrally selective.
- J. Fire Performance: Surface burning characteristics when applied to 1/4 inch, nominal clear glass and tested in accordance with ASTM E84:
1. Flame Spread Index: 25 maximum.
 2. Smoke Developed: 50 maximum.
- K. Minimum Peel Strength: 2,000 grams per inch, average of two specimens when tested in accordance with ASTM D 3330.

1.3 ACTION SUBMITTALS

- A. Product Data: For each film product indicated.
- B. Samples for Color Selection: Manufacturer's standard sample sets showing the full range of colors available for each type of product indicated.
- C. Samples for Verification: 12-inch square samples of each type of glazing film specified, in color specified.
- D. Shop Drawings: identify location for each type of film indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.5 CLOSEOUT SUBMITTALS

- A. Warranty: Special warranty specified in this Section.
- B. Maintenance Data and Replacement Instructions: For each type of film overlay to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Engage a firm experienced in manufacturing systems similar to those indicated for this Project and meeting the standards of the International Standards Organization (ISO), ISO 9001 Quality Assurance in Production and Installation.
- B. Installer Qualifications: Engage an experienced installer certified, licensed, or otherwise qualified by film manufacturer as having the necessary experience, staff, and training to install manufacturer's products according to specified requirements.
- C. Source Limitations: Obtain each type of film overlay through one source from a single manufacturer to provide products of consistent quality in appearance and physical properties.
- D. Mockups: Apply glazing films in locations as directed to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.
 - 1. Obtain approval of field samples before continuing with remainder of installation.
 - 2. Maintain field samples during remainder of installation in an undisturbed condition as a standard for judging the completed Work.
 - 3. Approved field samples may become part of the completed Work.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
 - 1. Conduct pre-installation conference in conjunction with installation of mockup.
 - 2. Meet with Owner, Architect, glazing film Installer and glazing film manufacturer's representative.
 - 3. Review methods and procedures related to installation, including manufacturer's written instructions.
 - 4. Examine substrate conditions for compliance with requirements.
 - 5. Review temporary protection measures required during and after installation.
 - 6. Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store and protect glazing films according to manufacturer's written instructions and as needed to prevent damage, condensation, temperature changes, direct exposure to sun, or other causes.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with film installation when ambient and substrate temperature conditions are outside limits permitted by manufacturer and when glass substrates are wet from frost, condensation, or other causes.

1.9 WARRANTY

- A. Manufacturer's Warranty: Fully executed warranty, written in favor of the Owner, agreeing to replace films that deteriorate as defined in "Definitions" Article, within 5 years from date of original installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. 3M.
 2. Hanita Coatings.
 3. Safe Haven Defense.

2.2 GLAZING SURFACE FILMS

- A. Film Overlay: Micro-layered applied glazing film products, applied to interior glass surfaces, consisting of the following (from outboard surface to inboard surface), as applicable to each type of film indicated:
1. Removable release liner.
 2. Pressure sensitive adhesive with integral ultraviolet absorbers.
 3. Clear, dyed, or printed pattern layer of polyester film.
 4. Possible layer of metallized or sputtered polyester film.
 5. Possible scratch resistant coating.
- B. Safety and Security Film:
1. Basis-of-Design Product: Safe Haven Defense; SW440BR.
 - a. Performance Characteristics:
 - 1) Protection Level: Exigent protection.
 - 2) Tensile Strength: 32,000 psi.
 - 3) Break Strength: Not less than 1,200 psi.
 - 4) Thickness: As required for performance requirements.
 - 5) Peel Strength: 6 psi.
- C. Translucent Film:
1. Basis-of-Design Product: 3M; CRYSTAL Glass Finishes, Frosted.
 - 1) Performance Characteristics:
 - a) Material: Vinyl.
 - b) Tensile Strength: Not less than 3.5 lbs./in.
 - c) Thickness: 4.7 mil (0.12 mm).
 - d) Shading Coefficient: 0.82.
 - e) Solar Heat Reflectance: 10 percent.
 - f) Solar Heat Transmittance: 64 percent.
 - g) Solar Heat Absorbance: 26 percent.
 - h) Visible Light Reflectance: 12 percent.
 - i) Visible Light Transmittance: 72 percent.
 - j) UV Transmittance: 20 percent.
- D. Patterned Film:
1. Basis-of-Design Product: 3M; FASARA Glass Finishes.
 - a. Performance Characteristics:
 - 1) Material: Polyester.
 - 2) Tensile Strength: Not less than 45 lbs./in.
 - 3) Thickness: 3.3 mil (0.08 mm).
- E. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.3 GLAZING FILM ACCESSORIES

- A. General: Provide products complying with requirements of glazing film manufacturer for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Sealant: Provide manufacturer's standard sealant. Sealant around perimeter is required.
- C. Adhesive: Pressure Sensitive acrylic adhesive system.
- D. Cleaners, Primers, and Sealers: Types recommended by glazing film manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine glass and surrounding adjacent surfaces for conditions affecting installation.
 - 1. Report conditions that may adversely effect installation. In report, include description of any glass that is broken, chipped, cracked, abraded, or damaged in any way.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Immediately before beginning installation of films, clean glass surfaces of substances that could impair glazing film's bond, including mold, mildew, oil, grease, dirt and other foreign materials.
- C. Blade the inside surface of window glass with industrial razors to ensure removal of foreign contaminants.
- D. Protect window frames and surrounding surfaces and materials from damage during installation.

3.3 INSTALLATION

- A. General: Comply with glazing film manufacturers' written installation instructions applicable to products and applications indicated, except where more stringent requirements are indicated.
- B. Install film continuously, but not necessarily in one continuous length. Install with no gaps or overlaps.
- C. If seamed, install with no gaps or overlaps. Install seams vertical and plumb. No horizontal seams allowed.
- D. Do not remove release liner from film until just before each piece of film is cut and ready for installation.
- E. Install film with mounting solution and custom cut to the glass with neat, square comers and edges to within 1/8 inch of the window frame.
- F. Remove air bubbles, wrinkles, blisters, and other defects.
- G. After installation, view film from a distance of 10 feet against a bright uniform sky or background. Film shall appear uniform in appearance with no visible streaks, banding, thin spots or pinholes.
 - 1. If installed film does not meet this criteria, remove and replace with new film.

3.4 CLEANING

- A. Remove excess mounting solution at finished seams, perimeter edges, and adjacent surfaces.
- B. After application of film, wash film using cleaning methods recommended by glazing film manufacturer. Do not use abrasive-type cleaning agents or bristle brushes.
- C. Replace films that cannot be cleaned.

END OF SECTION

SECTION 09 05 61

COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section applies to all floors identified in the contract documents as to receive the following types of floor coverings:
 - 1. Resilient tile and sheet.
 - 2. Carpet tile.
 - 3. Thin-set ceramic tile.
- B. Preparation of new concrete floor slabs for installation of floor coverings.
- C. Testing of concrete floor slabs for moisture and alkalinity (pH).
- D. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
 - 1. Construction Manager shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Construction Manager's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.

1.2 PRICE AND PAYMENT PROCEDURES

- A. Unit Prices: See Section 01 22 00 - Unit Prices.
- B. Unit Price for Alternate Flooring Adhesive: Do not include the cost of the alternate adhesive in the base bid; state on the bid form the unit price per square foot for using the alternate adhesive, in the event such remediation is required.
 - 1. Base the unit price on a total quantity of 10,000 square feet.
- C. Unit Price for Remedial Floor Coating: Do not include the cost of the floor coating in the base bid; state on the bid form the unit price per square foot for the floor coating, installed, in the event such remediation is required.
 - 1. Base the unit price on a total quantity of 10,000 square feet.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.4 SUBMITTALS

- A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
 - 1. Moisture and alkalinity (pH) limits and test methods.
 - 2. Manufacturer's required bond/compatibility test procedure.
- B. Testing Agency's Report:
 - 1. Description of areas tested; include floor plans and photographs if helpful.
 - 2. Summary of conditions encountered.
 - 3. Moisture and alkalinity (pH) test reports.
 - 4. Copies of specified test methods.
 - 5. Recommendations for remediation of unsatisfactory surfaces.
 - 6. Include certification of accuracy by authorized official of testing agency.
 - 7. Submit report to Architect.
 - 8. Submit report not more than two business days after conclusion of testing.
- C. Adhesive Bond and Compatibility Test Report.

1.5 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing will be performed by an independent testing agency employed and paid by Owner.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
 - 1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- C. Construction Manager's Responsibility Relating to Independent Agency Testing:
 - 1. Provide access for and cooperate with testing agency.
 - 2. Confirm date of start of testing at least 10 days prior to actual start.
 - 3. Allow at least 4 business days on site for testing agency activities.
 - 4. Achieve and maintain specified ambient conditions.
 - 5. Notify Architect when specified ambient conditions have been achieved and when testing will start.

1.6 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
 - 1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
 - 2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
 - 3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
- B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
- C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
 - 1. Thickness: 1/8 inch, maximum.
 - 2. If testing agency recommends any particular products, use one of those.
 - 3. Products:
 - a. ARDEX Engineered Cements; ARDEX MC ULTRA with ARDEX FEATHERFINISH: www.ardexamericas.com.
 - b. Floor Seal Technology, Inc; MES 100 with Floor Seal FloorCem SLU: www.floorseal.com.
 - c. KOSTER American; VAP 2000 Zero VOC with LevelStrong HS: www.kosterusa.com.
 - d. ProSpec, an Oldcastle brand; Moisture Guard Max: www.prospec.com.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 - EXECUTION

3.1 CONCRETE SLAB PREPARATION

- A. Perform following operations in the order indicated:
 - 1. Preliminary cleaning.
 - 2. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
 - 3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.

4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 5. Specified remediation, if required.
 6. Patching, smoothing, and leveling, as required.
 7. Other preparation specified.
 8. Adhesive bond and compatibility test.
 9. Protection.
- B. Remediations:
1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
 2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating over entire suspect floor area.
 3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.
- 3.2 PRELIMINARY CLEANING
- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
 - B. Do not use solvents or other chemicals for cleaning.
- 3.3 MOISTURE VAPOR EMISSION TESTING
- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
 - B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
 - C. Test in accordance with ASTM F1869 and as follows.
 - D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
 - E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
 - F. Report: Report the information required by the test method.
- 3.4 INTERNAL RELATIVE HUMIDITY TESTING
- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
 - B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
 - C. Test in accordance with ASTM F2170 Procedure A and as follows.
 - D. Testing with electrical impedence or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
 - E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
 - F. Report: Report the information required by the test method.

3.5 ALKALINITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Construction Manager's convenience.
- C. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
- D. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.6 PREPARATION

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with requirements and recommendations of floor covering manufacturer.
- C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- D. Do not fill expansion joints, isolation joints, or other moving joints.

3.7 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

3.8 APPLICATION OF REMEDIAL FLOOR COATING

- A. Comply with requirements and recommendations of coating manufacturer.

3.9 PROTECTION

- A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

SECTION 09 21 16.23

GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes gypsum board shaft wall assemblies.

1.2 ACTION SUBMITTALS

- A. Product Data: For each component of gypsum board shaft wall assembly.
- B. Span and Deflection Design Criteria: Provide height to load deflection charts showing studs supplied conform to deflection limit scheduled and allowed per ASTM C 754.
 - 1. Mark on chart(s) showing major partitions scheduled conformance with criteria.
 - 2. Submit manufacturer's certification of stud size, thickness, and spacing complying with performance requirements and selections made by architect are correct for application shown.

1.3 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified in accordance with the product-certification program of the Steel Framing Industry Association (SFIA) or a similar organization that provides a verifiable code compliance program

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and support them on risers on a flat platform to prevent sagging.
- B. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202 "Code of Standard Practice."

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with gypsum-shaftliner-board manufacturer's written instructions.
- B. Do not install finish panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, or mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.
- C. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members" and ASTM C645, Section 10, unless otherwise indicated.

2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

- A. Fire-Resistance Rating: As indicated.
- B. STC Rating: As indicated.

- C. Gypsum Shaftliner Board:
1. Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with paper faces, 1 inch (25.4 mm) thick, with double beveled long edges.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) American Gypsum; 1-inch Shaft Liner Gypsum.
 - 2) CertainTeed Corporation; Shaftliner Type X.
 - 3) Continental Building Products, LLC; Fire-Resistant Shaftliner Type X.
 - 4) Georgia-Pacific Building Products; ToughRock Shaftliner.
 - 5) LaFarge; Shaftliner Type X.
 - 6) National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner.
 - 7) PABCO Gypsum; Pabcore Shaftliner Type X.
 - 8) United States Gypsum Company; SheetRock Gypsum Liner Panels.
 2. Moisture- and Mold-Resistant Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with ASTM D 3273 mold-resistance score of 10 as rated according to ASTM D 3274, 1 inch (25.4 mm) thick, and with double beveled long edges.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) American Gypsum; M-Bloc 1 inch Shaft Liner with Mold & Moisture Resistance.
 - 2) CertainTeed Corporation; M2 Tech Shaftliner Type X.
 - 3) Continental Building Products, LLC; Mold Defense Shaftliner Type X.
 - 4) Georgia-Pacific Building Products; DensGlass Shaftliner.
 - 5) National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner XP.
 - 6) PABCO Gypsum; Pabcore Mold Curb Plus Shaftliner Mold & Water Resistant, Type X.
 - 7) United States Gypsum Company; Sheetrock Brand Mold Tough Gypsum Liner Panel.
 3. Moisture- and Mold-Resistant, Fiberglass-Mat Faced: ASTM C 1658/C 1658M; manufacturer's proprietary fire-resistive liner panels with ASTM D 3273 mold-resistance score of 10 as rated according to ASTM D 3274, 1 inch (25.4 mm) thick, and with double beveled long edges.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) American Gypsum; M-Glass Shaft Liner with Mold and Moisture Resistance.
 - 2) Continental Building Products, LLC; Weather Defense Platinum Shaftliner Type X.
 - 3) Georgia-Pacific Building Products; Dens-Glass Shaftliner Shaftwall/Stairwell Systems.
 - 4) National Gypsum Company; Gold Bond Brand eXP Shaftliner.
 - 5) United States Gypsum Company; Sheetrock Glass-Mat Liner Panel Mold Tough.
- D. Non-Load-Bearing Steel Framing, General: Complying with AISI S220 ASTM C 645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.
1. Protective Coating: Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40 (Z120) unless otherwise indicated.
- E. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:
1. Depth:.
 2. Minimum Base-Metal Thickness: As required by performance requirements for horizontal deflection.
- F. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches (51 mm) long and matching studs in depth.
1. Minimum Base-Metal Thickness: Matching steel studs.
- G. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Clark Dietrich Blazeframe DSL Max Track.
 - b. CEMCO; California Expanded Metal Products Co; FAS Track.
 - c. Fire Trak Corp; Fire Track System.
 - d. Metal-Lite; The System.
 - e. Steel Network, Inc. (The); VertiTrack VTD.
- H. Elevator-Hoistway-Entrance Struts: Manufacturer's standard J-profile jamb strut with long-leg length of 3 inches (76 mm), matching studs in depth, and not less than 0.033 inch (0.84 mm) thick.

- I. Finish Panels: Gypsum board as specified in Section 09 29 00 "Gypsum Board."
- J. Sound Attenuation Blankets: As specified in Section 09 81 16 "Acoustical Blanket Insulation."

2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with shaft wall manufacturer's written instructions.
- B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 09 29 00 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written instructions for application indicated.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
- D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
 - 1. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- E. Reinforcing: Galvanized-steel reinforcing strips with 0.033-inch (0.84-mm) minimum thickness of base metal (uncoated).
- F. Acoustical Sealant: Section 07 92 19 "Acoustical Joint Sealants."
- G. Gypsum Board Cants:
 - 1. Gypsum Board Panels: As specified in Section 09 29 00 "Gypsum Board," Type X, 1/2- or 5/8-inch (13- or 16-mm) panels.
 - 2. Adhesive: Laminating adhesive as specified in Section 09 29 00 "Gypsum Board."
 - 3. Non-Load-Bearing Steel Framing: As specified in Section 09 22 16 "Non-Structural Metal Framing."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 07 81 00 "Applied Fireproofing."
- B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.
- B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.
- C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
 - 1. Elevator Hoistway: At elevator hoistway-entrance door frames, provide jamb struts on each side of door frame.

2. Reinforcing: Provide where items attach directly to shaft wall assembly as indicated on Drawings; accurately position and secure behind at least one layer of face panel.
 - D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.
 - E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.
 - F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - G. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.
 - H. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.
 - I. Gypsum Board Cants: At projections into shaft exceeding 4 inches (102 mm), install gypsum board cants covering tops of projections.
 1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches (610 mm) o.c. with screws fastened to shaft wall framing.
 2. Where non-load-bearing steel framing is required to support gypsum board cants, install framing at 24 inches (610 mm) o.c. and extend studs from the projection to shaft wall framing.
 - J. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.
- 3.4 PROTECTION
- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
 - B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 09 22 16

NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior partitions.
 - 2. Suspension systems for interior ceilings and soffits.
 - 3. Grid suspension systems for gypsum board ceilings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Span and Deflection Design Criteria: Provide height to load deflection charts showing studs supplied conform to deflection limit scheduled and allowed per ASTM C 754.
 - 1. Mark on chart(s) showing all major partitions scheduled conformance with criteria.
 - 2. Submit manufacturer's certification of stud size, thickness, and spacing complying with performance requirements and selections made by architect are correct for application shown.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.
- B. Evaluation Reports: For firestop tracks, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association.

1.5 SEQUENCING

- A. Coordinate placement of concealed internal wall reinforcement, such as backing plates, for items to be attached to metal support systems.
- B. Coordinate installation of ceiling and soffit suspension systems with installation of overhead structural assemblies to ensure that inserts and other provisions for anchorage to building structure have been installed to receive ceiling hangers that will develop their full strength and at spacing required to support ceilings.
- C. Furnish concrete inserts, and other devices indicated, to other trades for installation well in advance of time needed for coordination with other construction.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202 "Code of Standard Practice."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members" and ASTM C645, Section 10, unless otherwise indicated.
- B. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

- C. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- D. Horizontal Deflection:
1. Minimum Base-Metal Thickness: 25 gage unless indicated otherwise on Drawings or below.
 2. Interior Metal Stud/Gypsum Board Assemblies, Typical Locations: Withstand lateral loading (air pressure) of 5 psf with deflection limit not more than L/240 of partition height.
 3. Interior Metal Stud/Gypsum Board Assemblies at Atriums, Lobbies, Service Corridors, Exit Corridors, Elevator Lobbies, Vertical Shafts, and walls receiving plaster veneer: Withstand lateral loading (air pressure) of 7.5 psf with deflection limit not more than L/360 of partition height.
 4. Interior Metal Stud/Gypsum Board Assemblies at Locations with Ceramic Tile or Other Hard Surface Finishes: Withstand typical lateral loading (air pressure) with deflection limit not more than L/360 of partition height, minimum 22 gage studs at 16 inches on center.
 5. Where wall mounted equipment, woodwork, and casework items are indicated or elsewhere as shown on Drawings, provide minimum 16 gage studs.
 6. At jams of openings provide two minimum 20 gage studs.
 7. Ceilings: At ceilings using mold-mildew resistant gypsum framing to be 16 inches o.c. for 5/8 inch gypsum.
 8. Refer to Division 05 for stud framing which is exposed to wind loads and for studs carrying heavy vertical loads, such as, cement plaster, manufactured stone masonry, stone tile thicker than 3/4 inch, etc.
 9. Design may not propose bracing that would be exposed to view in finished spaces. Bracing above ceiling is allowed as part of design where such bracing will not conflict with clearances required for above ceiling mechanical and electrical systems.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with AISI S220 and ASTM C645 for conditions indicated.
1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 2. Protective Coating: Comply with AISI S220 and ASTM A 653/A 653M, G40 (Z120) or coating with equivalent corrosion resistance of ASTM A653/A653M, G40 (Z120), hot-dip galvanized unless otherwise indicated. ,
 - a. Coating roll-formed from steel complying with mechanical and chemical requirements of ASTM A1003 with a zinc-based coating.
 - b. Coatings shall demonstrate equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction
- B. Studs and Tracks: AISI S220 and ASTM C 645, Section 10
1. Steel Studs and Tracks:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) CEMCO.
 - 2) ClarkDietrich
 - 3) Custom Stud.
 - 4) MarinoWARE.
 - 5) MBA Building Supplies.
 - 6) MRI Steel Framing, LLC.
 - 7) Phillips Manufacturing Co.
 - 8) SCAFCO Steel Stud Company.
 - 9) Steel Network, Inc. (The).
 - 10) Telling Industries
 - b. Minimum Base-Metal Thickness: As required by performance requirements for horizontal deflection .
 - c. Depth: As indicated on Drawings .

- C. Slip-Type Head Joints: Where studs are continuous from floor to structure above, provide one of the following:
1. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) BlazeFrame Industries.
 - 2) CEMCO; California Expanded Metal Products Co.
 - 3) ClarkDietrich Building Systems.
 - 4) MarinoWARE.
 - 5) MBA Building Supplies.
 - 6) Metal-Lite.
 - 7) Perfect Wall, Inc.
 - 8) SCAFECO Steel Stud Company.
 - 9) Steel Network, Inc. (The).
 - 10) Telling Industries.
- D. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BlazeFrame Industries.
 - b. CEMCO; California Expanded Metal Products Co.
 - c. ClarkDietrich Building Systems.
 - d. Fire Trak Corp.
 - e. MarinoWARE.
 - f. Metal-Lite.
 - g. Perfect Wall, Inc.
 - h. SCAFECO Steel Stud Company.
 - i. Steel Network, Inc. (The).
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ClarkDietrich Building Systems.
 - b. MarinoWARE.
 - c. MRI Steel Framing, LLC.
 - d. SCAFECO Steel Stud Company.
 2. Minimum Base-Metal Thickness: 0.0179 inch (0.455 mm).
- F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ClarkDietrich Building Systems.
 - b. MarinoWARE.
 - c. MRI Steel Framing, LLC.
 - d. SCAFECO Steel Stud Company.
 2. Depth: As indicated on Drawings.
 3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ClarkDietrich Building Systems.
 - b. MarinoWARE.
 - c. MRI Steel Framing, LLC.
 - d. SCAFECO Steel Stud Company.

2. Minimum Base-Metal Thickness: 0.0179 inch (0.455 mm).
 3. Depth: 7/8 inch (22.2 mm).
- H. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ClarkDietrich Building Systems.
 - b. MarinoWARE.
 - c. MRI Steel Framing, LLC.
 - d. SCAFCO Steel Stud Company
 2. Configuration: Asymmetrical.
- I. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
1. Depth: 3/4 inch (19 mm).
 2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch (0.8 mm).
 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire
- J. Partial Wall Framing Connection: Connector designed to support out-of-plane loading of cantilevered partial wall systems that are unsupported at the top track.
1. ClarkDietrich Pony Wall or comparable product.
 2. Minimum Base-Steel Thickness: 0.0966 inch (2.45 mm).

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- B. Hanger Attachments to Concrete:
1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.
 - a. Uses: Securing hangers to structure.
 - b. Type: Torque-controlled, expansion anchor.
 - c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
 - d. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).
 2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
- D. Flat Hangers: Steel sheet, 1 by 3/16 inch (25 by 5 mm) by length indicated.
- E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
1. Depth: As indicated on Drawings.
- F. Furring Channels (Furring Members):
1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
 2. Steel Studs and Tracks: AISI S220 and ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.0179 inch (0.455 mm).
 - b. Depth: 1-5/8 inches (41 mm).
 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
 - a. Minimum Base-Metal Thickness: 0.0179 inch (0.455 mm).
 4. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical.

- G. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong World Industries, Inc.
 - b. ROCKWOOL International (formerly Chicago Metallic Corporation).
 - c. United States Gypsum Company.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide the following:
 - 1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
 - 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (610 mm) o.c.
 - 2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Single-Layer Application: As required by horizontal deflection performance requirements unless otherwise indicated.
 - 2. Multilayer Application: As required by horizontal deflection performance requirements unless otherwise indicated.
 - 3. Tile Backing Panels: As required by horizontal deflection performance requirements unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
 - a. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
 - 6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.
- E. Direct Furring:
 - 1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Hangers: 48 inches (1219 mm) o.c.
 - 2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
 - 3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.

- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 5. Do not attach hangers to steel roof deck.
 - 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

SECTION 09 27 13

GLASS-FIBER-REINFORCED GYPSUM FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes factory-fabricated, glass-fiber-reinforced plaster fabrications for interior applications.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, weights, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details, including locations of attachments for fabrications suspended by tie wires from structure.
 - 2. Detail fabrication and assembly of glass-fiber-reinforced plaster fabrications.
 - 3. Indicate requirements for joint treatment.
 - 4. Indicate location of control joints.
- C. Samples: For each exposed product and for each color and texture specified.
 - 1. Linear Moldings: 24-inch- (600-mm-) long section with finished joint. Show complete pattern.
 - 2. Nonlinear Shapes: Full-size unit.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with one another, using input from installers of the items involved:
 - 1. Ceiling suspension system members.
 - 2. Structural members to which glass-fiber-reinforced plaster fabrications will be attached and method of attachment.
 - 3. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - 4. Perimeter moldings.

1.4 QUALITY ASSURANCE

- A. Mockups: Build mockups to set quality standards for fabrication and installation.
 - 1. Build mockup of each type of glass-fiber-reinforced plaster fabrication.
 - 2. Paint mockups to match finish indicated and to comply with requirements specified in Section 09 91 23 "Interior Painting."
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C 1467/C 1467M.

1.6 FIELD CONDITIONS

- A. Environmental Conditions:
 - 1. Comply with ASTM C 1467/C 1467M.
 - 2. Do not deliver or install glass-fiber-reinforced plaster fabrications until building is enclosed, wet-work is complete, and HVAC system is operating and continuously maintaining temperature and relative humidity at levels intended for building occupants.

- B. Conditioning: Acclimatize glass-fiber-reinforced plaster fabrications to ambient temperature and humidity of spaces in which they will be installed. Remove packaging and move units into installation spaces not less than 48 hours before installing them.

PART 2 - PRODUCTS

2.1 GLASS-FIBER-REINFORCED PLASTER FABRICATIONS

- A. Fabrications: Molded, glass-fiber-reinforced plaster units complying with ASTM C 1381/C 1381M.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CastWorks; by Armstrong World Industries, Inc.
 - b. Timeless Architectural Reproductions Inc.
 - c. Casting Designs, Inc.
 - d. GRG Technologies, LLC.
 - e. Melton Classics, Incorporated.
 - f. Stromberg Architectural Products, Inc.
 - 2. Basis-of-Design Manufacturer: CastWorks; by Armstrong World Industries, Inc.
- B. Embedments: As standard with glass-fiber-reinforced plaster fabrication manufacturer and as required for reinforcement and for anchorage to substrates and framing.
- C. Finish: Smooth for paint finish.
- D. Physical Properties:
 - 1. Shell Thickness: 3/16-inch.
 - 2. Weight: 2 to 3 lbs per sq. ft.
 - 3. Flexural Strength: Not less than 2,500 psi, in accordance with ASTM C 947.
 - 4. Tensile Strength: 1,810 psi, in accordance with ASTM D 638-94.
 - 5. Smoke Index: 0, Class A, in accordance with ASTM E 84.
 - 6. Flame Spread: 0, Class A, in accordance with ASTM E 84.

2.2 AUXILIARY MATERIALS

- A. Adhesives: As recommended in glass-fiber-reinforced plaster fabrication manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Screws complying with ASTM C 954 for fastening glass-fiber-reinforced plaster fabrications to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
- C. Control Joints: ASTM C 1047, one-piece control joint with V-shaped slot and removable strip covering the slot opening.
 - 1. Material: Steel sheet zinc-coated by hot-dip process.
- D. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

2.3 FABRICATION

- A. Tolerances:
 - 1. Dimensional: 1/8-inch.
 - 2. Thickness: 1/16-inch.
 - 3. Warpage or Bowing: 1/16-inch per foot.
- B. Fabricate glass-fiber-reinforced plaster units in factory to comply with ASTM C 1381/C 1381M, with smooth-finished surfaces; repair hollows, voids, scratches, and other surface imperfections. Fabricate units in lengths and sizes that will minimize number of joints between abutting units.
- C. Embedments: Incorporate embedments into units to develop the full strength of glass-fiber-reinforced plaster fabrications. Cover embedments with not less than 3/16-inch (5-mm) thickness of glass-fiber-reinforced plaster composite.
- D. Connection Hardware: Designed and fabricated to support and connect glass-fiber-reinforced plaster fabrications to hangers, support framing, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with ASTM C 1467/C 1467M.
- B. Install glass-fiber-reinforced plaster fabrications level, plumb, true, and aligned with adjacent materials. Use concealed shims where required for alignment.
- C. Attach glass-fiber-reinforced plaster fabrications to framing and substrates with steel drill screws unless otherwise indicated. Do not use pneumatic staple guns. Countersink screw heads below adjoining finished surface.
 - 1. Predrill fastener holes in units. Clean fastener holes to remove dirt and oil.
 - 2. Locate fasteners not less than 5/16 inch (7.9 mm) from edges or ends of units.
- D. Suspended Systems: Attach suspended glass-fiber-reinforced plaster fabrications to structure with tie wire at each attachment point indicated on approved Shop Drawings. Comply with requirements for hangers specified in Section 09 22 16 "Non-Structural Metal Framing."
- E. Where glass-fiber-reinforced plaster fabrications are joined to form composite units, join fabrications with adhesive. Band or brace units together until adhesive cures.
- F. Install control joints between glass-fiber-reinforced plaster fabrications where indicated.

END OF SECTION

SECTION 09 29 00

GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
 - 2. Tile backing panels.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 QUALITY ASSURANCE

- A. Mockups: Build mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Build mockups for the following:
 - a. Each level of gypsum board finish indicated for use in exposed locations.
 - 2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
 - 3. Simulate finished lighting conditions for review of mockups.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C 1396/C 1396M.
- B. Gypsum Board, Type X: ASTM C 1396/C 1396M.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. American Gypsum; 5/8 inch FireBloc Type X Gypsum Wallboard.
 - b. CertainTeed Corporation; Type X Gypsum Board.
 - c. Continental Building Products, LLC; Firecheck Type X.
 - d. Georgia-Pacific Building Products; ToughRock Fireguard X Gypsum Board.
 - e. National Gypsum Company; Gold Bond Brand Fire-Shield Gypsum Board.
 - f. PABCO Gypsum; Flame Curb Type X.
 - g. United States Gypsum Company; USG Sheetrock Brand Firecode X Gypsum Panels.
 - 2. Thickness: 5/8 inch (15.9 mm).
 - 3. Long Edges: Tapered.
- C. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. American Gypsum; 1/2" Interior Ceiling Board.
 - b. CertainTeed Corporation; Interior Ceiling Gypsum Board.
 - c. Continental Building Products, LLC; Sagcheck.
 - d. Georgia-Pacific Building Products; ToughRock Span 24 Ceiling Board.
 - e. PABCO Gypsum; Interior Ceiling Sag-Resistant Ceiling Panel.
 - f. United States Gypsum Company; Imperial Sag-Resistant Interior Ceiling Gypsum Base.
 - 2. Thickness: 1/2 inch (12.7 mm).
 - 3. Long Edges: Tapered.
- D. Abuse-Resistant Gypsum Board: ASTM C 1396/C 1396M gypsum board, tested according to ASTM C 1629/C 1629M.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. American Gypsum; 5/8" M-Bloc AR Type X with Mold & Moisture Resistance.
 - b. CertainTeed Corporation; AirRenew Extreme Abuse.
 - c. Continental Building Products, Protecta AR 100 Type X with Mold Defense.
 - d. Georgia-Pacific Building Products; ToughRock Fireguard X Abuse-Resistant Gypsum Board.
 - e. National Gypsum Company; eXP Interior Extreme AR.
 - f. PABCO Gypsum; Abuse Curb.
 - g. United States Gypsum Company;USG Sheetrock Brand Mold Tough Abuse-Resistant Firecode X.
 - 2. Core:5/8 inch (15.9 mm), Type X.
 - 3. Surface Abrasion: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements.
 - 4. Indentation: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements.
 - 5. Soft-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements.
 - 6. Long Edges: Tapered.
 - 7. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- E. Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. American Gypsum ;5/8" M-Bloc Type X with Mold & Moisture Resistance.
 - b. CertainTeed Corporation; M2Tech, Type X.
 - c. Continental Building Products, LLC; Mold Defense, Type X.
 - d. Georgia-Pacific Building Products; ToughRock Mold-Guard.
 - e. National Gypsum Company; Gold Bond Brand XP Fire-Shield.
 - f. PABCO Gypsum; Mold Curb Plus, Type X.
 - g. United States Gypsum Company; USG Sheetrock Brand Mold Tough® Gypsum Panels, Type X.
 - 2. Core:5/8 inch (15.9 mm), Type X.
 - 3. Long Edges: Tapered.
 - 4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 SPECIALTY GYPSUM BOARD

- A. Gypsum Board, Type C: ASTM C 1396/C 1396M. Manufactured to have increased fire-resistive capability.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. American Gypsum ; 1/2" FireBloc Type C Gypsum Wallboard.
 - b. CertainTeed Corporation; Type C Gypsum Board.
 - c. Continental Building Products, LLC Firecheck Type C.
 - d. Georgia-Pacific Building Products ToughRock Fireguard C.
 - e. National Gypsum Company; Gold Bond Fire-Shield C.
 - f. PABCO Gypsum; Flame Curb Type Super C.
 - g. United States Gypsum Company; USG Imperial Gypsum Base, Firecode C.
 - 2. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
 - 3. Long Edges: Tapered.
- B. Glass-Mat Interior Gypsum Board: ASTM C 1658/C 1658M. With fiberglass mat laminated to both sides. Specifically designed for interior use.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Continental Building Products, LLC; Weather Defense Platinum Interior Type X.
 - b. Georgia-Pacific Building Products; DensArmour Plus.
 - c. National Gypsum Company; eXP Interior Extreme.
 - d. United States Gypsum Company; USG Sheetrock Brand Glass-Mat Panels Mold Tough.
 - 2. Core: 5/8 inch (15.9 mm), Type X.
 - 3. Long Edges: Tapered.
 - 4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.5 TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; GlasRoc Tile Backer.
 - b. Georgia-Pacific Gypsum LLC; DensShield Tile Backer.
 - c. National Gypsum; eXP Tile Backer.
 - d. United States Gypsum Company; USG Durock Glass-Mat Tile Backerboard.
 - 2. Core: 5/8 inch (15.9 mm), Type X.
 - 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.6 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 - 2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - f. Expansion (control) joint.
- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. Pittcon Industries.
 - 2. Basis-of-Design Product: Fry Reglet Corp.; DRMF-625-625.
 - 3. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), Alloy 6063-T5.
 - 4. Finish: Clear anodized.

2.7 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.

2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 3. Tile Backing Panels: As recommended by panel manufacturer.
 - C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
 5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.
 - D. Joint Compound for Tile Backing Panels:
 1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
- 2.8 AUXILIARY MATERIALS
- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
 - B. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 - C. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
 - D. Electrical Box Pads: Putty Pads: Moldable non-curing one component, intumescent, fire-rated material for through-penetration fire stop systems and sound attenuation systems; self-adhering; 1/8-inch thick minimum.
 - E. Acoustical Sealant: Refer to Section 07 92 19 "Acoustical Joint Sealants."
 - F. Thermal Insulation: As specified in Section 07 21 00 "Thermal Insulation."

PART 3 - EXECUTION

- 3.1 EXAMINATION
- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
 - C. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.2 ELECTRICAL BOX PADS FOR SMOKE / FIRE-RATED AND STC-RATED WALLS
- A. Prior to installing wallboards, install electrical box pads in accordance with manufacturer's written instructions.
 - B. Overlap front edge of box so that pad will be compressed around edges of box as gypsum panels are installed.
- 3.3 APPLYING AND FINISHING PANELS, GENERAL
- A. Comply with ASTM C 840.
 - B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
 - C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.4 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Type X: Vertical surfaces unless otherwise indicated.
 - 2. Flexible Type: Apply in double layer at curved assemblies.
 - 3. Ceiling Type:
 - a. Fire-Rated Ceilings: Type C.
 - b. All Other Ceiling Surfaces: Type X.
 - 4. Abuse-Resistant Type:
 - a. At all corridors that do not have a wainscot.
 - b. All walls in stairwells.
 - c. As indicated on Drawings.
 - 5. Mold-Resistant Type: At restrooms, laundry, kitchen areas, custodial, and similar wet and washable locations, except for backer board installed behind tile.
 - 6. Glass-Mat Interior Type: As indicated on Drawings and the following.
 - a. Interior side of exterior walls.
 - b. Interior partitions where Contractor chooses to install gypsum board prior to building dry-in.
 - c. On tile walls, unless noted otherwise.
 - d. At urinal and toilet fixtures as indicated on Drawings.
 - 7. Tile Backer, Glass-Mat Type:
 - a. Walls in toilet room with shower.
 - b. Tiled walls in showers and bathtubs.
 - c. Tiled walls in toilet rooms and kitchens.
 - d. Behind prefabricated shower or bathtub units.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.

- b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 - 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
 - C. Multilayer Application:
 - 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
 - 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 - 3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- 3.5 APPLYING TILE BACKING PANELS
 - A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at showers, tubs, and where indicated. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
 - 1. Do not install screws within 6 inches of the shower wall base so as to not penetrate shower pan waterproofing.
 - B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.
- 3.6 INSTALLING TRIM ACCESSORIES
 - A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
 - B. Control Joints: Install control joints at locations indicated on Drawings according to ASTM C 840 and in specific locations approved by Architect for visual effect.
 - C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners unless otherwise indicated.
 - 2. Bullnose Bead: Use where indicated.
 - 3. LC-Bead: Use at exposed panel edges.
 - 4. L-Bead: Use where indicated.
 - 5. U-Bead: Use where indicated.
 - D. Aluminum Trim: Install in locations indicated on Drawings.
- 3.7 FINISHING GYPSUM BOARD
 - A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
 - B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
 - C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
 - D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges and sand joints. Provide Level 2 finish where panels are substrate for tile, behind plywood backer boards, in mechanical and electrical rooms and where specifically indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
 - 3. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound over entire surface, and sand smooth. Provide Level 4 finish typical, where panels are to receive painted finish unless specifically indicated otherwise.
 - a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."

4. Level 5: All joints and interior angles shall have tape embedded in joint compound and three separate coats of joint compound applied over all joints, angles fastener heads, and accessories. A thin skim coat of joint compound, or a material manufactured especially for this purpose, shall be applied to the entire surface. The surface shall be smooth and free of tool marks and ridges. Finish work free of noticeable defects which include joint ridging, staved joints, board edges damaged or out of place, joint blisters, nail pops, pinholes in joint treatment or any other noticeable defects. Finish work true to line, perfectly smooth and ready for painting or wall covering. Provide Level 5 finish at all walls indicated to receive graphic wall coverings, PT 6, PT 7, and all walls to receive acrylic signage.
- E. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.8 RATED PARTITION IDENTIFICATION

- A. At fire-rated wall and smoke partition assemblies, provide an identification of wall rating in 4-inch high stenciled block letters in red paint. Space identifications 12 feet on center maximum, 4 feet from corners maximum, above ceiling. Provide identification on both sides of wall.
- B. Partition Identification Text: Apply the following, as applicable:
 1. WARNING: SMOKE PARTITION – PROPERLY SEAL ALL OPENINGS.
 2. WARNING: 1-HOUR SMOKE BARRIER – PROPERLY SEAL ALL OPENINGS.
 3. WARNING: 1-HOUR FIRE PARTITION – PROPERLY SEAL ALL OPENINGS.
 4. WARNING: 1-HOUR FIRE BARRIER – PROPERLY SEAL ALL OPENINGS.
 5. WARNING: 2-HOUR FIRE WALL – PROPERLY SEAL ALL OPENINGS.
 6. WARNING: 2-HOUR FIRE BARRIER – PROPERLY SEAL ALL OPENINGS.
- C. Refer to Section 09 91 23 "Interior Painting" for painting requirements.
 1. Use interior semi-gloss, latex, low VOC paint.

3.9 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Before installing gypsum board ceilings, conduct an above-ceiling inspection, and report and correct deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
 1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for Contractor's above-ceiling inspection. Provide Architect with copy of deficiencies report. Architect reserves the right to supplement Contractor's deficiency report with other incomplete or incorrect items that might be observed during Architect's site visit.
 2. Before notifying Architect, complete the following in areas to receive gypsum board ceilings:
 - a. Installation of 80 percent of lighting fixtures, powered for operation.
 - b. Installation, insulation, and leak and pressure testing of water piping systems.
 - c. Installation of air-duct systems.
 - d. Installation of air devices.
 - e. Installation of mechanical system control-air tubing.
 - f. Installation of ceiling support framing.
 - g. Touch-up/patching of spray fire-resistive materials (SFRM).
 - h. Installation of penetration firestopping in fire- and smoke-rated partitions.
 - i. Installation of fire-resistant joint sealants in fire-rated partitions.
 - j. Installation of acoustical sealants at adjacent sound-rated partitions.
 - k. Application of fire- and smoke-rated partition identification.

3.10 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 09 30 13

CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ceramic mosaic tile.
 - 2. Porcelain tile.
 - 3. Glazed wall tile.
 - 4. Waterproof membrane for thinset applications.
 - 5. Crack isolation membrane.
 - 6. Metal edge strips.

1.2 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Verification:
 - 1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.
 - 2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches (300 mm) square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
 - 3. Full-size units of each type of trim and accessory for each color and finish required.
 - 4. Metal edge strips in 6-inch (150-mm) lengths.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- C. Product Certificates: For each type of product.
- D. Product Test Reports: For tile-setting and -grouting products and certified porcelain tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
 2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
 3. Installer employs Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Build mockup of each type of floor tile installation.
 2. Build mockup of each type of wall tile installation.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.10 WARRANTY

- A. Warranty: Manufacturer agrees to repair or replace components of tile system that fail in materials or workmanship within specified warranty period, when the products are installed within their shelf life and according to governmental regulations and manufacturer's written materials which are in effect at the time installation.
 1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.
 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
 1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
 2. Obtain waterproof membrane and crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
 1. Waterproof membrane.
 2. Crack isolation membrane.
 3. Metal edge strips.

- D. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Olean; a division of Dal-Tile Corporation.
 - 2. Daltile.
 - 3. Interceramic.
 - 4. Pantheon Floor Solutions.
 - 5. Portobello America, Inc.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
 - 1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

2.3 TILE PRODUCTS

- A. Available Suppliers whose products may be incorporated into the Work include, but are not limited to, the following:
 - 1. As scheduled for new tile.
- B. Wall Porcelain Tile: Porcelain ceramic tile. Size and type as indicated on Drawings.
- C. Floor Tile: Porcelain ceramic tile. Size and type as indicated on Drawings.
- D. Trim and Special Tile: Provide necessary caps, stops, coves, returns, trimmers, and other shapes as required for a complete installation. Items to be supplied by the same manufacturer supplying the tile.

2.4 WATERPROOF MEMBRANE

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
 - b. H.B. Fuller Construction Products Inc. / TEC; Hydrflex Waterproofing Crack Isolation Membrane with Waterproofing Mesh.
 - c. LATICRETE SUPERCAP, LLC; Laticrete 9235 Waterproof Membrane.
 - d. MAPEI Corporation; Fiberglass Mesh with Mapelastic Waterstop.

2.5 CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch (0.76-mm) nominal thickness.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Noble Company (The); Nobleseal CIS.
 - b. Mapei Corporation Mapeguard 2,

- C. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
 - b. H.B. Fuller Construction Products Inc. / TEC; Hydraflex Waterproofing Crack Isolation Membrane.
 - c. LATICRETE SUPERCAP, LLC; Laticrete 9235 Waterproof Membrane.
 - d. MAPEI Corporation; Mapelastic CI.

2.6 SETTING MATERIALS

- A. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15, A118.11, and ISO 13007 C2ES1P1.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Custom Building Products; CEGLite™ 100% Solids Commercial Epoxy Grout.
 - b. H.B. Fuller Construction Products Inc. / TEC; TEC® AccuColor EFX® Epoxy Special Effects Grout (TA-440).
 - c. LATICRETE SUPERCAP, LLC; LATICRETE® SUPERCAP™ Moisture Vapor Control.
 - d. MAPEI Corporation; Floor Tile Mortar.
 - 2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.15.

2.7 GROUT MATERIALS

- A. High-Performance Tile Grout: ANSI A118.7 and ISO 13007 CG2FAW.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Custom Building Products; Prism Color Consistent Grout.
 - b. H.B. Fuller Construction Products Inc. / TEC; TEC Power Grout.
 - c. LATICRETE SUPERCAP, LLC; Permacolor.
 - d. MAPEI Corporation; Ultracolor Plus.
 - 2. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.
- B. Water-Cleanable Epoxy Grout: ANSI A118.3.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Custom Building Products; CEG Lite 100% Solids Commercial Epoxy Grout.
 - b. H.B. Fuller Construction Products Inc. / TEC; AccuColor EFX Epoxy Special Effects Grout.
 - c. LATICRETE SUPERCAP, LLC; SpectraLOCK Pro Premium.
 - d. MAPEI Corporation; Kerapoxy CQ.
 - 2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F (60 and 100 deg C), respectively, and certified by manufacturer for intended use.
- C. Grout for PregROUTed Tile Sheets: Same product used in factory to pregROUT tile sheets.

2.8 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D 4397, 4.0 mils (0.1 mm) thick.
- C. Metal Edge Strips: As scheduled on Drawings, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; aluminum exposed-edge material.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Blanke Corporation.
 - b. Ceramic Tool Company, Inc.
 - c. Schluter Systems L.P.
 - 2. Finish: As scheduled.
- D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

- E. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout as approved by grout manufacturer.

2.9 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 - 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors consisting of tiles 8 by 8 inches (200 by 200 mm) or larger.
 - c. Tile floors consisting of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
 - D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
 - E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
 - F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
 - 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - 3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
 - G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Ceramic Mosaic Tile: 1/16 inch (1.6 mm) unless scheduled otherwise.
 - 2. Glazed Wall Tile: 1/16 inch (1.6 mm) unless scheduled otherwise.
 - 3. Porcelain Tile: 1/4 inch (6.4 mm) unless scheduled otherwise.
 - H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
 - I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
 - J. Metal Edge Strips: Install at locations indicated.
 - K. Floor Sealer: Apply floor sealer to cementitious grout joints in tile floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.
- 3.4 WATERPROOFING INSTALLATION
- A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
 - B. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.
- 3.5 CRACK ISOLATION MEMBRANE INSTALLATION
- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
 - B. Allow crack isolation membrane to cure before installing tile or setting materials over it.
- 3.6 ADJUSTING AND CLEANING
- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
 - B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.7 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.8 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
 - 1. Ceramic Tile Installation: TCNA F113; thinset mortar.
 - a. Ceramic Tile Type: As scheduled.
 - b. Thinset Mortar: Improved modified dry-set mortar.
 - c. Grout: High-performance sanded grout.
 - 2. Ceramic Tile Installation: TCNA F115; thinset mortar; epoxy grout.
 - a. Ceramic Tile Type: As scheduled.
 - b. Thinset Mortar: Improved modified dry-set mortar.
 - c. Grout: Water-cleanable epoxy grout.
 - 3. Ceramic Tile Installation: TCNA F122; thinset mortar on waterproof membrane.
 - a. Ceramic Tile Type: As scheduled.
 - b. Thinset Mortar: Improved modified dry-set mortar.
 - c. Grout: High-performance sanded grout.
 - 4. Ceramic Tile Installation: TCNA F125-Full; thinset mortar on crack isolation membrane.
 - a. Ceramic Tile Type: As scheduled.
 - b. Thinset Mortar: Medium-bed, modified dry-set mortar.
 - c. Grout: High-performance sanded grout.
- B. Interior Wall Installations, Masonry or Concrete:
 - 1. Ceramic Tile Installation: TCNA W202; thinset mortar.
 - a. Ceramic Tile Type: As scheduled.
 - b. Thinset Mortar: Improved modified dry-set mortar.
 - c. Grout: High-performance unsanded grout.
- C. Interior Wall Installations, Wood or Metal Studs or Furring:
 - 1. Ceramic Tile Installation: TCNA W243; thinset mortar on gypsum board.
 - a. Ceramic Tile Type: As scheduled.
 - b. Thinset Mortar: Improved modified dry-set mortar.
 - c. Grout: High-performance unsanded grout.
 - 2. Ceramic Tile Installation: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units or fiber-cement backer board.
 - a. Ceramic Tile Type: As scheduled.
 - b. Thinset Mortar: Improved modified dry-set mortar.
 - c. Grout: High-performance unsanded grout.
 - 3. Ceramic Tile Installation: TCNA W245 or TCNA W248; thinset mortar on glass-mat, water-resistant gypsum backer board.
 - a. Ceramic Tile Type: As scheduled.
 - b. Thinset Mortar: Improved modified dry-set mortar.
 - c. Grout: High-performance unsanded grout.

END OF SECTION

SECTION 09 51 13

ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
 - 1. Acoustical Panels: Samples of each type, color, pattern, and texture in manufacturer's standard sample size, minimum 6 inches square.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Ceiling suspension-system members.
 - 2. Structural members to which suspension systems will be attached.
 - 3. Method of attaching hangers to building structure.
 - a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
 - 4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
 - 5. Size and location of initial access modules for acoustical panels.
 - 6. Items penetrating finished ceiling and ceiling-mounted items including the following:
 - a. Lighting fixtures.
 - b. Diffusers.
 - c. Grilles.
 - d. Speakers.
 - e. Sprinklers.
 - f. Access panels.
 - g. Perimeter moldings.
 - 7. Minimum Drawing Scale: 1/4 inch = 1 foot (1:48).
- B. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Units: Full-size panels equal to 2percent of quantity installed.
 - 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
 - 3. Hold-Down Clips: Equal to 2percent of quantity installed.

1.6 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockup of typical ceiling area as directed by Architect.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Armstrong World Industries, Inc.
 2. CertainTeed Corporation.
 3. Rockfon, LLC.
 4. United States Gypsum.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: Class A according to ASTM E 1264.
 2. Smoke-Developed Index: 450 or less.

2.3 ACOUSTICAL PANELS

- A. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- B. AT-1:
 1. Basis-of-Design Product: As scheduled.
 2. Classification: Provide fire-resistance-rated panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - a. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 2, water felted; with vinyl overlay on face.
 - b. Pattern: E (lightly textured).
 3. Color: White.
 4. LR: Not less than 0.82.
 5. NRC: Not less than 0.75.
 6. CAC: Not less than 35.
 7. AC: Not less than 170.
 8. Edge/Joint Detail: Square.
 9. Thickness: 7/8 inch (22 mm).
 10. Modular Size: 24 by 24 inches (610 by 610 mm) .
 11. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

- A. AT-2:
 - 1. Basis-of-Design Product: As scheduled.
 - 2. Classification: Provide fire-resistance-rated panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - a. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 2, water felted; with vinyl overlay on face.
 - b. Pattern: E (lightly textured).
 - 3. Color: White.
 - 4. LR: Not less than 0.78.
 - 5. NRC: Not less than 0.55.
 - 6. Edge/Joint Detail: Manufacturer's standard.
 - 7. Modular Size: As indicated on Drawings.
 - 8. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 METAL SUSPENSION SYSTEM

- A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M and designated by type, structural classification, and finish indicated.
- B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation; with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.
 - 1. Structural Classification: Intermediate -duty system.
 - 2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
 - 3. Face Design: Flat, flush.
 - 4. Cap Material: Cold-rolled steel or aluminum.
 - 5. Cap Finish: Painted white, unless otherwise indicated.
- C. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation; with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges. System supplied with all main runner tees, cross tees, wall angles, clips, connectors, fastening, and hangar wires.
 - 1. Basis-of-Design Product for Grid Type 1: Armstrong World Industries, Inc.; Prelude XL.
 - a. No substitutions permitted.
 - 2. Size: 24 by 24 inches pattern with white finish.
 - 3. Structural Classification: Intermediate -duty system.
 - 4. End Condition of Cross Runners: Override (stepped) or butt-edge type.
 - 5. Face Design: Flat, flush.
 - 6. Cap Material: Cold-rolled steel or aluminum.
 - 7. Cap Finish: Painted white.

2.5 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- (2.69-mm-) diameter wire.
- C. Hold-Down Clips: Manufacturer's standard hold-down.

2.6 METAL EDGE MOLDINGS AND TRIM

- A. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.
 - 1. Basis-of-Design Product: Armstrong World Industries; AXIOM Knife Edge.
 - a. Application: Library cloud ceilings, unless noted otherwise.
 - 2. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils (0.04 mm). Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - a. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C 636/C 636M and manufacturer's written instructions.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 7. Do not attach hangers to steel deck tabs.
 - 8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 9. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
 - 10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends. Miter corners accurately and connect securely.
 - 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
 - 1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 - 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 - 3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 - 4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
 - 5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 - 6. Install hold-down clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.
 - a. Hold-Down Clips: Space 24 inches (610 mm) o.c. on all cross runners.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 09 51 33

SUSPENDED METAL PAN CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes acoustical metal pans and associated suspension system for interior ceilings.
- B. Products furnished, but not installed, under this Section include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include procedure for cutting metal pans.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.
- C. Samples for Initial Selection: For units with factory-applied finishes.
- D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below:
 - 1. Metal Pans: Set of 6-inch- (150-mm-) square Samples of each type, finish, color, pattern, and texture. Show pan edge profile.
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- (150-mm-) long Samples of each type, finish, and color.
 - 3. Sound Absorber: Sample of each type matching size of Sample metal pan.
- E. Delegated-Design Submittal: For design of attachment devices.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which suspension systems will be attached.
 - 3. Size and location of access modules for acoustical panels.
 - 4. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - 5. Perimeter moldings.
- B. Qualification Data: For testing agency.
- C. Product Test Reports: For each acoustical metal pan ceiling, for tests performed by a qualified testing agency.
- D. Evaluation Reports: For each acoustical metal pan ceiling suspension system and anchor and fastener type.
- E. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Metal Pans : Full-size units equal to 2 percent of quantity installed.
 - 2. Suspension-System Components: Quantity of each grid, exposed molding, and trim equal to 2 percent of quantity installed.
 - 3. Hold-Down Clips: Equal to 2 percent of quantity installed.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockup of typical ceiling area as shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical metal pans, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they are protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Handle acoustical metal pans, suspension-system components, and accessories carefully to avoid damaging units and finishes in any way.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design attachment devices.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
 - 2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL METAL PANS, GENERAL

- A. Source Limitations: Obtain each type of acoustical metal ceiling pan and supporting suspension system from single source from single manufacturer.
- B. Acoustical Panel Standard: Provide manufacturer's standard pans of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface according to ASTM E 795.
- C. Sheet Metal Characteristics: For metal components exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, roughness, stains, or discolorations.
 - 1. Aluminum Sheet: Rolled aluminum sheet, complying with ASTM B 209 (ASTM B 209M); alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

2.3 SOLID ALUMINUM PANS FOR ACOUSTICAL METAL PAN CEILING

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. American Decorative Ceilings (ADC).
 - 2. Armstrong World Industries, Inc.
 - 3. Arktura.
 - 4. Ceilings Plus.
 - 5. Gage Corporation International (The).

6. Hunter Douglas Architectural Products, Inc.
 7. Rockfon (Roxul Inc.).
 8. Steel Ceilings Inc.
 9. USG Corporation.
- B. Basis-of-Design Product: Arktura; Vapor, Solid.
1. Openness: 0 percent.
- C. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated and finished to comply with requirements indicated.
1. Torsion-Spring-Hinged Pans: Designed to be securely retained in preslotted, exposed suspension grid by torsion springs provided by manufacturer.
- D. Pan Thickness: Not less than 1-1/2 inches (38 mm).
- E. Pan Edge Detail: Manufacturer's standard edge detail.
- F. Pan Joint Detail: Flush narrow reveal, not greater than 9/16 inch (15 mm) wide.
- G. Pan Size: 24 by 48 inches (610 by 1220 mm).
- H. Pan Face Finish: Powder coat gray, matte.
- 2.4 PERFORATED ALUMINUM PANS FOR ACOUSTICAL METAL PAN CEILING
- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. American Decorative Ceilings (ADC).
 2. Armstrong World Industries, Inc.
 3. Arktura.
 4. Ceilings Plus.
 5. Gage Corporation International (The).
 6. Hunter Douglas Architectural Products, Inc.
 7. Rockfon (Roxul Inc.).
 8. Steel Ceilings Inc.
 9. USG Corporation.
- B. Basis-of-Design Products:
1. Arktura; Vapor, Frequency.
 - a. Openness: As indicated on Drawings.
 - b. Translucent Backer: Frosted polycarbonate.
 - c. Lighting: Backlighting.
 - d. Finish: As indicated on Drawings.
 2. Arktura; Vapor, Trail.
 - a. Openness: As indicated on Drawings.
 - b. Translucent Backer: Frosted polycarbonate.
 - c. Lighting: Backlighting.
 - d. Finish: As indicated on Drawings.
- C. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated and finished to comply with requirements indicated.
1. Torsion-Spring-Hinged Pans: Designed to be securely retained in preslotted, exposed suspension grid by torsion springs provided by manufacturer.
- D. Pan Thickness: Not less than 1-1/2 inches (38 mm).
- E. Pan Edge Detail: Manufacturer's standard edge detail.
- F. Pan Joint Detail: Flush narrow reveal, not greater than 9/16 inch (15 mm) wide.
- G. Pan Size: 24 by 48 inches (610 by 1220 mm).
- 2.5 METAL SUSPENSION SYSTEMS, GENERAL
- A. Metal Suspension System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635/C 635M requirements.

- B. Suspension Systems: Provide systems complete with carriers, runners, splice sections, connector clips, alignment clips, leveling clips, hangers, molding, trim, retention clips, load-resisting struts, and other suspension components required to support ceiling units and other ceiling-supported construction.
 - C. Attachment Devices: Size for 5 times the design load indicated in ASTM C 635/C 635M, Table 1, Direct Hung, unless otherwise indicated.
 - D. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488/E 488M conducted by a qualified testing agency.
 - E. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
 - F. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C 635/C 635M, Table 1, Direct Hung, is less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
- 2.6 DIRECT-HUNG, STANDARD-GRID, METAL SUSPENSION SYSTEM FOR ACOUSTICAL METAL PAN CEILING
- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Armstrong World Industries, Inc.
 - 2. CertainTeed Corporation.
 - 3. Rockfon (Roxul Inc.).
 - 4. USG Corporation.
 - B. Suspension System for Torsion-Spring-Hinged Metal Pans: Provide runners with factory-cut slots fabricated to accept torsion-spring-hinged attachment.
- 2.7 GENERAL FINISH REQUIREMENTS
- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
 - B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- 2.8 ALUMINUM FINISHES
- A. Color-Coated Finish: Manufacturer's standard powder-coat baked paint complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical metal pan ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical metal pan ceilings.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical metal pans to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width pans at borders, and comply with layout shown on reflected ceiling plans and coordination drawings.

3.3 INSTALLATION

- A. General: Install acoustical metal pan ceiling assemblies to comply with ASTM C 636/C 636M and manufacturer's written instructions.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that do not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Secure flat, angle, channel, and rod hangers to ceiling suspension members and to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that does not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 8. Do not attach hangers to steel deck tabs.
 - 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
 - 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical metal pans.
 - 1. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
 - 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Cut acoustical metal pan units for accurate fit at borders and at interruptions and penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet. Cut and treat edges to comply with manufacturer's written instructions.
- G. Install acoustical metal pans in coordination with suspension system and exposed moldings and trim. Comply with manufacturer's installation tolerances.
 - 1. For torsion-spring-hinged pans, position pans according to manufacturer's written instructions.
 - 2. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
 - 3. Fit adjoining units to form flush, tight joints.
 - 4. Install directionally patterned or textured metal pans in directions indicated.

- H. Install sound attenuation panels in areas indicated by reflected ceiling plans or room finish schedules. Lay panels directly on ceiling system and close major openings to form complete coverage in required areas. Lay second sound-absorbent pads on sound attenuation panels.
- I. Install hold-down clips where indicated.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical metal pan ceilings, including trim and edge moldings, after removing strippable, temporary protective covering, if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, cleaning, and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

END OF SECTION

SECTION 09 54 29
LINEAR PVC CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Concealed suspension system for PVC ceiling panels.
 - 2. PVC ceiling panels for concealed suspension system.
 - 3. Trim and accessories.
- B. Related Requirements:
 - 1. Section 07 46 16 "Aluminum Soffits" for acceptable substitution.

1.2 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer, approved by PVC ceiling manufacturer, who has completed panel ceilings similar in species, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Inspection: All work must pass inspection and approval of architect, as well as the local codes and regulations or authorities having jurisdiction.
- C. Single-Source Responsibility for PVC Ceiling System: Obtain each type of PVC panels from a single fabricator, with in-house Shop Drawing capabilities, in-house assembly and finishing capabilities, and with resources to provide products of consistent quality in appearance and physical properties without delaying the project.
- D. Single-Source Responsibility for Suspension System: Obtain each type of suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying project.
- E. Pre-Installation Conference: Conduct conference at Project site to comply with requirements of Division 01 Section "Project Meetings."
- F. Ceiling Panel Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup as directed by architect.
 - 2. Build mockups of typical linear PVC ceiling panels in sizes approximately 48 inches long by 72 inches high by full thickness, including backup ceiling materials and accessories.
 - a. Include a typical steel plate and panel joint.
 - b. Include suspended ceiling grid and acoustical ceiling panel.
 - 3. Approval of mockups is for proper alignment of adjacent surfaces, material finish and edge treatment.
 - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
 - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect, in writing.
 - 4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.3 SUBMITTALS

- A. Product Data: For each type of product specified.
- B. Samples: For verification of each type of exposed finish required, prepared on samples of size indicated below. Where finishes involve normal color and texture variations, include sample sets showing the range of variations expected.
 - 1. 12 inches by 18 inches samples of each panel type, pattern, and color.

1.4 SHOP DRAWINGS AND COORDINATION WITH OTHER TRADES

- A. Shop Drawings: Provide Shop Drawings/Coordination Drawings for all ceilings, which should include RCP and product details. Coordinate PVC ceiling panel layout and installation of PVC panels and suspension system components with other construction elements that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components, partition assemblies and all perimeter conditions.

1.5 PROJECT CONDITIONS

- A. Space Enclosure and Environmental Limitations: Do not install PVC panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is completed and dry, work above ceilings is completed, and ambient temperature and humidity conditions are being maintained at the levels indicated for Project when occupied for its intended use.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery & Unloading: Coordinate crate sizes, weights, unloading options, and delivery schedule with manufacturer prior to fabrication. Deliver PVC panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other mistreatment.
- B. Acclimatization: Before installing PVC panels, permit them to reach room temperature and a stabilized moisture content (at least 72 hours) per AWI standards.
- C. Handling: Handle PVC ceiling panels carefully to avoid chipping edges or damaging units in any way.
- D. Protection:
 - 1. Personnel: Follow good safety and industrial hygiene practices during handling and installing of all products and systems, with personnel to take necessary precautions and wear appropriate protective equipment as needed. Read related literature for important information on products before installation. Contractor to be solely responsible for all personal safety issues during and subsequent to installation; architect, specifier, owner, and manufacturer will rely on contractor's performance in such regard.
 - 2. Existing completed work: Protect completed work above suspension system from damage during installation of suspension system components.

1.7 EXTRA MATERIALS

- A. Extra Materials: Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.
 - 1. PVC ceiling panels: Furnish quantity of full-size units equal to 2.0 percent of amount installed.
 - 2. Suspension System Components: Furnish quantity of each component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less in compliance with ASTM E 1264 for Class A materials.
 - 2. Smoke-Developed Index: 450 or less.

2.2 PVC CEILING PANELS AND SUSPENSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. 9Wood.
 - 2. Architectural Components Group.
 - 3. Rulon International.
- B. Refer to Section 07 46 16 "Aluminum Soffits" for acceptable substitution.

2.3 PVC CEILING PANELS

- A. Basis of Design: Rulon International; Endure Linear 910, 8-inch Module with Integrated Spacer Profile in Matching Film.
 - 1. PVC Panels:
 - a. Member Size: 8 inches.
 - b. Edge Profile: Straight edge with integrated spacer.
 - c. Finish: Woodgrain.

2.4 METAL CARRIER SYSTEM

- A. Manufacturer's standard galvanized metal carrier system, prefinished perimeter trim, and expansion joints.
- B. Attachment Devices: Size for 3 times the design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
- C. Wire, Braces, Ties, Hanger Rods, Flat Hangers and Angle Hangers: Provide wires, rods and hangers that comply with applicable ASTM specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General: Examine substrates and structural framing to which ceiling panels attach or abut, with installer present, for compliance with requirements specified in this and other sections that affect installation and anchorage. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors whose installation is specified in other Sections.
- B. Layout: Measure each ceiling area and establish the layout of PVC Panel to balance border widths at opposite edges. Avoid using less-than-half-width panels at borders, and conform to the layout shown on drawings in accordance with approved Shop Drawings.

3.3 INSTALLATION

- A. General: Comply with manufacturer's written instructions.
- B. Attachments: Suspend carrier system and ceiling hangers from building's structural members per manufacturer's instructions and in compliance with all local codes and regulations.
- C. Installation of PVC Panels: Install PVC ceiling panels in accordance with manufacturer's installation instructions and in compliance with all local codes and regulations. Install with undamaged edges and fitted accurately to suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit, as required.
- D. Suspension Runners: Install suspension system runners so they are square and securely interlocked with one another. Install number and use on-center spacing per PVC ceiling manufacturer's instructions, as indicated on approved Shop Drawings and in compliance with all local codes.
- E. Reference manufacturer's installation standards for recessed light fixtures, MEP systems, equipment, etc.

3.4 CLEANING

- A. General: Clean exposed surfaces of PVC panels. Comply with manufacturer's instructions for cleaning and touchup of minor finish damage. Remove and replace PVC ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 09 61 16
CONCRETE FLOOR SEALING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes:
 - 1. Sealing of concrete floor areas not otherwise scheduled to receive finish floor covering.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include data to indicate chemical, solvent, and detergent resistance.
 - 2. Include information for primer, sealants, accessories and other required components.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fluid-applied floor sealer to include in maintenance manuals. Include the following:
 - 1. Manufacturer's instructions on maintenance renewal of applied treatments.
 - 2. Protocols and product specifications for joint filing, crack repair and/or surface repair.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing Products specified in this Section with minimum 10 years documented experience.
- B. Installer Qualifications: An installer (applicator) who is approved, trained, or certified by fluid-applied floor sealer manufacturer.
- C. Source Limitations: Furnish products from one manufacturer for entire Project, unless otherwise acceptable to Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manner to prevent damage to containers and bags.
- B. Store materials in accordance with manufacturer's instructions in clean and dry location with temperature between 60 deg F and 90 deg F.
- C. Keep products away from fire or open flame.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with flooring manufacturer's written instructions for substrate temperature, ambient temperature, humidity, ventilation, and other conditions affecting flooring application.
 - 1. Do not apply flooring until spaces are enclosed and weatherproof; wet work in spaces is complete and dry; and overhead work, including installing mechanical systems, lighting, and athletic equipment, is complete.
- B. Conditioning Period: Begins not less than 7 days before flooring application, is continuous through application, and continues not less than 3 days after application.
 - 1. After conditioning period, maintain relative humidity and ambient temperature planned for building occupants.
- C. Ventilate area where flooring is being installed. Post and enforce no smoking and no open flame signs until flooring has cured.
- D. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during floor sealer application.
- E. Close spaces to traffic during floor sealer application and for not less than 24 hours after application unless manufacturer recommends a longer period.

1.7 SEQUENCING AND SCHEDULING

- A. Sequence work under provisions of Section 01 32 00 "Construction Progress Documentation."

1.8 WARRANTY

- A. Provide written warranty signed by manufacturer warranting work to be free from defective materials and workmanship, and agreeing to replace components which fail within 2 years from date of Substantial Completion.
 - 1. Failed materials and workmanship includes spalling, cracking, and delamination.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Dayton Superior Specialty Chemical Corp.
 - 2. L & M Construction Chemicals, Inc.
 - 3. Euclid Chemical.
 - 4. The Sherwin-Williams Company.

2.2 CONCRETE FLOOR SEALER

- A. Epoxy Floor Coating: Two component, water-based, high-performance, high-solids, epoxy floor coating system.
 - 1. Basis-of-Design Product:
 - a. W.R. Meadows; Cocomp-25 Curing & Sealing Compound.
 - 2. Use sealers that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 ACCESSORIES

- A. Joint Sealant Materials: Manufacturer's recommended sealant compatible with flooring system for type of service and joint condition indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for conditions affecting performance of flooring including substrate moisture content.
- B. Examine areas to receive flooring for:
 - 1. Defects in substrate that may affect proper execution of flooring work.
 - 2. Deviations beyond allowable tolerance for concrete slab work.
 - 3. Surface curing agents or sealers that would inhibit bond.
 - 4. Surface defects such as cracks that could transfer through to finished flooring surface if not corrected.
- C. Do not begin flooring work until concrete has cured a minimum of 28 days.
- D. Do not begin work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare Substrate: Tests concrete substrate for pH, contaminants, and moisture content in accordance with manufacturer's recommendations. Ensure concrete is within manufacturers recommended limits prior to installation.
- B. Concrete Sub-floors: Verify that concrete slabs comply with ASTM D 4258 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond.
 - 2. Mechanically abrade or shot-blast concrete flooring to remove inappropriate curing agents and to open pores of concrete surfaces to allow penetration of bonding agent. Completely remove cleaning residue. Acid washing is not acceptable.
 - 3. Repair cracks, divots and surface imperfections according to manufacturer's instructions.
 - 4. Vacuum to remove dust and debris.
- C. Protect walls, floor openings, equipment, electrical openings, door frames, and other obstructions during installation. Cover floor and wall areas at mixing stations.

3.3 APPLICATION

- A. General: Mix and apply flooring components according to manufacturer's written instructions.
- B. Apply a minimum of 2 coats in accordance with manufacturer's recommended coverage rates.

3.4 CURING

- A. Cure flooring materials according to manufacturer's directions, taking care to prevent contamination during application stages and before completing curing process.

3.5 CLEANING AND PROTECTION

- A. Clean as recommended by manufacturer. Do not use materials or methods which may damage surface or surrounding construction.
- B. Remove temporary covering and clean flooring prior to final inspection. Use cleaning materials and procedures recommended by flooring manufacturer.
- C. Protect finished work in accordance with Section 01 73 00 "Execution."
- D. Do not permit traffic over finished flooring surfaces.
- E. Protect flooring materials from damage and wear during construction operation.

END OF SECTION

SECTION 09 64 34
HARDBOARD FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Provide anchored resilient wood flooring system with hardboard surface.

1.2 SCOPE OF WORK

- A. Furnish all labor, materials, tools, equipment, transportation, services, and supervision necessary to complete installation of resilient stage floor system. The work is comprised of, but not limited to, the following principal items:
1. Sheet moisture retarder on substrate surface.
 2. Tempered-hardboard flooring, screwed.
 3. Surface finishing.

1.3 JOB CONDITIONS

- A. Verify conditions applicable or pertaining to this work. Coordinate with scheduled work of other trades and notify Architect in writing of discrepancies, conflicts, or omissions prior to bid time or correct same at Contractor's expense.
- B. Do not deliver or install flooring until after spaces to receive flooring have been enclosed, are dry, and maintained at or above the same humidity conditions as will prevail during occupancy. Place materials in spaces to be floored 10 days prior to start of installation. Open packaging to permit natural adjustment of moisture content. Maintain ambient temperature range of 65 degrees F to 75 degrees F prior to, during and after installation.
- C. If existing conditions make installation of work as shown impossible, prepare drawings for Architect's review showing how work may be installed.
- D. Do not damage materials or equipment to be reused. Disconnect wiring only as required to install new materials or equipment. Existing construction to remain that is damaged by the Contractor shall be repaired or replaced at no cost to the Owner.
- E. Owner assumes no responsibility for actual condition of area affected by the work. Conditions existing at time of inspection will be maintained by Owner in so far as practicable.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Flooring manufacturer shall be a firm established in the industry, been in business for minimum 10-years. Manufacturer shall submit a list of projects where the specified flooring has been installed. Square footage of these projects must total at least 150,000 square feet.
- B. Installer Qualifications: Installer shall have a minimum five continuous years' experience and be approved by manufacturer of flooring materials.
- C. Single Installer Responsibility: Entire resilient wood floor system shall be installed by a single firm, for undivided responsibility. Include anchorage system, adhesives or mastics, resilient mounts, flooring, insulation, trim, expansion provisions, and other accessory items as indicated, or as required.
- D. Performance Qualifications of Flooring System: Shock absorption shall average 53% min. (DIN 18032 Part II). "Uniformity" of shock absorption of plus or minus 5 percentage points shall be maintained throughout entire surface at each test point using DIN test 18032 Part II.
- E. Warranty: Warrant the product and installation for a period of 2-years from date of acceptance. An unsigned copy of the Warranty must accompany product samples before a contract for installation is issued.

1.5 SUBMITTALS

- A. Shop Drawings:
 - 1. Indicate floor joint pattern, grain direction, and termination details.
 - 2. Indicate provisions for expansion and contraction.
- B. Product Data: Provide data for floor materials and floor finishing system.
- C. Samples: Submit one 12-inch by 12-inch sample illustrating floor finish, color and sheen.
- D. Submit certification that products meet or exceed specified requirements.
- E. Manufacturers Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Protect wood flooring from excessive moisture in shipment, storage and handling. Deliver in unopened bundles and store in a dry place, with adequate air circulation. Materials shall not be delivered to building until wet work such as concrete and plaster have been completed and cured to a condition of equilibrium.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall be new and of first quality. All materials and equipment shall be manufactured and installed in accordance with applicable standards of the American National Standards Institute (ANSI), the American Hardboard Association (AHA), the American Lumber Standards Committee (ALSC), the American Plywood Association (APA), the Surface Burning Characteristics of Building Materials (ASTM E84), the American Wood Preservers Association (AWPA) - All Timber Products - Preservative Treatment by Pressure Process, the Southern Pine Inspection Bureau (SPIB), the West Coast Lumber Inspection Bureau (WCLIB), the Western Wood Products Association (WWPA), and DIN test 18032-Part II, Otto-Graf Institut, Stuttgart, plus any local applicable codes having jurisdiction.

2.2 PRIMARY MATERIALS

- A. Tempered Hardboard: A product complying with American National Standard A135.4-1982, Class-1, tempered in 4' x 4' factory cut panels, surface S1S, nominal 1/4" thick. Actual panel dimensions shall be 47.999" to 48.001", as delivered.

2.3 ACCESSORY MATERIALS

- A. Fasteners:
 - 1. Flooring Nails: as recommended by flooring manufacturer.-
- B. Cork Expansion Strip: Composition cork expansion strip; FS HH-C 576, Type I-B, Class 2.

2.4 FINISHES

- A. Paint:
 - 1. First Coat: Sherwin Williams Enamel Undercoater.
 - 2. Second and Third Coat: Sherwin Williams Pro-Mar 200 Latex Paint, flat black.
 - 3. Ensure surface is finished-sanded prior to paint application.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surface is smooth and flat to plus or minus 1/8" over 10 feet.

3.2 PREPARATION

- A. Broom clean substrate surfaces.
- B. Conditioning: Do not proceed with delivery and installation of flooring until after spaces to receive flooring have been enclosed and are dry and maintained at or above approximately the same humidity condition as planned for occupancy. Place flooring materials in spaces to be floored 10 days prior to start of installation. Open packages of flooring which are sealed (if any) to permit natural adjustment of moisture content.

- C. Tempered Hardboard Preparation: At least 10 days prior to installation of floor, Contractor shall prepare tempered hardboard for installation by assuring maximum moisture content, and maximum expanded size. Sprinkle the stacked hardboard with water until outer surfaces of the edge and top are wet. Cover entire stack with polyethylene sheet so that moisture can permeate the entire stack. Do not allow hardboard to freeze. After moisture content of tempered hardboard has been raised, install before hardboard dries out. During installation process, the remaining stack of hardboard shall be kept covered with polyethylene sheet at all times. Contractor shall check moisture content on a daily basis and add water as required to maintain desired conditions.

3.3 INSTALLATION

- A. Comply with flooring manufacturer's instructions and recommendations for applications indicated.
- B. Install tempered hardboard flooring, leaving 3/32" gaps between panels for expansion with end joints staggered. Hardboard shall be installed with tempered side up. Leave 1/8" joint for expansion at edge of floor. Pre-drill and counter-sink screws through hardboard panel face extending minimum of 1" into substrate. Locate screws at center of panels, at panel corners, and at 12" intervals around perimeter of each panel. Screws at edge should be 1/2" from edge.
- C. Level the installed flooring to +/- 1/8 inch over 10 feet.

3.4 FINISHING - HARDBOARD FLOORING

- A. Remove dust by vacuum or tack floor before first coat of finish.
- B. Protect adjacent surfaces.

3.5 PROTECTION

- A. Protect completed flooring during remainder of construction period with heavy Kraft paper or other suitable covering, so that flooring and finish will be without damage or deterioration at time of acceptance.

3.6 CLEANING

- A. Clean work areas of trash and debris.
- B. Clean floor surfaces in accordance with manufacturer's instructions.

END OF SECTION

SECTION 09 64 66

WOOD ATHLETIC FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes wood athletic flooring.

1.2 COORDINATION

- A. Coordinate layout and installation of slab depressions to accommodate layout and height of wood athletic flooring assembly.
- B. Coordinate layout and installation of flooring with floor inserts for gymnasium equipment.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for wood athletic flooring.
- B. Shop Drawings: For each type of floor assembly, include the following:
 - 1. Plans, sections, and attachment details.
 - 2. Details of concrete-slab depressions.
 - 3. Locations of different grades of wood flooring.
 - 4. Expansion provisions and trim details.
 - 5. Layout, colors, widths, and dimensions of game lines and markers.
 - 6. Locations of floor inserts for athletic equipment installed through flooring assembly.
- C. Samples for Verification: For each type of wood athletic flooring and accessory required; approximately 12 inches (300 mm) long and of same thickness and material indicated for the Work.
 - 1. Include Sample sets showing the full range of normal color and texture variations expected in wood flooring.
 - 2. Include Sample sets showing finishes and game-line and marker paints applied to wood flooring.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each wood athletic flooring system, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For wood athletic flooring and finish systems to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual that has been approved by MFMA as an accredited Installer according to the MFMA Accreditation Program.
 - 1. Installer responsibilities include installation and field finishing of wood athletic flooring components and accessories, and application of game lines and markers.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for installation.
 - 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver floor assembly materials in unopened cartons or bundles.
- B. Protect wood from exposure to moisture. Do not deliver wood components until after concrete, masonry, plaster, ceramic tile, and similar wet-work is complete and dry.

- C. Store wood components in a dry, warm, well-ventilated, weathertight location and in a horizontal position.

1.8 FIELD CONDITIONS

- A. Conditioning period begins not less than seven days before wood athletic flooring installation, is continuous through installation, and continues not less than seven days after installation.
 - 1. Environmental Conditioning: Maintain ambient temperature between 65 and 75 deg F (18 and 24 deg C) and relative humidity planned for building occupants, but not less than 35 percent or more than 50 percent, in spaces to receive wood athletic flooring during the conditioning period.
 - 2. Wood Conditioning: Move wood components into spaces where they will be installed, no later than beginning of the conditioning period.
 - a. Do not install wood athletic flooring until wood components adjust to relative humidity of, and are at same temperature as, spaces where they are to be installed.
 - b. Open sealed packages to allow wood components to acclimatize immediately on moving wood components into spaces in which they will be installed.
- B. After conditioning period, maintain relative humidity and ambient temperature planned for building occupants.
- C. Install wood athletic flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Action Floor Systems, LLC.
 - 2. Aacer Sports Flooring..
 - 3. Conner Sport Court International.
 - 4. Horner Sports Flooring Co.
 - 5. Ponder Floor Company.
 - 6. Robbins Sports Surfaces.
- B. Basis-of-Design Product: Robbins Sports Surfaces; BioChannel SB.

2.2 SYSTEM DESCRIPTION

- A. System Type: Anchored resilient.
- B. Overall System Height: 1-3/4 inches (45 mm).

2.3 FLOORING MATERIALS

- A. Maple Flooring: Comply with MFMA grading rules for species, grade, and cut.
 - 1. Certification: Provide flooring that carries MFMA mark on each bundle or piece.
- B. Random-Length Strip Flooring: Northern hard maple (*Acer saccharum*), kiln dried, random length, tongue and groove, and end matched.
 - 1. Grade: MFMA-RL Second and Better.
 - 2. Thickness: 25/32 inch (20 mm).
 - 3. Face Width: 2-1/2 inches (63 mm), unless otherwise indicated.

2.4 SUBFLOOR MATERIALS

- A. Plywood Underlayment: APA rated, C-D plugged, exterior glue, tongue and groove, 15/32 inch (12 mm) thick.
- B. Channels: Manufacturer's standard.
 - 1. Channel Anchors: Manufacturer's standard, but not less than modified steel drive pins recommended by anchor manufacturer to achieve minimum 900-lbf (4000-N) pullout strength.
 - 2. Clips: Manufacturer's standard.
- C. Resilient Pads: With air voids for resiliency and installed at manufacturer's standard spacing for product designation indicated above.
 - 1. Basis-of-Design Product: Robbins Sports Surfaces; Zero/G Shockpad.
 - 2. Type: Open cell foam.
 - 3. Thickness: 9/16-inch.

2.5 FINISHES

- A. Floor-Finish System: System of compatible components recommended in writing by flooring manufacturer, and MFMA approved.
 - 1. Floor-Sealer Formulation: Pliable, penetrating type. MFMA Group 1, Sealers.
 - 2. Finish-Coat Formulation: Formulated for gloss finish indicated and multicoat application.
 - a. Type: MFMA Group 3, Gymnasium-Type Surface Finishes.
 - 3. Game-Line and Marker Paint: Industrial enamel compatible with finish coats and recommended in writing by manufacturers of finish coats, and paint for this use.

2.6 ACCESSORIES

- A. Vapor Retarder: ASTM D 4397, polyethylene sheet not less than 6 mils (0.15 mm) thick.
- B. Resilient Wall Base: As specified in Section 09 65 13 "Resilient Base and Accessories."
- C. Thresholds: As specified in Section 08 71 00 "Door Hardware" or if not specified, Manufacturer's standard threshold plate.
- D. Fasteners: Type and size recommended by manufacturer, but not less than those recommended by MFMA for application indicated.
- E. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by wood athletic flooring manufacturer.
- F. Adhesives: Manufacturer's standard for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Concrete Slabs: Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
 - 1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - c. Perform additional moisture tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

3.2 PREPARATION

- A. Concrete Slabs:
 - 1. Grind high spots and fill low spots on concrete substrates to produce a maximum 1/8-inch (3-mm) deviation in any direction when checked with a 10-foot (3-m) straight edge.
 - 2. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- B. Broom and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Comply with wood athletic flooring manufacturer's written instructions, but not less than written recommendations of MFMA applicable to flooring type indicated.
- B. Pattern: Lay flooring parallel with long dimension of space to be floored unless otherwise indicated.

- C. Expansion Spaces: Provide as indicated, but not less than that required by manufacturer's written instructions and MFMA's written recommendations at walls and other obstructions, and at interruptions and terminations of flooring.
 - 1. Cover expansion spaces with base molding, trim, and saddles, as indicated on Drawings.
 - D. Vapor Retarder: Cover entire slab area beneath wood flooring. Install with joints lapped a minimum of 6 inches (150 mm) and sealed.
 - E. Underlayment: Install perpendicular to direction of flooring, staggering end joints in adjacent rows.
 - F. Channels: Anchor channels to substrate according to manufacturer's written instructions.
 - 1. Install wood strip flooring across channels.
 - 2. Insert steel clip at each intersection of a flooring strip with a channel.
 - G. Strip Flooring: Mechanically fasten perpendicular to supports.
 - H. Installation Tolerances: 1/8 inch in 10 feet (3 mm in 3 m) of variance from level.
- 3.4 SANDING AND FINISHING
- A. Allow installed flooring to acclimate to ambient conditions before sanding.
 - B. Follow applicable recommendations in MFMA's "Industry Recommendations for Sanding, Sealing, Court Lining, Finishing, and Resurfacing of Maple Gym Floors."
 - C. Machine sand with coarse, medium, and fine grades of sandpaper to achieve a level, smooth, uniform surface without ridges or cups. Remove sanding dust by tack or vacuum.
 - D. Finish: Apply seal and finish coats of finish system according to finish manufacturer's written instructions. Provide no fewer than four coats total and no fewer than two finish coats.
 - 1. Water-Based Finishes: Use finishing methods recommended by finish manufacturer to reduce grain raise and sidebonding effect.
 - 2. Game-Line and Marker Paint: Apply game-line and marker paint between final seal coat and first finish coat according to paint manufacturer's written instructions.
 - a. Mask flooring at game lines and markers, and apply paint to produce lines and markers with sharp edges.
 - b. Where game lines cross, break minor game line at intersection; do not overlap lines.
 - c. Apply game lines and markers in widths and colors according to requirements indicated on Drawings.
 - d. Apply finish coats after game-line and marker paint is fully cured.
- 3.5 PROTECTION
- A. Protect wood athletic flooring during remainder of construction period to allow finish to cure and to ensure that flooring and finish are without damage or deterioration at time of Substantial Completion.
 - 1. Do not cover flooring after finishing until finish reaches full cure and not before seven days after applying last finish coat.
 - 2. Do not move heavy and sharp objects directly over flooring. Protect fully cured floor finishes and surfaces with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION

SECTION 09 65 13

RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Thermoset-rubber base.
 - 2. Thermoset-rubber vent cove base.
 - 3. Rubber molding accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long.
- C. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.4 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Coordinate mockups in this Section with mockups specified in other Sections.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Burke Mercer Flooring Products; a division of Burke Industries Inc.
 - 2. Johnsonite; a Tarkett company.
 - 3. Roppe Corporation, USA.
- B. Basis-of-Design Product: As scheduled.
- C. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
 - 1. Style and Location: As scheduled
- D. Thickness: 0.125 inch (3.2 mm).
- E. Height: 4 inches (102 mm).
- F. Lengths: Coils in manufacturer's standard length.
- G. Outside Corners: Job formed.
- H. Inside Corners: Job formed.
- I. Colors: As scheduled.

2.2 THERMOSET-RUBBER VENT COVE BASE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Burke Mercer Flooring Products; a division of Burke Industries Inc.
 - 2. Johnsonite; a Tarkett company.
 - 3. Roppe Corporation, USA.
- B. Basis-of-Design Product: Johnsonite; a Tarkett company; Johnsonite Vent Cove.
- C. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
 - 1. Style and Location: As scheduled.
 - 2. Back Surface: Grooved, semi-circular vents.
- D. Base:
 - 1. Thickness: 0.260 inch (6.6 mm).
 - 2. Height: 4 inches (102 mm).
- E. Toe:
 - 1. Thickness: 0.300 inch (7.6 mm).
 - 2. Length: 3 inches (76 mm).
- F. Lengths: Coils in manufacturer's standard length.
- G. Outside Corners: Preformed.
- H. Inside Corners: Preformed.
- I. Colors: As selected by Architect from manufacturer's full range.

2.3 RUBBER MOLDING ACCESSORY

- A. Profile and Dimensions: As indicated.
- B. Locations: Provide rubber molding accessories in areas indicated.
- C. Colors and Patterns: As Scheduled.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.

- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION

SECTION 09 65 19

RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Luxury vinyl floor tile.
 - 2. Metal edge strips.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of resilient floor tile.
 - 1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - 2. Show details of special patterns.
- C. Samples for Verification:
 - 1. Full-size units of each color and pattern of floor tile required.
 - 2. Metal edge strips in 6-inch (150-mm) lengths.
- D. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Coordinate mockups in this Section with mockups specified in other Sections.
 - a. Size: Minimum 100 sq. ft. (9.3 sq. m) for each type, color, and pattern in locations directed by Architect.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
 - 1. Metal edge strips.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.3 LUXURY VINYL FLOOR TILE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Altro Group.
 - 2. Armstrong World Industries, Inc.
 - 3. Johnsonite; a Tarkett company.
 - 4. Mannington Mills, Inc.
 - 5. Shaw Contract Group; a Berkshire Hathaway company.
- B. Basis-of-Design Products, Color, Pattern, and Size: As scheduled.
 - 1. Requirements:
 - a. Tile Standard: ASTM F 1700.
 - b. Class: Class III, Printed Film Vinyl Tile.
 - c. Type: B, Embossed Surface.
 - 2. Thickness: Manufacturer's standard.

2.4 MISCELLANEOUS MATERIALS

- A. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Blanke Corporation.
 - b. Ceramic Tool Company, Inc.
 - c. Schluter Systems L.P.
 - 2. Applications: Outside tile transitions: Schluter Systems L.P.; QUADEC.

2.5 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay tiles in pattern indicated.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles in pattern of colors and sizes indicated.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
 - H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
 - I. Metal Edge Strips: Install at locations indicated.
- 3.4 CLEANING AND PROTECTION
- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
 - B. Perform the following operations immediately after completing floor tile installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
 - C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
 - D. Cover floor tile until Substantial Completion.

END OF SECTION

SECTION 09 65 66

RESILIENT ATHLETIC FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rubber sheet flooring.

1.2 COORDINATION

- A. Coordinate layout and installation of flooring with floor inserts for gymnasium equipment.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show installation details and locations of the following:
 - 1. Floor patterns.
 - 2. Locations of floor inserts for athletic equipment installed through flooring.
 - 3. Seam locations for sheet flooring.
- C. Samples for Verification: For each type, color, and pattern of flooring specified, 6-inch- (150-mm-) square in size and of same thickness and material indicated for the Work.
 - 1. Seam Samples: For each vinyl sheet flooring color and pattern required; with seam running lengthwise and in center of 6-by-9-inch (150-by-230-mm) Sample applied to a rigid backing and prepared by Installer for this Project.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For sheet vinyl flooring Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For resilient athletic flooring to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sheet Flooring: Furnish full-width rolls of not less than 10 linear feet (3 linear m) for each 500 linear feet (150 linear m) or fraction thereof, of each type, color, and pattern of flooring installed.

1.7 QUALITY ASSURANCE

- A. Sheet Vinyl Flooring Installer Qualifications: An experienced installer who has completed sheet vinyl flooring installations using seaming methods indicated for this Project and similar in material, design, and extent to that indicated for this Project; who is acceptable to manufacturer; and whose work has resulted in installations with a record of successful in-service performance.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storing.
- B. Store materials to prevent deterioration.
 - 1. Store rolls upright.

1.9 FIELD CONDITIONS

- A. Adhesively Applied Products:
 - 1. Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive flooring 48 hours before installation, during installation, and 48 hours after installation unless longer period is recommended in writing by manufacturer.
 - 2. After postinstallation period, maintain temperatures within range recommended in writing by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
 - 3. Close spaces to traffic during flooring installation.
 - 4. Close spaces to traffic for 48 hours after flooring installation unless manufacturer recommends longer period in writing.
- B. Install flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RUBBER SHEET FLOORING

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Acer Flooring, LLC.
 - 2. Flexco.
 - 3. Ecore.
 - 4. Johnsonite; a Tarkett company.
 - 5. Mondo America Inc.
 - 6. Nora Systems, Inc.
 - 7. Tarkett Sports; a division of the Tarkett Group.
- B. Basis-of-Design Product: Ecore; Performance Beast.
- C. Description: Rubber athletic flooring provided as rolled goods for adhered installation.
- D. Traffic-Surface Texture: Smooth.
- E. Roll Size: Not less than 48 inches (1219 mm) wide by longest length that is practical to minimize splicing during installation.
- F. Thickness: 10.5 mm.
- G. Color and Pattern: As scheduled.

2.2 ACCESSORIES

- A. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.
- B. Adhesives: Water-resistant type recommended in writing by manufacturer for substrate and conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of flooring.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Alkalinity Testing: Perform pH testing according to ASTM F 710. Proceed with installation only if pH readings are not less than 7.0 and not greater than 8.5.
 3. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.
 - D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
 - E. Move flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation unless manufacturer recommends a longer period in writing.
 1. Do not install flooring until it is the same temperature as space where it is to be installed.
 - F. Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.3 FLOORING INSTALLATION, GENERAL
- A. Comply with manufacturer's written installation instructions.
 - B. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.
 - C. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.
 - D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on flooring. Use nonpermanent, nonstaining marking device.
- 3.4 SHEET FLOORING INSTALLATION
- A. Unroll sheet flooring and allow it to stabilize before cutting and fitting.
 - B. Lay out sheet flooring as follows:
 1. Maintain uniformity of flooring direction.
 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches (150 mm) away from parallel joints in flooring substrates.
 3. Match edges of flooring for color shading at seams.
 4. Locate seams according to approved Shop Drawings.
 - C. Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
 1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
 - D. Vinyl Sheet Flooring Seams: Prepare and finish seams to produce surfaces flush with adjoining flooring surfaces.
 1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless flooring.
- 3.5 FIELD-APPLIED FINISHES
- A. Apply finish according to manufacturer's written instructions to produce a sealed surface that is ready for use.
 - B. Do not cover flooring after finishing until finish reaches full cure.
- 3.6 CLEANING AND PROTECTION
- A. Perform the following operations immediately after completing flooring installation:

1. Remove adhesive and other blemishes from flooring surfaces.
 2. Sweep and vacuum flooring thoroughly.
 3. Damp-mop flooring to remove marks and soil after time period recommended in writing by manufacturer.
- B. Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION

SECTION 09 68 13

TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Modular carpet tile.
 - 2. Textile composite flooring.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include manufacturer's written installation recommendations for each type of substrate.
- B. Shop Drawings: For carpet tile installation, plans showing the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color, and dye lot.
 - 3. Type of subfloor.
 - 4. Type of installation.
 - 5. Pattern of installation.
 - 6. Pattern type, location, and direction.
 - 7. Pile direction.
 - 8. Type, color, and location of edge, transition, and other accessory strips.
 - 9. Transition details to other flooring materials.
- C. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.
- D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Build mockups at locations and in sizes shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI's "CRI Carpet Installation Standard."

1.7 FIELD CONDITIONS

- A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Atlas Carpet Mills, Inc.
 2. Interface, Inc.
 3. J+J Flooring Group.
 4. Mannington Mills, Inc.
 5. Milliken & Company.
 6. Mohawk Group (The); Mohawk Carpet, LLC.
 7. Shaw Contract Group; a Berkshire Hathaway company.

2.2 MODULAR CARPET TILE

- A. CP-1:
1. Basis-of-Design Product: As scheduled.
 2. Color: As scheduled.
 3. Pattern: Match Architect's samples.
 4. Fiber Type: Manufacturer's standard.
 5. Pile Characteristic: Patterned loop.
 6. Density: 6193 oz/yd².
 7. Stitches: 10.5 per inch.
 8. Gauge: 1/12 inches.
 9. Tufted Pile Weight: 16.00 oz/yd² (543 g/m²).
 10. Total Thickness: 0.207 inches.
 11. Primary Backing/Backcoating: Manufacturer's standard composite materials .
 12. Backing System: Manufacturer's standard material.
 13. Size: 24 by 24 inches (610 by 610 mm).
- B. CP-2:
1. Basis-of-Design Product: As scheduled.
 2. Color: As scheduled.
 3. Pattern: Match Architect's samples.
 4. Fiber Type: Manufacturer's standard.
 5. Pile Characteristic: Patterned loop.
 6. Density: 6193 oz/yd².
 7. Stitches: 10.5 per inch.
 8. Gauge: 1/12 inches.
 9. Tufted Pile Weight: 16.00 oz/yd² (543 g/m²).
 10. Total Thickness: 0.207 inches.
 11. Primary Backing/Backcoating: Manufacturer's standard composite materials .
 12. Backing System: Manufacturer's standard material.
 13. Size: 24 by 24 inches (610 by 610 mm).

- C. CP-3:
1. Basis-of-Design Product: As scheduled.
 2. Color: As scheduled.
 3. Pattern: Match Architect's samples.
 4. Fiber Type: Manufacturer's standard.
 5. Pile Characteristic: Textured patterned loop.
 6. Density: 6187 oz/yd².
 7. Stitches: 28.5 per inch.
 8. Gauge: 1/12 inches.
 9. Tufted Pile Weight: 22.00 oz/yd² (543 g/m²).
 10. Total Thickness: 0.297 inches.
 11. Primary Backing/Backcoating: Manufacturer's standard composite materials .
 12. Backing System: Manufacturer's standard material.
 13. Size: 12 by 36 inches (304 by 914 mm).
- D. CP-4:
1. Basis-of-Design Product: As scheduled.
 2. Color: As scheduled.
 3. Pattern: Match Architect's samples.
 4. Fiber Type: Manufacturer's standard.
 5. Tufted Face Weight: 24 oz/yd².
 6. Gauge 5/32 inches.
 7. Stitches: 9.5 per inch.
 8. Tufts: 6038/ in².
 9. Finished Pile Height: 0.186 inches.
 10. Nominal Total Thickness: 0.50 inches.
 11. Nominal Total Weight: 125.0 oz/yd²
 12. Primary Backing/Backcoating: Manufacturer's standard composite materials.
 13. Backing System: Manufacturer's standard material.
 14. Size: 50 by 50 cm.
- E. CP-5:
1. Basis-of-Design Product: As scheduled.
 2. Color: As scheduled.
 3. Pattern: Match Architect's samples.
 4. Fiber Type: Manufacturer's standard.
 5. Pile Characteristic: Tufted textured patterned loop.
 6. Carpet Fiber Type: Type 6, nylon.
 7. Gauge: 1/12 inches.
 8. Face Weight: 19 oz/yd².
 9. Primary Backing/Backcoating: Manufacturer's standard composite materials .
 10. Backing System: Manufacturer's standard material.
 11. Size: 50 by 50 cm.
- F. CP-6:
1. Basis-of-Design Product: As scheduled.
 2. Color: As scheduled.
 3. Pattern: Match Architect's samples.
 4. Fiber Type: Manufacturer's standard.
 5. Pile Characteristic: Textured patterned cut and loop.
 6. Construction: Tufted.
 7. Gauge: 1/12 inches.
 8. Tufted Weight: 26 oz/yd².
 9. Backing System: Manufacturer's standard material.
 10. Size: 50 by 50 cm.

2.3 TEXTILE COMPOSITE FLOORING

- A. TCF-1:
1. Basis-of-Design Product: As scheduled.

2. Color: As scheduled.
3. Pattern: Match Architect's samples.
4. Size: 24 by 24 inches (610 by 610 mm).

2.4 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- B. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that finishes comply with requirements specified in Structural Engineer's documents and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
 1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI's "Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns indicated on Drawings.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI's "Carpet Installation Standard," Section 20, "Protecting Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

SECTION 09 72 00

WALL COVERINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Vinyl wall covering.

1.2 PREINSTALLATION MEETING

- A. Conduct preinstallation conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.
- B. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement, veneer matching, seams and termination points.
- C. Samples for Verification: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36-inch- (914-mm-) long in size.
 - 1. Wall-Covering Sample: From same production run to be used for the Work, with specified treatments applied. Show complete pattern repeat.
- D. Product Schedule: For wall coverings. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For wall coverings to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Wall-Covering Materials: For each type, color, texture, and finish, full width by length to equal to 5 percent of amount installed.

1.6 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for installation.
 - 1. Build mockups for each type of wall covering on each substrate required. Comply with requirements in ASTM F 1141 for appearance shading characteristics.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.
- B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall covering.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 50 or less.
 - 2. Fire-Growth Contribution: No flashover and heat and smoke release according to NFPA 265.

2.2 VINYL WALL COVERING

- A. As indicated on Drawings.

2.3 ACCESSORIES

- A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.
- B. Primer/Sealer: Mildew resistant, complying with requirements in Section 09 91 23 "Interior Painting" and recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Conduct preconstruction meeting with installer, Contractor, and Architect prior to install.
- B. Comply with manufacturer's written instructions for surface preparation.
- C. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.
- D. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
 - 1. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer. Ensure Level 5 gypsum board has been achieved, where indicated, prior to wall-covering installation.
 - 2. Painted Surfaces: Treat areas susceptible to pigment bleeding.
- E. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finish with fine sandpaper.
- F. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
- G. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.3 WALL-COVERING INSTALLATION

- A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.
- B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.
- C. Install strips in same order as cut from roll.
 - 1. For solid-color, even-texture, or random-match wall coverings, reverse every other strip or as recommended by wall covering manufacturer.

- D. Install wall covering without lifted or curling edges and without visible shrinkage.
- E. Match pattern as recommended by wall covering manufacturer above the finish floor.
- F. Install seams vertical and plumb at least 6 inches (150 mm) from outside corners and 3 inches (75 mm) from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.
- G. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.
- H. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

3.4 CLEANING

- A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended in writing by wall-covering manufacturer.
- C. Replace strips that cannot be cleaned.
- D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION

SECTION 09 78 36

INTERIOR MODULAR WALL PANELING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pre-manufactured panel system including mounting hardware and specified accessories.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's Safety Data Sheets (MSDS) on each product to be used, including:
- B. Preparation instructions and recommendations.
- C. Storage and handling requirements and recommendations.
- D. Installation methods.
- E. Shop Drawings: Shop drawings in sufficient detail to show fabrication, installation, anchorage, and interface of the work of this Section with adjacent work.
- F. Selection Samples: For each finish product specified, one complete set of color samples representing manufacturer's standard range of available colors and patterns.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Firm experienced in successful production of wall systems similar to that indicated for the Project, with sufficient production capacity to produce required units without causing delay in the work.
 - 2. Provide certificate signed by panel manufacturer certifying that products comply with specified requirements.
- B. Installer Qualifications: Demonstrate successful experience in installing architectural woodwork similar in type and quality to those required for this project.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver wall system until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate wall system have been completed in installation areas as specified by AWI 1700-G-3.
- B. If panels are stored prior to installation, store them flat in completely enclosed areas, out of the weather. If panels must be stored in other than installation areas, store only in areas where environmental conditions comply with manufacturers recommendations. Do not expose panels to continuous direct sunlight, nor to extremes in temperature and humidity. Store products in manufacturer's packaging until ready for installation.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.5 PROJECT CONDITIONS

- A. Do not deliver or install wall system until building is enclosed, wet work is complete and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period as specified by AWI 1700-G-3.
- B. Do not install wall system until normal lighting conditions exist. Normal lighting conditions are described as those in place when the project is finished. This includes, but not limited to, design lighting (wall washers, spotlights and flood lights, and similar fixtures) and natural lighting.
- C. Wall, ceilings, floors, and openings must be level, plumb, straight, in-line and square as specified by AWI 1700-G-3.

- D. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results, both during installation and subsequent occupancy. Do not install products under environmental conditions outside manufacturer's absolute limits. Panels shall be conditioned in the environment in which they will be installed for a minimum of 72 hours prior to installation. The recommended environment is 600 to 800 F and 35% to 55% relative humidity.
- E. Manufacturer warrants any product it has manufactured and sold against defects in materials or workmanship for a period of one year from the date of original purchase and acceptance for use. This warranty extends to products assembled / installed and used in the manner intended and does not cover damage or failure caused by misuse, abuse or accidents, exposure to extreme temperature, improper installation, improper maintenance, and exposure to water or excessive humidity or excessive moisture.
- F. Use at Glass Panels:
 - 1. Sub wall must be flat and dry and conform to ML/SFA 540 Specifications. Vertical alignment (plumbness) of wall shall be within 1/960th (1/8-inch in 10 ft.) of the span. Horizontal alignment (levelness) of the walls shall be within 1/960th (1/8-inch in 10ft.) of their respective heights. Squareness of walls shall not be more than 1/8-inch out of square within the length of the wall. All corners, window mullions, are door frames must be plumb and level.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Panel Specialists, Inc.
- B. Basis-of-Design Products: As scheduled.

2.2 PANEL SYSTEMS

- A. Provide prefinished decorative panels where shown on the drawings, as specified herein, and as needed for a complete and proper installation.
- B. Comply with applicable requirements of "Architectural Woodwork Quality Standards" in the production and installation of the wall panel system as published by the Architectural Woodwork Institute (AWI) unless otherwise indicated.
- C. A progressive panel system with an exposed divider molding creating a 1/4-inch (6mm) concave radiused reveal horizontally and vertically between edge banded panels. Recommended for vertical and horizontal interior installations. Maximum panel length for horizontal installations is 96 inches (2438 mm).
- D. Panel Thickness: 7/16-inch (11.1 mm).
- E. Horizontal Reveal: System to provide a 1/16-inch wide concave reveal between panels.
- F. Vertical Reveal: System to provide a 1/16-inch wide concave reveal between panels.
- G. Panel Edge Finish: Panel edges to be finished with .018-inch (.5mm) PVC edge banding or wood veneer, as selected by Architect.
- H. Panel Finish: As scheduled.
- I. Main Laminated Panel Fire Rating:
 - 1. Fire Rating: ASTM E84, Class A.
- J. Molding: 6063 alloy aluminum with T5 temper.
 - 1. Divider Moldings:
 - a. Width: 1/16-inch.
 - 2. Edge Trims and Corners: As selected by Architect from manufacturer's full range.
 - 3. Finishes: As selected by Architect from manufacturer's full range.

2.3 MATERIALS

- A. High Pressure Decorative Laminates:
 - 1. High Pressure Laminate (VGS, VGF.) and non-decorative backers (BKV) used to surface wall panels systems shall be manufactured to meet or exceed the National Electrical Manufacturing Association (NEMA LD3-2005) for thickness, performance properties and appearance.

- B. Back Painted Glass Panels, Where Indicated:
 - 1. Back painted glass panels to be 1/4-inch tempered, low iron glass bonded to a suitable substrate profiled to accept full range of molding systems.
 - 2. Paint adhesion to meet or exceed 2,000 PSI.
 - 3. Paint Color: As scheduled.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared according to AWI 1700-G-3.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 FIELD DIMENSIONS

- A. Where wall system is indicated to be fitted to other constructions, check actual dimensions of other constructions by accurate field measurements before manufacturing wall system; show recorded measurements on final shop drawings. Coordinate manufacturing schedule with construction progress to avoid delay of work.
- B. Where field measurements cannot be made without delaying the work, guarantee dimensions and proceed with manufacture of wall system without field measurements coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.

3.3 PREPARATION

- A. Panels must be acclimated to ambient temperature and humidity conditions in accordance with manufacturer's specifications prior to installation. Refer to manufacturer's installation guide for proper, handling, storage, and acclimation procedures.
- B. Clean surfaces thoroughly prior to installation.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.4 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. When interior paneling is on an exterior wall or in a wet area, provide a barrier sheet of plastic film between the outside wall and the panels in order to prevent condensation affecting the stability of the panels.
- C. Field cutting of all wall systems should be accomplished using carbide tools. All face penetrations and cutouts should have a minimal 1/8-inch (3 mm) radius in corners according to NEMA Standards Publication LD 3-2005.
- D. Wall systems should receive an "S" bead of panel mastic on the back of the panel during installation.
- E. For vertical applications, wall systems shall be mechanically fastened to horizontal metal furring strapping spaced 24 inches (610 mm) O.C. Furring straps shall be no less than 18-ga 3-1/2 inches (89 mm) wide, continuously. Metal strapping to be installed to the drywall studs prior to the application of the gypsum board by the framing contractor. For panels installed with a horizontal orientation, strapping is recommended but not necessary.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 09 81 16

ACOUSTICAL BLANKET INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Concealed building insulation.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E 84.
 - 2. Fire-Resistance Ratings: ASTM E 119.
 - 3. Combustion Characteristics: ASTM E 136.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Glass-Fiber Insulation:
 - a. CertainTeed Corporation.
 - b. Johns Manville Corporation.
 - c. Owens Corning.
 - 2. Slag-Wool-/Rock-Wool-Fiber Insulation:
 - a. Fibrex Insulations Inc.
 - b. Owens Corning.
 - c. Thermafiber.

2.2 INSULATING MATERIALS

- A. General: Provide insulating materials that comply with requirements and with referenced standards.
 - 1. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thicknesses, widths, and lengths.
- B. Unfaced Mineral-Fiber Blanket Insulation (in walls): ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- C. Unfaced, Flexible Glass-Fiber Blanket Insulation (above ceilings): ASTM C 612, Type IA; ASTM C 553, Types I, II, and III; or ASTM C 665, Type I; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; and of the following properties:
 - 1. Nominal density of 1.0 lb/cu. ft., thermal resistivity of 3.7 deg F x h x sq. ft./Btu x in. at 75 deg F.
 - 2. Nominal density of not less than 1.5 lb/cu. ft. nor more than 1.7 lb/cu. ft., thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F.
 - 3. Combustion Characteristics: Passes ASTM E 136.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Water-Piping Coordination: If water piping is located on inside of insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- E. Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Install mineral-fiber blankets in cavities formed by framing members according to the following requirements:
 - 1. Use blanket widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
 - 2. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping stapling flanges to flanges of metal studs.

3.5 PROTECTION

- A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 09 84 00
ACOUSTIC ROOM COMPONENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fabric-covered fiberglass core panels and mounting accessories.
- B. Sound-absorbing baffle panels.
- C. Wood Fiber Panels.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's printed data sheets for products specified.
- B. Shop Drawings: Fabrication and installation details, panel layout, and fabric orientation.
- C. Selection Samples: Manufacturer's color charts for fabric covering, indicating full range of fabrics, colors, and patterns available.
- D. Verification Samples: Fabricated two samples of each type of panel specified; 12 by 12 inch, showing construction, edge details, and fabric covering.
- E. Test Reports: Certified test data from an independent test agency verifying that panels meet specified requirements for acoustical and fire performance.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company with not less than 5 years of experience in manufacturing acoustical products similar to those specified.
- B. Installer Qualifications: Company, acceptable to the manufacturer of the acoustical products being installed, with three years minimum experience in similar sized installations.
- C. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect acoustical panels from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until panels are needed for installation.
- B. Store panels flat, in dry, well-ventilated space; do not stand panels on end.
- C. Protect panel edges from damage.
- D. Acclimatization: Before installing acoustical wall panels, allow panels to acclimatize to room temperature and humidity.

1.5 ENVIRONMENTAL CONDITIONS

- A. Do not apply acoustical treatments when surface and ambient temperatures are outside the temperature ranges required by the wall panel manufacturer.
- B. Do not install acoustical panels until wet work such as concrete, plastering and painting is done and building is completely enclosed.
- C. Provide continuous ventilation and heating facilities to maintain substrate surface and ambient temperatures above 60 degrees F and not more than 85 degrees F unless required otherwise by manufacturer's instructions.
- D. Maintain constant recommended temperature and humidity for at least 48 hours prior to, throughout the installation period and continuously after panel installation completion.
- E. Field Measurements: Check and verify actual wall surfaces by accurate field measurements before fabrication.

1.6 WARRANTY

- A. Submit manufacturer's 1 year written warranty against manufacturing defects from date of substantial completion.

1.7 EXTRA MATERIALS

- A. Provide 5 percent, but not less than one of each type of panel, for Owner's use in maintenance.

PART 2 - PRODUCTS

2.1 FABRIC-COVERED ACOUSTICAL PANELS

- A. Subject to compliance with requirements, provide products by one of the following:
1. Acoustic Enterprises, Inc.
 2. Armstrong Ceiling & Wall Solutions.
 3. CertainTeed; a Saint-Gobain company.
- B. Basis-of-Design Product: CertainTeed; a Saint-Gobain company; Ecophon Akusto One.
- C. Panels: Prefinished, factory assembled fabric-covered panels.
1. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 50 or less, when tested in accordance with ASTM E84 or UL 723 by a qualified testing agency.
 2. Panel Dimensions: As indicated on Drawings.
 3. Core: Fiberglass.
 4. Noise Reduction Coefficient (NRC): 0.95, when tested in accordance with ASTM C423 for Type A mounting, per ASTM E795.
 5. Edges: Perimeter edges reinforced by chemically hardened edges.
 6. Mounting: Manufacturer's standard; furnish mounting hook for wall panels.
 - a. Basis-of-Design Product: CertainTeed; a Saint-Gobain company; Connect One Hook Fixing.
- D. Fabric Covering: Seamless fabric facing material, for stretched covering of core material.
1. Basis-of-Design Products: As scheduled.
 2. Color: As scheduled.

2.2 SOUND-ABSORBING BAFFLE PANELS

- A. Sound-Absorbing Baffle Panel: Manufacturer's standard panel construction consisting of facing material laminated to front and back faces and edges of core .
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Armstrong World Industries.
 - b. Benton Brothers Solutions, Inc.
 - c. CSI Creative.
 2. Basis-of-Design Products: CSI Creative; BFL-FLD-001.
 3. Panel Shape: As indicated on Drawings.
 4. Mounting: Rail suspension with pre-defined spacing, mounted with manufacturer's standard threaded rod, secured to substrate.
 5. Core: Manufacturer's standard .
 6. Edge Construction: Manufacturer's standard chemically hardened core with no frame.
 7. Edge Profile: Square.
 8. Corner Detail in Elevation: Square with continuous edge profile indicated.
 9. Facing Material: Felt.
 - a. Color: As scheduled.
 10. Acoustical Performance: Sound absorption NRC of not less than 0.75 according to ASTM C 423.
 11. Nominal Overall Panel Thickness: As indicated on Drawings.
 12. Panel Width: As indicated on Drawings.
 13. Panel Height: As indicated on Drawings.

2.3 SOUND-ABSORBING DIFFUSER PANELS

- A. Sound-Absorbing Diffuser Panel: Manufacturer's standard ceiling diffuser with internal absorption.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. G&S Acoustics.

2. Basis-of-Design Product: G&S Acoustics; PCD-CDA.
3. Panel Shape: Pyramidal.
4. Mounting: Lay-in.
5. Core: Manufacturer's standard.
6. Acoustical Performance: Sound absorption NRC of not less than 0.35 according to ASTM C 423.
7. Nominal Overall Panel Thickness: As indicated on Drawings.
8. Panel Width: As indicated on Drawings.
9. Panel Height: As indicated on Drawings.
10. Finish: Textured White.

2.4 ACOUSTIC WALL PANELS

- A. Acoustic Wall Panels: Manufacturer's standard polyethylene terephthalate and aluminum wall panels.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Arktura.
 2. Basis-of-Design Product: Arktura; Softscreen.
 3. Mounting: As indicated on Drawings.
 4. Pattern: As indicated on Drawing.
 5. Acoustical Performance: Sound absorption NRC of not less than 0.25.
 6. Panel Width: As indicated on Drawings.
 7. Panel Height: As indicated on Drawings.

2.5 WOOD FIBER PANELS

- A. Wood Fiber Interior Wall and Ceiling Panels:
1. Basis-of-Design Product: Armstrong Ceiling & Wall Solutions; TECTUM.
 - a. Approved Substitution: Cardinal Acoustics; Cardinal Standard Interior Panel.
 2. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 3. Material: Wood fibers bonded with inorganic hydraulic cement.
 4. Thickness: 2 inches.
 5. Noise Reduction Coefficient (NRC): Minimum 0.55 when tested in accordance with ASTM C423 for Type A mounting, per ASTM E795.
 6. Edge: Beveled edges.
 7. Width: 47-3/4 inches.
 8. Length: 47-3/4 inches.
 9. Color: Factory painted white.
 10. Pattern: Refer to drawings.
 11. Mounting Style: Provide all fasteners, furring strips, and Owens Corning, Type 703 plain fiberglass insulation for a complete single source installation.

2.6 FABRICATION

- A. Fabric Wrapped, General: Fabricate panels to sizes and configurations indicated, with fabric facing installed without sagging, wrinkles, blisters, or visible seams.
1. Where radiused or mitered corners are indicated, install fabric to avoid seams or gathering of material.
- B. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 inch for thickness, overall length and width, and squareness from corner to corner.

2.7 ACCESSORIES

- A. Acoustical Wall Panel Accessories:
1. Panel Anchors: Install Acoustical Wall Panels with RotoFast Snap-on stabilized, polypropylene plastic snap-on panel anchors. www.rotofast.com.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for conditions detrimental to installation of acoustical panels. Proceed with installation only after unsatisfactory conditions have been corrected.

- 3.2 ACOUSTICAL FABRIC COVERED WALL PANELS INSTALLATION (ACOUSTICAL FABRIC COVERED WALL PANELS)
- A. Install acoustical panels in locations indicated, following installation recommendations of panel manufacturer. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.
 - B. Install panels to construction tolerances of plus or minus 1/16 inch for the following:
 - 1. Plumb and level.
 - 2. Flatness.
- 3.3 INSTALLATION OF SOUND ABSORBING BAFFLE PANELS
- A. Install system in accordance with manufacturer's instructions and as supplemented below. Attach to suspended ceiling systems with manufacturer's metal clips and secure cross-tee to main tees with rivets.
- 3.4 INSTALLATION OF WOOD FIBER PANELS
- A. Install system in accordance with manufacturer's instructions and as supplemented below. Attach to suspended ceiling systems with manufacturer's metal clips and secure cross-tee to main tees with rivets.
- 3.5 CLEANING
- A. Clean fabric facing upon completion of installation from dust and other foreign materials, following manufacturer's instructions.
 - B. Remove surplus materials, trimmed portions of panels, and debris resulting from installation.
- 3.6 PROTECTION
- A. Provide protection of installed acoustical panels until completion of the work.
 - B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

END OF SECTION

SECTION 09 84 53

SOUND BARRIER MULLION TRIM CAP

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sound barrier mullion trim caps providing sound transmission control.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Include typical dimensioned cross-sections at location where gypsum board partition terminates at perimeter of curtain wall or storefront.
 - 1. Include dimensions and finish.
- C. Sample: Of each exposed product, made from 12-inch (300-mm) lengths of full-size components.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver sound barrier mullion trim caps until spaces to receive them are clean, dry, and ready for their installation.
- B. Store sound barrier mullion trim caps in original undamaged packaging inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Mullion trim cap to be sized to accommodate thermal movement.
- B. Class A rated per ASTM E84.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products one of the following:
 - 1. Gordon, Inc.
 - 2. Mull-It-Over Products.
- B. Basis-of-Design Product: Gordon, Inc.; Mullion Mate Plus 2, Against the Mullion.
 - 1. Location: Openings 2 inches to 2-15/16 inches.
- C. Profile: As required to conform to wall construction.

2.3 COMPONENTS

- A. Materials:
 - 1. Aluminum Extrusions: 6063-T5 temper alloy.
 - 2. Aluminum Sheet: 3000 Series alloy.
 - 3. Tensile Strength: 31 KSI (ASTM B221).
- B. Finish: Factory anodized to match storefront color.
- C. Caulk: ASTM C920 Type S, Grade NS, Class 35, Use NT, G, A.
- D. Accessories:
 - 1. End Caps: As required to match width of wall partition, or the following:
 - a. Basis-of-Design Products:
 - 1) Gordon, Inc.; Mullion Mate End Caps, MMEC-487.
 - 2) Gordon, Inc.; Mullion Mate End Caps, MMEC-600.

- E. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials. Fasteners to be installed with a maximum spacing of 12 inches o.c.

2.4 FABRICATION

- A. Ship extrusions and generic profiles in custom lengths as required to meet project requirements or shipped in standard incremental foot lengths and cut to exact length on jobsite.

2.5 ALUMINUM FINISHES

- A. As selected by Architect:
 - 1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
 - 2. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - 1) Color: As selected by Architect from full range of industry colors and color densities.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by manufacturer to achieve the best result for project conditions.

3.3 INSTALLATION

- A. Install in strict accordance with manufacturers typical details and instructions along with appropriate spacing to allow for differential movement as provided by manufacturers of adjacent systems or project engineers.
- B. Space Enclosure: Do not install any work until space is enclosed and weatherproofed, wet-work in space is completed and nominally dry, work above ceilings is complete, and temperature and humidity shall be continuously maintained at values near those of final occupancy.

END OF SECTION

SECTION 09 91 13

EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on exterior substrates.
- B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color doing), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
- C. Do not paint prefinished items and finished metal surfaces where otherwise noted in Drawings or specifications. Do not paint concealed surfaces, operating parts, and labels.
 - 1. Prefinished items include the following factory-finished components:
 - a. Finished mechanical and electrical equipment.
 - b. Light fixtures.
 - c. Masonry.
 - d. Metal wall panels.
 - e. Prefinished metal roof and soffit panels.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in the Exterior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. Colors: As scheduled.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
 - 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 - 2. Testing agency will perform tests for compliance with product requirements.
 - 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 - 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 - 4. Paint entire exposed surface of window frames and sashes.
 - 5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed to view:
 - a. Equipment, including panelboards and switch gear.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

- A. Ferrous Metal, Semigloss, Exterior Acrylic-Enamel Finish: Primer is not required on shop-primed items; touch up shop primer where provided.
 - 1. PPG:
 - a. First Coat: Primer 4020 Pitt-Tech Plus Int./Ext. Primer DTM, 2.5 mils DFT.
 - b. Finish Coat: 4216 Pitt-Tech Plus Int./Ext. Semi-Gloss DTM, 2.5 mils DFT.
 - 2. Sherwin-Williams: (Basis-of-Design)
 - a. Primer: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series 2.0 - 4.0 mils DFT.
 - b. Second Coat: Pro Industrial Acrylic Semi-Gloss, B66-650 Series 2.5 mils DFT.
- B. Zinc-Coated (Galvanized) Metal, Semigloss, Exterior Acrylic-Enamel Finish:
 - 1. PPG:
 - a. Primer: 4020 Pitt-Tech Int./Ext. Primer/Finish DTM, 2.5 mils DFT.
 - b. Second Coat: 4216 Pitt-Tech Plus Int./Ext. Semi-Gloss DTM, 2.5 mils DFT
 - c. Third Coat: Same as second coat.
 - 2. Sherwin-Williams:
 - a. Primer: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series 2.0 - 4.0 mils DFT.
 - b. Second Coat: Pro Industrial Acrylic Semi-Gloss, B66-650 Series 2.5 mils DFT.
 - c. Third Coat: Same as second.

END OF SECTION

SECTION 09 91 23

INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on interior substrates.
- B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
- C. Do not paint prefinished items and finish metal surfaces except where otherwise noted in Drawings or specifications. Do not paint concealed surfaces, operating parts, and labels.
 - 1. Prefinished items include the following factory-finished components:
 - a. Architectural woodwork.
 - b. Acoustical wall panels intended to be fabric-wrapped.
 - c. Toilet enclosures.
 - d. Metal lockers.
 - e. Finished mechanical and electrical equipment.
 - f. Light fixtures.
 - 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Foundation spaces.
 - b. Furred areas.
 - 3. Finished metal surfaces include the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - d. Copper and copper alloys.
 - e. Bronze and brass.
 - 4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
 - 5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in the Interior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. Colors: As scheduled.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
 - 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 - 2. Testing agency will perform tests for compliance with product requirements.
 - 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (Clay and CMUs): 12 percent.
 - 3. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
 - C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
 - D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
 - E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards and switch gear.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - 2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Architect.
 - 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.
 - F. Rated Wall Assemblies Identification:
 - 1. Identify fire-rated wall assemblies with stenciled lettering on wall surface above ceiling line.
 - 2. Provide stenciled block letters in red to identify each rated wall assembly.
- 3.4 FIELD QUALITY CONTROL
- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.
- 3.5 CLEANING AND PROTECTION
- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
 - B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
 - C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
 - D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

- A. Gypsum Board, Flat Latex-Based Acrylic Finish: 2 finish coats over a primer.
 - 1. PPG:
 - a. Primer: 6-2 Speedhide Interior Latex Sealer
 - b. Second Coat: Speedhide Zero Interior Latex Flat 6-4110XI, 1.4 mils DFT.
 - c. Third Coat: Same as second coat.
 - 2. Sherwin-Williams:
 - a. Primer: Roller applied latex texturing compound, ProMar 200 Zero VOC Interior Latex Primer, B28W2600.
 - b. Second Coat: ProMar 200 Zero VOC Interior Latex Flat, B30-2600 Series 1.6 mils DFT.
 - c. Third Coat: Same as second coat.
 - 3. Location: At ceilings.
- B. Gypsum Board, Gloss, Latex-Based Acrylic-Enamel Finish: 2 finish coats over a primer.
 - 1. Sherwin-Williams:
 - a. Primer: Roller applied latex texturing compound, ProMar 200 Zero VOC Interior Latex Primer, B28W2600.
 - b. Second Coat: ProMar 200 Zero VOC Interior Latex Gloss, B31-2600 Series 1.6 mils DFT.
 - c. Third Coat: Same as second coat.
 - 2. Location: As indicated on Drawings.
- C. Gypsum Board, Eggshell, Low Odor: 2 finish coats over a primer.
 - 1. Sherwin-Williams:
 - a. Primer: ProMar 200 Zero VOC Interior Latex Primer, B28W2600.
 - b. Second Coat: ProMar 200 Zero VOC Interior Latex Eg-Shel, B20-2600 Series 1.7 mils DFT.
 - c. Third Coat: Same as second coat.
 - 2. Location: At all locations, unless noted otherwise.
- D. Ferrous Metal, Eggshell, Acrylic-Enamel Finish: Two finish coats over a primer.
 - 1. Sherwin-Williams:
 - a. Primer: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series 2.0 - 4.0 mils DFT.
 - b. Second Coat: Pro Industrial Acrylic Eg-Shel, B66-660 Series 2.5 mils DFT.
 - c. Third Coat: Same as second coat.
- E. Dryfall Paint at Areas of Painted Exposed to Deck Structure: Paint structure, deck, mechanical, plumbing, and other exposed metal items below structure as appropriate: 1 or 2 finish coats as required for complete coverage and consistent appearance, over 1 coat primer.
 - 1. Primer: Alkyd or Acrylic primer as recommended by Manufacturer for metal substrate types.
 - 2. Finish Coats: Dryfall Paint (Sherwin-Williams Pro Industrial Waterborne Acrylic Dryfall B42W00181).
- F. Semi-Gloss Epoxy Finish: Two finish coats over block filler.
 - 1. Sherwin-Williams:
 - a. Concrete Unit Masonry Block Filler: Pro Industrial Heavy-Duty Interior/Exterior Block Filler B42W150.
 - b. Finish Coats: Pre-catalyzed water-based semi-gloss epoxy.
 - 1) Pro Industrial Pre-Catalyzed Water-Based Epoxy Semi-Gloss, K45W00151.
- G. Exterior and Interior Concrete Rubbed or Parged Bases at Light Poles, Columns, Grade Beams over 4-inch of Exposure, and Similar Conditions as Directed by Architect: Provide the following finish systems over architectural concrete surfaces scheduled for paint application:
 - 1. Exterior Satin Latex Finish: Two finish coats over concrete and masonry primer.
 - a. Primer: Concrete and Masonry Latex Primer (SW A24W8300, Loxon Concrete and Masonry Primer).
 - b. Finish Coats: Exterior Satin Latex (SW A82-100 Series, A-100 Exterior Latex Satin).
 - 2. Architect may direct not to paint some of these surfaces where, in Architect's opinion, the exposed raw concrete finish is of good aesthetic quality to be the exposed finish.

END OF SECTION

SECTION 09 93 00

STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and application of wood stains and transparent finishes.

1.2 DEFINITIONS

- A. MPI Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- D. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- E. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Indicate VOC content.
- B. Samples for Initial Selection: For each type of product.
- C. Samples for Verification: For each type of finish system and in each color and gloss of finish required.
 - 1. Submit Samples on representative samples of actual wood substrates, 8 inches (200 mm) square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Stains and Transparent Finishes: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.5 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of stain color selections will be based on mockups.
 - a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply finishes when relative humidity exceeds 85 percent, at temperatures less than 5 deg F (3 deg C) above the dew point, or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Behr Process Corporation.
 - 2. PPG Architectural Coatings.
 - 3. Sherwin-Williams Company (The).
- B. Basis-of-Design Product: As scheduled.

2.2 MATERIALS, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. Stain Colors: As scheduled.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Materials: Owner reserves the right to invoke the following procedure:
 - 1. Owner will engage the services of a qualified testing agency to sample wood finishing materials. Contractor will be notified in advance and may be present when samples are taken. If materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 - 2. Testing agency will perform tests for compliance with product requirements.
 - 3. Owner may direct Contractor to stop applying wood finishes if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying materials from Project site, pay for testing, and refinish surfaces finished with rejected materials. Contractor will be required to remove rejected materials from previously finished surfaces before refinishing with complying materials if the two finishes are incompatible or produce results that, in the opinion of the Architect, are aesthetically unacceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Interior Wood Substrates: 10 percent, when measured with an electronic moisture meter.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with finish application only after unsatisfactory conditions have been corrected.
 - 1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
 - 1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.
 - 1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
 - 2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.
- D. Interior Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2. Apply wood filler paste to open-grain woods, as defined in "MPI Architectural Painting Specification Manual," to produce smooth, glasslike finish.
 - 3. Sand surfaces exposed to view and dust off.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dry.

3.3 APPLICATION

- A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 - 1. Use applicators and techniques suited for finish and substrate indicated.
 - 2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
 - 3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 INTERIOR WOOD -FINISH-SYSTEM SCHEDULE

- A. Wood Substrates:
 - 1. Stain System:
 - a. Prime Coat: As recommended by manufacturer.
 - b. Intermediate coat: As recommended by manufacturer.
 - c. Topcoat: As recommended by manufacturer.

END OF SECTION

SECTION 09 96 00

HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of high-performance coating systems.
- B. Coating Systems Include:
 - 1. Gloss Urethane Metal Coating – apply to exterior metal frames (all exposed exterior surfaces).
 - 2. Low Gloss Urethane Metal Coating – apply to exterior masonry lintels and shelf angles.

1.2 DEFINITIONS

- A. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- B. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- C. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Indicate VOC content.
- B. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- C. Product List: Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Coatings: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.5 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each coating system.
 - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in the Exterior High-Performance Coating Schedule for the coating category indicated.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

- A. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
 - 3. Products shall be of same manufacturer for each coat in a coating system.
- B. Low-Emitting Materials: For field applications that are inside the weatherproofing system, 90 percent of paints and coatings shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Colors: As scheduled.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:
 - 1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 - 2. Testing agency will perform tests for compliance with product requirements.
 - 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 - 1. Use applicators and techniques suited for coating and substrate indicated.
 - 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
 - 1. Contractor shall touch up and restore coated surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

- C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Primer, Intermediate, and Top Coat Colors
 - 1. Except where coating materials cannot be tinted, tint each successive (primer, intermediate, top) coat of paint a sufficiently contrasting color to facilitate identification of complete coating coverage. The preceding coat may be in the same color family, but shall be noticeably different. Provide additional top coats without change in Contract Price if necessary to achieve complete hiding and uniform sheen.
 - 2. Top coat colors are indicated on the Drawings and schedules. For approval of actual colors, see sample and mock-up requirements specified above.
 - 3. Top coat colors of manufacturers listed on the Finish Schedule (or elsewhere) indicate the required color, only, and do not indicate the required brand name product, which shall be as specified below.
- B. Gloss Urethane Coatings:
 - 1. Location: Apply to exterior architecturally exposed steel.
 - 2. System Description:
 - a. Wash primer on galvanized surfaces.
 - b. Epoxy primer.
 - c. Epoxy intermediate coat.
 - d. Urethane top coat.
 - 3. Sherwin-Williams:
 - a. Wash Primer for Non-Ferrous Metals: P60G2 Industrial Wash Primer.
 - b. Epoxy Primer: B58-600 Series Macropoxy 646 Fast Cure Epoxy, DFT 5.0 to 10.0 mils. (336 g/l)
 - c. Intermediate Coat: B58-600 Series Macropoxy 646 Fast Cure Epoxy, DFT 5.0 to 10.0 mils. (336 g/l)
 - d. Gloss Finish Coat: 1) B65-600 Series Acrolon 218 HS; DFT 3.0 to 6.0 mils. (320 g/l)
- C. Low Gloss Urethane Coatings:
 - 1. Apply system to all exposed portions of metal stairs, steel rails, steel lintels, shelf angles, or other horizontal / vertical steel not part of window system.
 - 2. Where masonry preparation requires removal of mortar from joint between steel and masonry, apply system to top surface and all steel surfaces exposed.
 - 3. System Description:
 - a. Chemical conversion treatment on ferrous surfaces.
 - b. Universal primer, brush apply – no roller or spray.
 - c. Epoxy intermediate coat, brush apply – no roller or spray.
 - d. Urethane top coat, brush apply – no roller or spray.
 - 4. Sherwin-Williams:
 - a. Chemical Conversion Treatment on Ferrous Surfaces: Not required.
 - b. Epoxy Primer: B58-600 Series Macropoxy 646 Fast Cure Epoxy, DFT 5.0 to 10.0 mils. (336 g/l)
 - c. Intermediate Coat: B58-600 Series Macropoxy 646 Fast Cure Epoxy, DFT 5.0 to 10.0 mils. (336 g/l)
 - d. Low Gloss (semi-gloss) Finish Coat: 1) B65-350 Series Hi-Solids Polyurethane, DFT 3.0 to 5.0 mils. (315 g/l)

END OF SECTION

SECTION 09 97 23

MASONRY COLOR TREATMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Water-based stain.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Product characteristics.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods.
- B. Shop Drawings: Indicate materials, construction, sizes, quantities, finishes, and installation details.
- C. Preliminary Samples: To be provided as required for the specific project.
- D. Verification Samples: To be provided on the specific materials to be treated when they are available in plant or on site.
- E. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Instructions: For installation, maintenance, and repair.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: An international manufacturer with a minimum of 20 years of experience in the production of the stains and coatings of type specified.
- B. Installer Qualifications: Installer licensed by Nawkaw to apply the stain products specified and with a minimum of three years documented experience in applying stains and coatings similar in type and scale to this Project.
- C. Environmental Regulations: The masonry stain material to be applied is in compliance with federal, provincial and local environmental Volatile Organic Compounds (VOC) regulations.
- D. Mock-Up: Apply a minimum one square foot sample of each type of color application required.
 - 1. Finish areas designated by Architect.
 - 2. Prepare each sample in an area where it will be exposed to the same conditions as will be present on the building during curing.
 - 3. Samples should be viewed from a minimum distance of 20 feet.
 - 4. Do not proceed with remaining work until color and finish is approved by Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and handle products in accordance with requirements of manufacturer.
- C. Store materials inside if possible, away from open flame. Store in a secure area to avoid tampering and contamination. Water-based materials must be kept from freezing.

1.6 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.7 WARRANTY

- A. At project closeout, provide to Owner or Owner's Representative an executed copy of the manufacturer's standard limited warranty against manufacturing defects, outlining its terms, conditions, and exclusions from coverage.
 - 1. Duration:
 - a. Color Treatment: 25 years.
 - b. Water Repellency: 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Nawkaw Inc.

2.2 WATER-BASED STAIN

- A. Basis-of-Design Product: Nawkaw Inc.; NawTone+Plus.
 - 1. General: High-quality, water-based, highly permeable acrylic stain with water repellent. Mold, mildew, UV and weather resistant.
 - 2. Properties:
 - a. Viscosity: (72° F) 70°-90° KU
 - b. pH: 8.5-9.5
 - c. Finish: flat
 - d. Nonflammable (ASN/ZS 1530.3-1999)
 - e. VOC: < 5 g/L (SCAQMDR 1168)
 - f. Abrasion Resistance: excellent
 - g. Freeze/Thaw Test (ASTM C216-86): exceeded
 - h. Salt Attack Resistance (AS/NZS 4456.10): no blisters
 - i. Water Penetration and Leakage (ASTM E514-90, ASTM C270, ASTM C140):
 - 1) Appearance of first visible water (min): none
 - 2) Area of dampness (4h, % of test area): none
 - 3) Water collected (4h, liter): none
 - j. UV Resistant–Accelerated Weathering (ASTM G154:2000, ASTM G53-88, D2244-89) 2000 hrs: excellent
 - 3. Finish: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Verify that new masonry and concrete have cured at least 21 days prior to applying NawTone+Plus.
- C. Verify that surfaces to receive work have a neutral pH, are clean, dry and free of efflorescence.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Clean surfaces thoroughly prior to installation. Allow surfaces to dry completely before applying coating.
- C. Verify that walls, masonry, concrete, stucco, block split faced/fluted and mortar that may have been treated with any form of chemical/acid wash are neutralized.
- D. Treat alkali or efflorescence with proper neutralizing compounds as recommended by masonry supplier before stain application.
- E. Before application, verify that the masonry walls have a neutral pH.
- F. Before application, verify that surface to be treated is clean, dry and contains no frozen water.
- G. Mix products as recommended immediately prior to application.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Apply stain using airless spray pump to help control airborne particles or overspray. If site conditions prohibit spray application, apply by hand; utilizing brushes and rollers.
- C. Do not proceed with work when ambient temperatures are less than 25 degrees F (-4 degrees C) or greater than 110 degrees F (43 degrees C).
- D. Allow manufacturer's specified drying time for each coat before applying next coat (if required).
- E. Verify color consistency. Recoat areas where blotches, blemishes or imperfections are present.

3.4 FIELD QUALITY CONTROL

- A. Verify color consistency. Recoat any areas that are unacceptable.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Protect prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels as required.
- C. Protect shrubs, metal, wood trim, glass, asphalt and other building hardware during application from overspray.
- D. Do not permit mist (if spraying) or liquid to drift onto surrounding properties or parking lots.
- E. Touch-up, repair or replace damaged products before substantial completion.

END OF SECTION

SECTION 10 11 00
VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Visual display board assemblies.
 - 2. Rail support systems for visual display board assemblies.
 - 3. Glass markerboards.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
 - 2. Include electrical characteristics for motorized units.
- B. Shop Drawings: For visual display units.
 - 1. Include plans, elevations, sections, details, and attachment to other work.
 - 2. Show locations of panel joints. Show locations of field-assembled joints for factory-fabricated units too large to ship in one piece.
 - 3. Show locations and layout of special-purpose graphics.
 - 4. Include sections of typical trim members.
- C. Samples for Initial Selection: For each type of visual display unit indicated, for units with factory-applied color finishes, and as follows:
 - 1. Samples of facings for each visual display panel type, indicating color and texture.
 - 2. Fabric swatches of fabric facings for tackboards.
 - 3. Actual factory-finish color samples, applied to aluminum substrate.
 - 4. Include accessory Samples to verify color selected.
- D. Product Schedule: For visual display units. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each visual display unit, for tests performed by a qualified testing agency.
- C. Sample Warranties: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For visual display units to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.9 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities.
 - b. Surfaces exhibit crazing, cracking, or flaking.
 - 2. Warranty Period: 50 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.

2.2 VISUAL DISPLAY BOARD ASSEMBLY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ADP Lemco.
 - 2. AJW Architectural Products.
 - 3. American Visual Display Products LLC.
 - 4. Claridge Products and Equipment, Inc.
 - 5. Clarus Glassboards, LLC.
 - 6. MooreCo, Inc.
 - 7. Nelson Adams NACO.
- B. Basis-of-Design Manufacturer: Claridge Products and Equipment, Inc.
- C. Visual Display Board Assembly: Field or factory fabricated.
 - 1. Assembly: Markerboard and tackboard.
 - 2. Corners: Square.
 - 3. Width: As indicated on Drawings.
 - 4. Height: As indicated on Drawings.
 - 5. Mounting Method: Rail support system.
- D. Markerboard Panel: Porcelain-enamel-faced markerboard panel on core indicated.
 - 1. Color: White.
- E. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- (1.57-mm-) thick, extruded aluminum; standard size and shape.
 - 1. Field-Applied Trim: Manufacturer's standard, snap-on trim with no visible screws or exposed joints.
 - 2. Aluminum Finish: Clear anodic finish.
- F. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.
- G. Combination Assemblies: Provide manufacturer's standard exposed trim between abutting sections of visual display panels.

2.3 RAIL SUPPORT SYSTEM FOR VISUAL DISPLAY BOARD ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Brefford Manufacturing.
 - 2. Egan Visual Inc.
 - 3. KOH Design, Inc.
 - 4. Peter Pepper Products, Inc.

- B. Support Rails: Horizontal, wall-mounted, extruded-aluminum rails designed to receive hanger clip and to support visual display boards; and capable of gripping and suspending paper directly from rail.
 - 1. Finish: Clear anodic.
- C. Hanger Clips: Extruded aluminum with finish to match rails; designed to support independent visual display board assemblies by engaging support rail and top trim of board.
- D. Visual Display Board Assemblies: Fabricated from not less than 3/8-inch- (9.5-mm-) thick, kraft-paper honeycomb core; designed to be rigid and to resist warpage, and with aluminum trim designed to engage hanger clips.

2.4 GLASS MARKERBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. AARCO Products, Inc.
 - 2. ADP Lemco.
 - 3. AJW Architectural Products.
 - 4. Claridge Products and Equipment, Inc.
 - 5. Clarus Glassboards, LLC.
 - 6. Egan Visual Inc.
- B. Basis-of-Design Products: As scheduled.
- C. Glass Markerboards: Fabricated of 6-mm tempered glass with steel backing for use with magnets.
 - 1. Edge Treatment: Smooth polished edge with rounded corners.
 - 2. Surface: Matte.
 - 3. Color: As scheduled.
- D. Mounting: Round, stainless steel standoffs, holding glass approximately 1 (25) inch (mm) from wall surface; mounted in notches in standoffs at top and bottom edges of markerboard.
- E. Marker Tray: Aluminum, attached with stainless steel clips.
- F. Size: As indicated on Drawings.

2.5 MARKERBOARD PANELS

- A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with high -gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.
 - 1. Face Sheet Thickness: 0.021 inch (0.53 mm) uncoated base metal thickness.
 - 2. Manufacturer's Standard Core: Minimum 1/4 inch (6 mm) thick, with manufacturer's standard moisture-barrier backing.
 - 3. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

2.6 TACKBOARD PANELS

- A. Tackboard Panels:
 - 1. Facing: Vinyl fabric.
 - 2. Core: Manufacturer's standard.

2.7 MATERIALS

- A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.
- B. Vinyl Fabric: Mildew resistant, washable, complying with ASTM F 793/F 793M, Type II, burlap weave; weighing not less than 13 oz./sq. yd. (440 g/sq. m); with surface-burning characteristics indicated.
- C. Clear Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering.
- D. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063.
- E. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.

- F. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements in Section 09 91 23 "Interior Painting" and recommended in writing by visual display unit manufacturer for intended substrate.

2.8 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine walls and partitions for proper preparation and backing for visual display units.
- C. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.
- D. Prime wall surfaces indicated to receive visual display units and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.
- E. Prepare recesses for sliding visual display units as required by type and size of unit.

3.3 INSTALLATION

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Factory-Fabricated Visual Display Board Assemblies: Adhere to wall surfaces with egg-size adhesive gobs at 16 inches (400 mm) o.c., horizontally and vertically.
- C. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches (400 mm) o.c. Secure tops and bottoms of boards to walls.
- D. Visual Display Board Assembly Mounting Heights: Install visual display units at mounting heights indicated on Drawings, or if not indicated, at heights indicated below.
 - 1. Mounting Height for Grades 7 and Higher: 36 (914) inches (mm) above finished floor to top of chalktray.
- E. Display Rails: Install rails at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall surface with fasteners at not more than 16 inches (400 mm) o.c.
 - 1. Mounting Height: 48 (1219) inches (mm) above finished floor to top of rail.

- F. Rail Support System: Install horizontal support rail at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall with fasteners at 12 inches (300 mm) o.c.
 - 1. Hang visual display units on rail support system.

3.4 CLEANING AND PROTECTION

- A. Clean visual display units in accordance with manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display units after installation and cleaning.

END OF SECTION

SECTION 10 14 00

SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Identifying devices where shown on the Drawings complete and as specified including the following:
 - a. Parking signs indicating accessible spaces.
 - b. Interior code required signs.

1.2 SUBMITTALS

- A. Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.
- B. Shop Drawings: Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, accessories, layout, and installation details.

1.3 QUALITY ASSURANCE

- A. Single-Source Responsibility: For each separate type of sign required, obtain signs from one source from a single manufacturer.
- B. Manufacturer shall have a minimum of five years experience in the manufacturing of signs specified.
- C. Codes and Standards:
 - 1. Panel signs shall have 1/32-inch raised copy and grade 2 Braille, and shall comply with all existing federal, state, and local accessibility standards.
 - 2. Code and Standards: Comply with American with Disabilities Act of 1990, Title 3 Provisions, Public Accommodations and Commercial Facilities. Updated March 15, 2012.
 - 3. Comply with the State of Texas Accessibility Standards, 2012 edition, as administered by the Texas Department of Licensing and Regulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. A Sign of Quality.
 - 2. ASI Signs, Dallas, Texas.
 - 3. Best Sign Systems, Montrose, Colorado.
 - 4. Mohawk Sign Systems, Schenectady, New York.
 - 5. Nelson-Harkins, Chicago, Illinois.

2.2 HANDICAPPED PARKING

- A. Screen Printed Signs:
 - 1. 18 gage bonderized steel with blue baked enamel finish and white screen printed copy.
 - 2. Copy and Size:
 - a. "Handicapped Parking Only" – 12 inches by 18 inches.
 - b. "Van Accessible" – 12 inches by 6 inches.
 - 3. Acceptable Product: Best Traffic Signs No. SS04 with SS52 as required.
- B. Post: Galvanized pipe column minimum 9 feet long.

2.3 ROOM SIGNAGE SYSTEMS

- A. Basis-of-Design Product: ASI Unframed SP Series Signs with requirements indicated for materials, thickness, finish colors, designs, shapes, sizes and details.

- B. Sign Face: Clear acrylic, 0.080-inch thick, matte first surface.
 - 1. Adhesive: Pressure sensitive adhesive film, second surface.
- C. Tactile Graphics and Text:
 - 1. Fabrication: Provide tactile copy and grade 2 Braille raised 1/32 inch minimum from plaque first surface by manufacturer's stratification process as follows:
 - a. Basis-of-Design Product: ASI Intouch, photo-mechanical method.
 - 2. Provide lettering and graphics precisely formed, uniformly opaque to comply with relevant ADA regulations and requirements indicated for size, style, spacing, content, position, and colors.
- D. Non-Tactile Graphics and Text:
 - 1. Fabrication options:
 - a. Basis-of-Design Product: ASI; Series SPE/SPJ: Non-tactile graphic plaque, no back plate.
 - 2. Text or graphic technique:
 - a. Screen process using subsurface method.
 - 3. Provide lettering and graphics precisely formed, uniformly opaque, and consistent in size, style, spacing, content, position, and colors.
- E. Overall Panel Size: Refer to Drawings.
- F. Panel Colors: As selected by Architect.
- G. Text or Graphic Colors: As selected by Architect.
- H. Letter styles, colors, letter sizes and layout position: As selected by Architect.
- I. Installation Method: System SA, silicone adhesive.

PART 3 - EXECUTION

3.1 DELIVERY AND STORAGE

- A. Deliver and store identifying devices in protective wrappings until ready for installation. Install letters in protective wrappings and remove wrappings just prior to substantial completion.

3.2 INSTALLATION

- A. Install signs plumb, level and square and in proper planes with other work, at heights required by accessibility codes and standards.
- B. Anchor each plastic laminate sign with adhesive.
- C. Install signs with sufficient amount of foam tape for proper installation.
- D. Attach as recommended by sign manufacturer.
- E. Anchor each sign with adhesive.
- F. Coordinate arrival and installation of graphic signs with hardware installation. Graphic signs function as and are coordinated with the hardware as shown on the Drawings.
- G. Room name signs shall be placed on the public side of the door except where noted otherwise.
- H. Single Door Sign: Provide one sign as specified above, mounted to wall adjacent to door on knob side.
- I. Pair of Doors: Provide one sign as specified above, mounted to adjacent wall closest to active leaf of door. Do not install sign where it will be obstructed by door when door is in the 'open' position.
- J. Attachment: Mounting to surfaces shall be done by pressure sensitive frame double-faced tape. Signs shall be delivered to the project site with the tape in place and trimmed on each sign, but with the protective paper layer not removed. Paper layer shall be removed just prior to installation of signs.

3.3 EXTERIOR INSTALLATION - PARKING SIGNS

- A. Mount posts in 12-inch round by 2'-6" deep concrete footing.
- B. Handicapped Signs: Mount signs at height to comply with accessibility codes.

3.4 COORDINATION

- A. Coordinate the installation of the identifying devices with the hardware manufacturer for lockset and knob leave outs as detailed and scheduled.

3.5 DAMAGE

- A. Any identifying device which is scratched or defaced will be rejected.

3.6 CLEANING

- A. Remove protective materials and clean all signs. Clean surfaces with plain water or water with soap or household detergent.

END OF SECTION

SECTION 10 14 16

PLAQUES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes metal plaques.

1.2 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For plaques.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show plaque mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each plaque at least half size.
- C. Samples for Initial Selection: For each type of plaque, exposed component, and exposed finish.
 - 1. Include representative Samples of available typestyles and graphic symbols.
- D. Product Schedule: For plaques. Use same designations indicated on Drawings or specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For plaques to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of plaques that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design," the ABA standards of the Federal agency having jurisdiction, and Texas Accessibility Standards (TAS).

2.2 PLAQUES

- A. Cast Plaque: Cast-metal plaque with background texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. A.R.K. Ramos.
 - b. Metal Arts.
 - c. Southwell Company (The).
 2. Plaque Material: Cast aluminum.
 3. Plaque Thickness: 0.75 inch.
 4. Finishes: As selected by Architect from full range of colors.
 5. Background Texture: As selected by Architect from manufacturer's full range.
 6. Integrally Cast Border Style: As indicated on Drawings.
 7. Applied Frame Material, Style, and Finish: As indicated on Drawings.
 8. Mounting: Concealed studs.
 9. Text and Typeface: Typeface as selected by Architect from manufacturer's full range.
 10. Mounting shall be by lag bolts into solid wood block in metal stud wall.
 11. Owner shall provide graphics, and layout and copy requirements for each sign. Fabricator is responsible to convert any non-vector graphics provided by Owner to vector graphic images as may be required. Architect and Construction Manager will provide image files of their respective logos in appropriate resolution as may be required for incorporation into plaques.
 12. Fabricator shall translate general information and design information from Castleberry ISD into proofs and submit for approval.
 13. Architect and Owner shall approve final color image proof prior to casting.

2.3 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M, alloy and temper recommended by plaque manufacturer for casting process used and for type of use and finish indicated.
- B. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of plaques, noncorrosive and compatible with each material joined, and complying with the following:
1. Use concealed fasteners and anchors unless indicated to be exposed.
 2. Plaque Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of plaque, screwed into back of plaque, or screwed into tapped lugs cast integrally into back of plaque unless otherwise indicated.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2.5 FABRICATION

- A. General: Provide manufacturer's standard plaques according to requirements indicated.
1. Preassemble plaques in the shop to greatest extent possible. Disassemble plaques only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 5. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match plaque finish.

6. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.
 - B. Surface-Engraved Graphics: Machine-engrave characters and other graphic devices into indicated plaque surface to produce precisely formed copy, incised to uniform depth.
 1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.
- 2.6 GENERAL FINISH REQUIREMENTS
- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
 - B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
 - C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.
 - D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.
- 2.7 ALUMINUM FINISHES
- A. As selected by Architect:
 1. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.
 2. Color Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.
 3. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Verify that plaque-support surfaces are within tolerances to accommodate plaques without gaps or irregularities between backs of plaques and support surfaces unless otherwise indicated.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install plaques using mounting methods indicated and according to manufacturer's written instructions.
 1. Install plaques level, plumb, true to line, and at locations and heights indicated, with plaque surfaces free of distortion and other defects in appearance.
 2. Install plaques so they do not protrude or obstruct according to the accessibility standard.
 3. Before installation, verify that plaque surfaces are clean and free of materials or debris that would impair installation.
 4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:
 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of plaque. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place plaque in position and push until flush to surface, embedding studs in holes. Temporarily support plaque in position until adhesive fully sets.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed plaques and plaques that do not comply with specified requirements. Replace plaques with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

- B. Remove temporary protective coverings and strippable films as plaques are installed.
- C. On completion of installation, clean exposed surfaces of plaques according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain plaques in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

SECTION 10 14 19

DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Illuminated, fabricated channel dimensional characters and backlit signs.

1.2 DEFINITIONS

- A. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

1.3 COORDINATION

- A. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.
 - 4. Show locations of electrical service connections.
 - 5. Include diagrams for power, signal, and control wiring.
- C. Product Schedule: For dimensional letter signs. Use same designations indicated on Drawings or specified.
- D. Delegated-Design Submittal: For signs indicated in "Performance Requirements" Article.
 - 1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer of products.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design sign structure and anchorage of dimensional character sign type(s) according to structural performance requirements.
- B. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.
 - 1. Uniform Wind Load: As indicated on Drawings.
 - 2. Concentrated Horizontal Load: As indicated on Drawings.
 - 3. Other Design Load: As indicated on Drawings
 - 4. Uniform and concentrated loads need not be assumed to act concurrently.
- C. Thermal Movements: For exterior fabricated channel dimensional characters, allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 DIMENSIONAL SIGN LETTERS AND BACKLIT SIGNS

- A. Fabricated Exterior Aluminum Sign Letters: Fabricated aluminum metal face and side returns, formed free from warp and distortion; with uniform faces, sharp corners, and precisely formed lines and profiles; internally braced for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners; and as follows.
 - 1. All sign letters shall be by a single manufacturer or fabricator and shall match in font, color, finish, and other visual characteristics, unless otherwise indicated. Letters and mounting shall be designed by manufacturer to withstand design loads. LED backlit where indicated.
 - 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. A.R.K. Ramos.
 - b. ASI Sign Systems, Inc.
 - c. Gemini Incorporated.
 - d. Southwell Company (The).
 - 3. Illuminated Characters: Backlighting character construction with LED lighting, including transformers, insulators, and other accessories for operability, with provision for servicing and concealing connections to building electrical system. Use tight or sealed joint construction to prevent unintentional light leakage. Space lamps apart from each other and away from character surfaces as needed to illuminate evenly.
 - a. Power: As indicated on electrical Drawings.
 - b. Weeps: Provide weep holes to drain water at lowest part of exterior characters. Equip weeps with permanent baffles to block light leakage without inhibiting drainage.
 - c. LED Color: White.
 - 4. Character Material: Plate aluminum.
 - 5. Character Height: As indicated on Drawings.
 - 6. Character Depth: 1-inch deep at letters without backlighting; 2 inches deep at backlit letters/characters that are less than 18 inches high; 3 inches deep at signs over 18 inches tall.
 - 7. Finishes:
 - a. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.
 - 8. Mounting: Concealed, painted aluminum back bar or bracket assembly.
 - a. Hold characters at manufacturer's recommended distance from wall surface.
 - 9. Typeface: As indicated.
- B. Backlit Lion Logo Sign:
 - 1. Backlit fabricated aluminum sign with 3-inch edge returns, including cut-out openings in the field of the sign. The School District will provide a non-vector-image format of the logo design as a guideline for signage contractor to confirm an exact design with Architect through submittal reviews.

2. Signage contractor is responsible to develop vector graphics as required. Any seams in aluminum fabricated so they are not visible in the completed work.
 - a. Material: Aluminum.
 - b. Finish: Painted, automotive grade Matthews Paint or equal, graphics including up to five colors as selected by Architect to best match School Logo colors.
 - c. Depth of Returns: 3 inches.
 - d. Size: As indicated on Drawings.
 - e. Mounting: Stainless steel pin / project mounting in front of masonry wall, with 2-inch projection from face of wall.
 - f. LED Color: White.

2.3 DIMENSIONAL CHARACTER MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.
- B. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
 1. Use concealed fasteners and anchors unless indicated to be exposed.
 2. For exterior exposure, furnish hot-dip galvanized devices unless otherwise indicated.
 3. Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 5. Internally brace dimensional characters for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
 6. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
 7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.
- B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
 1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match sign-background color unless otherwise indicated.

2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.
- D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Verify that electrical service is correctly sized and located to accommodate signs.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
 - 3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:
 - 1. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position, so that signage is correctly located and aligned.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

SECTION 10 14 23.16

ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes room-identification signs that are directly attached to the building.

1.2 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.3 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.
- B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For room-identification signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- C. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Variable Component Materials: 12 replaceable text inserts and interchangeable characters (letters, numbers, and graphic elements) of each type.
 - 2. Tools: One set(s) of specialty tools for assembling signs and replacing variable sign components.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer of products.

1.9 FIELD CONDITIONS

- A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design," the ABA standards of the Federal agency having jurisdiction, and Texas Accessibility Standards (TAS).

2.2 ROOM-IDENTIFICATION SIGNS

- A. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASI Sign Systems, Inc.
 - b. Bayuk Graphic Systems, Inc.
 - c. Best Sign Systems, Inc.
 - d. InPro Corporation (IPC).
 - e. Mohawk Sign Systems.
 - f. MULTI-graphics, Inc.
 - g. National Signage Affiliates.
 - h. Nelson-Harkins Industries.
 - i. Poblocki Sign Company, LLC.
 - j. Vomar Products, Inc.
 - 2. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated to acrylic backing sheet to produce composite sheet.
 - a. Composite-Sheet Thickness: As indicated on Drawings.
 - b. Color(s): As selected by Architect from manufacturer's full range.
 - 3. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition: As indicated on Drawings.
 - b. Corner Condition in Elevation: As indicated on Drawings.
 - 4. Frame: Entire perimeter.
 - a. Material: Aluminum.
 - b. Material Thickness: As indicated on Drawings.
 - c. Frame Depth: As indicated on Drawings.
 - d. Profile: As indicated on Drawings.
 - e. Corner Condition in Elevation: As indicated on Drawings.
 - f. Finish and Color: As selected by Architect from manufacturer's full range.
 - 5. Mounting: Manufacturer's standard method for substrates indicated .
 - 6. Text and Typeface: typeface as selected by Architect from manufacturer's full range.

2.3 SIGN MATERIALS

- A. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- B. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
 - 2. For exterior exposure, furnish nonferrous-metal devices unless otherwise indicated.

- B. Adhesive: As recommended by sign manufacturer.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Accessibility: Install signs in locations on walls as indicated on Drawings and according to the accessibility standard.
- C. Mounting Methods:
 - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
 - 2. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
 - 3. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

3.2 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.

- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

SECTION 10 14 24

STORM SHELTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Signage for Storm Shelters.

1.2 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.
- B. Shop Drawings: Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, accessories, layout, and installation details.

1.3 QUALITY ASSURANCE

- A. Single-Source Responsibility: For each separate type of sign required, obtain signs from one source from a single manufacturer.
- B. Manufacturer shall have a minimum of five years' experience in the manufacturing of signs specified.
- C. Codes and Standards:
 - 1. Panel signs shall have 1/32-inch raised copy and grade 2 Braille, and shall comply with all existing federal, state, and local accessibility standards.
 - 2. Code and Standards: Comply with American with Disabilities Act of 1990, Title 3 Provisions, Public Accommodations and Commercial Facilities.
 - 3. Comply with the State of Texas Accessibility Act as administered by the Texas Department of Licensing and Regulation.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in factory packages with factory labels attached.
- B. Cover and protect material in transit and at job site. Damaged or defaced material will be rejected and shall be replaced at no cost to the Owner.

PART 2 - PRODUCTS

2.1 STORM SHELTER SIGNAGE

- A. Provide signs where indicated on Drawings.
- B. Text: Include name of building of storm shelter, identification as a Tornado Shelter, design wind speeds.
 - 1. Comply with ICC A117.1.
- C. Materials and Fabrication: Refer to Drawings and Section 10 14 00 "Signage".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and conditions are ready to receive work of this Section.
- B. Correct existing conditions which will adversely affect installation.

3.2 PREPARATION

- A. Prepare substrate surfaces as recommended by sign manufacturer.

3.3 INSTALLATION

- A. Install signs plumb, level and square and in proper planes with other work, at heights required by Accessibility codes and standards.
 - 1. Mount on public side of in locations indicated.
- B. Attachment: Mounting to surfaces shall be done by pressure sensitive frame double faced tape, unless otherwise indicated. Signs shall be delivered to the project site with the tape in place and trimmed on each sign, but with the protective paper layer not removed. Paper layer shall be removed just prior to installation of signs.

3.4 CLEANING AND PROTECTION

- A. At completion of installation, remove protective coatings and clean sign surfaces in accordance with sign manufacturer's instructions. Protect units from damage until date of Substantial Completion.
- B. Any identifying device which is scratched or defaced shall be replaced at no cost to the Owner.
- C. Clean up all debris caused by the work of this Section, keeping the premises clean and neat at all times.

END OF SECTION

SECTION 10 14 27

MARQUEE PYLON SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Internally illuminated pylon signs, electronic, integrated display.

1.2 COORDINATION

- A. Furnish templates and tolerance information for placement of sign-anchorage devices embedded in permanent construction by other installers.
- B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For signage.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.
 - 4. Show locations of electrical service connections.
 - 5. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
 - 1. Include representative Samples of available typestyles and graphic symbols.
- D. Samples for Verification: For each type of sign assembly, showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Pylon Signs: Not less than 12 inches (300 mm) square, including corner.
 - 2. Variable Component Materials: 8-inch (200-mm) Sample of each base material, character or graphic element, in each exposed color and finish not included in other Samples.
 - 3. Exposed Accessories: Half-size Sample of each accessory type.
- E. Delegated-Design Submittal: For signs indicated in "Performance Requirements" Article.
 - 1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design sign structure and anchorage of pylon sign type(s) according to structural performance requirements.
- B. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.
 - 1. Uniform Wind Load: As indicated on Drawings.
 - 2. Concentrated Horizontal Load: As indicated on Drawings.
 - 3. Other Design Load: As indicated on Drawings.
 - 4. Uniform and concentrated loads need not be assumed to act concurrently.
- C. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 PYLON SIGNS

- A. Pylon Sign: Sign with smooth, uniform surfaces and support assembly; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. ACE Sign Systems, Inc.
 - b. A-ERO TEC Graphics.
 - c. ASI Sign Systems, Inc.
 - d. Daktronics.
 - 2. Solid-Sheet Sign Panels and Returns: Aluminum frame with acrylic sheet with finish specified in "Sign-Panel-Face Finish and Applied Graphics" Subparagraph and as follows:
 - a. Thickness: 0.060 inch (1.52 mm).
 - b. Surface-Applied Graphics: Applied vinyl film.
 - c. Cabinet Hinges: Manufacturer's standard.
 - d. Locks: Manufacturer's standard barrel locks. Provide minimum two per face.
 - 3. Multiple-Message Bars and Inserts: Fixed message bars capable of receiving changeable messages in the form of slide-in, acrylic-sheet changeable inserts.
 - a. Provide minimum 300 letters, including English and Spanish characters with storage box.
 - 4. Pylon Structure: Internal frame.
 - a. Pylon Shape: Rectangular.
 - b. External-Frame Finish and Color: As selected by Architect from manufacturer's full range.
 - 5. Sign-Panel-Face Finish and Applied Graphics:
 - a. Integral Metal Finish: As selected by Architect from full range of industry finishes.
 - b. Integral Acrylic Sheet Color: As selected by Architect from full range of industry colors.

2.3 MATERIALS

- A. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

- D. Polycarbonate Sheet: ASTM C 1349, Appendix X1, Type II (coated, mar-resistant, UV-stabilized polycarbonate), with coating on both sides.
- E. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following unless otherwise indicated:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
 - 2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
 - 3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
 - b. Fastener Heads: For nonstructural connections, use flathead screws and bolts with tamper-resistant, Allen-head slots unless otherwise indicated.
 - 4. Inserts: Furnish inserts to be set by other installers into concrete or masonry work.
- B. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.
 - 1. Uses: Securing signs with imposed loads to structure.
 - 2. Type: Torque-controlled, expansion anchor.
 - 3. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).
- C. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- E. Anchoring Materials:
 - 1. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
 - 2. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - a. Water-Resistant Product: At exterior locations, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Preassemble signs in the shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in locations concealed from view after final assembly.
 - 2. Mill joints to tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed joints of flux, and dress exposed and contact surfaces.
 - 4. Conceal fasteners and anchors unless indicated to be exposed; locate exposed fasteners where they will be inconspicuous.
 - 5. Internally brace signs for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.

- B. Sign Message Panels: Construct sign-panel surfaces to be smooth and to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch (1.5 mm) measured diagonally from corner to corner.
 - 1. Coordinate dimensions and attachment methods to produce message panels with closely fitting joints. Align edges and surfaces with one another in the relationship indicated.
 - 2. Increase panel thickness or reinforce with concealed stiffeners or backing materials as needed to produce surfaces without distortion, buckles, warp, or other surface deformations.
 - 3. Continuously weld joints and seams unless other methods are indicated; grind, fill, and dress welds to produce smooth, flush, exposed surfaces with welds invisible after final finishing.
- C. Pylon Fabrication: Fabricate pylon signs with integral base consisting of channels, angles, plates, or other fittings. Design and fabricate pylon and anchorage for structural performance indicated. Detail anchorage so that water can drain out of assembly without obstruction. Drill holes in members for anchor-bolt connection. Provide anchor bolts of size required for connecting base to concrete foundations.
 - 1. Internal Frames: Manufacturer's standard internal steel framing system and anchorage, modified as required for Project requirements. Provide welded construction. Cut, drill, and tap units to receive hardware, bolts, and similar items.
 - a. Hot-dip galvanize steel framing system after fabrication according to ASTM A 123/A 123M.

2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.
- D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs.
- C. Verify that anchorage devices embedded in permanent construction are correctly sized and located to accommodate signs.
- D. Verify that electrical service is correctly sized and located to accommodate signs.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install signs using installation methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify that sign components are clean and free of materials or debris that would impair installation.
 - 4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.3 INSTALLING PYLONS

- A. Vertical Tolerance: Install pylons plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
- B. Attachment with Preset Anchor Bolts: Set pylon base in position over anchor bolts projecting from concrete foundation, shim and support pylon to prevent movement, place washers and nuts, and tighten. Fill shim space with nonshrink, nonmetallic grout, mixed and placed to comply with manufacturer's written instructions.
- C. Attachment with Drilled-in-Place Anchor Bolts: Set pylon base in position over concrete foundation, locate and drill anchor holes, shim and support pylon to prevent movement, place washers and anchor bolts, and tighten. Fill shim space with nonshrink, nonmetallic grout, mixed and placed to comply with manufacturer's written instructions.

3.4 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

SECTION 10 21 13.19

PLASTIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid-plastic toilet compartments configured as toilet enclosures and urinal screens.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.
- B. Shop Drawings: For toilet compartments.
 - 1. Include plans, elevations, sections, details, and attachment details.
 - 2. Show locations of cutouts for compartment-mounted toilet accessories.
 - 3. Show locations of centerlines of toilet fixtures.
 - 4. Show locations of floor drains.
- C. Samples for Initial Selection: For each type of toilet compartment material indicated.
 - 1. Include Samples of hardware and accessories involving material and color selection.
- D. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of toilet compartment.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents and source.
 - 1. Door Hinges: One hinge(s) with associated fasteners.
 - 2. Latch and Keeper: One latch(es) and keeper(s) with associated fasteners.
 - 3. Door Bumper: One bumper(s) with associated fasteners.
 - 4. Door Pull: One door pull(s) with associated fasteners.
 - 5. Fasteners: Ten fasteners of each size and type.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and Texas Accessibility Standards (TAS) for toilet compartments designated as accessible.

2.2 SOLID-PLASTIC TOILET COMPARTMENTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Bradley Corporation; Mills Partitions.
 - 2. General Partitions Mfg. Corp.
 - 3. Global Steel Products Corp.
 - 4. Hadrian Manufacturing Inc.
 - 5. Scranton Products.
- B. Basis-of-Design Product: Scranton Products; Hiny Hiders, Eclipse Partitions.
- C. Toilet-Enclosure Style: Floor anchored, overhead braced.
- D. Urinal-Screen Style: Wall hung.
- E. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch (25 mm) thick, seamless, with eased edges, no-sightline system, and with homogenous color and pattern throughout thickness of material.
 - 1. Height: 55 inches.
 - 2. Heat-Sink Strip: Manufacturer's standard continuous, stainless-steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
 - 3. Color and Pattern: One color and pattern in each room as selected by Architect from manufacturer's full range.
- F. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; stainless steel.
- G. Brackets (Fittings):
 - 1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

2.3 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.
 - 1. Hinges: Manufacturer's minimum 0.062-inch- (1.59-mm-) thick stainless-steel- continuous, cam type that swings to a closed or partially open position-, allowing emergency access by lifting door. Mount with through-bolts.
 - 2. Latch and Keeper: Manufacturer's heavy-duty surface-mounted cast-stainless-steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.
 - 3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless-steel hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through-bolts.
 - 4. Door Bumper: Manufacturer's heavy-duty rubber-tipped cast-stainless-steel bumper at out-swinging doors-. Mount with through-bolts.
 - 5. Door Pull: Manufacturer's heavy-duty cast-stainless-steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.
 - 6. Occupancy Indicator: Provide manufacturer's standard occupancy indicator.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 MATERIALS

- A. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- B. Stainless-Steel Castings: ASTM A 743/A 743M.

2.5 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- D. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
 - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch (13 mm).
 - b. Panels and Walls: 1 inch (25 mm).
 - 2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
 - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches (51 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.
- D. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION

SECTION 10 21 23

CUBICLE CURTAINS AND TRACK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cubicle-curtain tracks and carriers.
 - 2. Cubicle curtains.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For each type of curtain fabric indicated, include durability, laundry temperature limits, fade resistance, applied curtain treatments, and fire-test-response characteristics.
- B. Shop Drawings: For curtains and tracks.
 - 1. Show layout and types of cubicles, sizes of curtains, number of carriers, anchorage details, and conditions requiring accessories. Indicate dimensions taken from field measurements.
 - 2. Include details of blocking for track support.
- C. Samples for Initial Selection: For each type of curtain material indicated.
- D. Product Schedule: For curtains and tracks. Use same designations indicated on Drawings.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For curtains, tracks, and hardware to include in operation and maintenance manuals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Curtain Carriers and Track End Caps: Full-size units equal to 3 percent of amount installed for each size indicated, but no fewer than 10 units.
 - 2. Curtains: Full-size units equal to 10 percent of amount installed for each size indicated, but no fewer than two units.

1.5 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockup of typical cubicle as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Cubicle Curtains: Provide curtain fabrics with the following characteristics:
 - 1. Laundering: Launderable to a water temperature of not less than 160 deg F (71 deg C).
 - 2. Flame Resistance: Provide fabrics identical to those that have passed NFPA 701 when tested by a qualified testing agency acceptable to authorities having jurisdiction.
 - a. Identify fabrics with appropriate markings of a qualified testing agency.

2.2 CUBICLE-CURTAIN SUPPORT SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. A. R. Nelson Co.
 - 2. Construction Specialties, Inc.
 - 3. Imperial Fastener Company, Inc.
- B. Extruded-Aluminum Curtain Track: Not less than 1-1/4 inches wide by 3/4 inch high (32 mm wide by 19 mm high).
 - 1. Track Minimum Wall Thickness: 0.050 inch (1.27 mm).
 - 2. Curved Track: Factory-fabricated, 12-inch- (305-mm-) radius bends.
 - 3. Finish: Clear anodized.
- C. Curtain Track Accessories: Fabricate splices, end caps, connectors, end stops, coupling and joining sleeves, wall flanges, brackets, ceiling clips, and other accessories from same material and with same finish as track.
 - 1. End Stop: Removable with carrier hook.
 - 2. Switch Unit: Shuttle and coupling device for rerouting and securing cubicle curtain, with pull chain for switching track.
- D. Curtain Roller Carriers: Two nylon rollers and nylon axle with chrome-plated steel hook.
- E. Exposed Fasteners: Stainless steel.
- F. Concealed Fasteners: Stainless steel.

2.3 CURTAINS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. A. R. Nelson Co.
 - 2. Construction Specialties, Inc.
 - 3. Imperial Fastener Company, Inc.
 - 4. Maharam.
- B. Basis-of-Design Product: As scheduled.
- C. Fabric: Curtain manufacturer's standard, 100 percent polyester; inherently and permanently flame resistant, stain resistant, and antimicrobial.
 - 1. Proprietary Fiber: Polyester.
 - 2. Pattern and Color: As scheduled.
- D. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than 6 inches (152 mm) o.c.; machined into top hem.
- E. Mesh Top: Not less than 20-inch- (508-mm-) high mesh top.
 - 1. Mesh: No. 50 nylon mesh.
- F. Curtain Tieback: Nickel-plated brass chain; one at each curtain termination.

2.4 CURTAIN FABRICATION

- A. Continuous Curtain Panels:
 - 1. Width: Equal to track length from which curtain is hung plus 10 percent of added fullness, but not less than 12 inches (305 mm) of added fullness.
 - 2. Length: Equal to floor-to-ceiling height, minus depth of track and carrier at top, and minus clearance above the finished floor of 12 inches (305 mm).
 - 3. Mesh Top: Top hem of mesh not less than 1 inch (25.4 mm) and not more than 1-1/2 inches (38 mm) wide, triple thickness, reinforced with integral web, and double lockstitched. Double lockstitch bottom of mesh directly to 1/2-inch (13-mm) triple thickness, top hem of curtain fabric.
 - 4. Bottom Hem: Not less than 1 inch (25.4 mm) and not more than 1-1/2 inches (38 mm) wide, double thickness and double lockstitched.
 - 5. Side Hems: Not less than 1/2 inch (13 mm) and not more than 1-1/4 inches (32 mm) wide, with double turned edges, and single lockstitched.
 - 6. Vertical Seams: Not less than 1/2 inch (13 mm) wide, double turned and double stitched.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install tracks level and plumb, according to manufacturer's written instructions.
- B. For tracks of up to 20 feet (6.0 m) in length, provide track fabricated from single, continuous length.
 - 1. Curtain-Track Mounting: Surface.
- C. Surface-Track Mounting: Fasten tracks to ceilings at intervals recommended by manufacturer. Fasten tracks to structure at each splice and tangent point of each corner. Center fasteners in track to ensure unencumbered carrier operation. Attach track to ceiling as follows:
 - 1. Mechanically fasten directly to finished ceiling with toggle bolts.
 - 2. Mechanically fasten to furring through suspended ceiling with screw and tube spacer.
 - 3. Mechanically fasten to suspended ceiling grid with screws.
- D. Track Accessories: Install splices, end caps, connectors, end stops, coupling and joining sleeves, and other accessories as required for a secure and operational installation.
 - 1. Provide one locking switch unit for each pair of beds.
- E. Curtain Carriers: Provide curtain carriers adequate for 6-inch (152-mm) spacing along full length of curtain plus an additional carrier.

END OF SECTION

SECTION 10 26 00

WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Corner guards.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For each type of wall and door protection showing locations and extent.
 - 1. Include plans, elevations, sections, and attachment details.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of handrail.
- B. Material Certificates: For each type of exposed plastic material.
- C. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.
 - 1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of cover installed, but no fewer than two, 48-inch- (1200-mm-) long units.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 - 1. Maintain room temperature within storage area at not less than 70 deg F (21 deg C) during the period plastic materials are stored.
 - 2. Keep plastic materials out of direct sunlight.
 - 3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F (21 deg C).
 - a. Store corner-guard covers in a vertical position.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
 - b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall- and door-protection products of each type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and Texas Accessibility Standards (TAS).

2.3 CORNER GUARDS

- A. Flush-Mounted, Vinyl-Cover Corner Guards: Manufacturer's standard assembly consisting of snap-on, resilient vinyl cover installed over retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Babcock-Davis.
 - b. Balco, Inc.
 - c. Construction Specialties, Inc.
 - d. Inpro Corporation.
 - e. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - 2. Basis-of-Design Products:
 - a. Inpro Corporation; 130F.
 - b. Inpro Corporation; 160F.
 - 3. Cover: Vinyl; in dimensions and profiles indicated on Drawings.
 - a. Color and Texture: As selected by Architect from manufacturer's full range.
 - 4. Continuous Retainer: Minimum 0.060-inch- (1.5-mm-) thick, one-piece, extruded aluminum.
- B. Flush-Mounted, Plastic-Cover Corner Guards: Manufacturer's standard assembly consisting of snap-on, resilient plastic cover, PVC-free, installed over retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Babcock-Davis.
 - b. Balco, Inc.
 - c. Construction Specialties, Inc.
 - d. Inpro Corporation.
 - e. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - 2. Basis-of-Design Product: Inpro Corporation; EnviroGT G2-150F.
 - 3. Cover: Extruded rigid plastic, minimum 0.078-inch (2.0-mm) wall thickness; in dimensions and profiles indicated on Drawings.
 - a. Color and Texture: As selected by Architect from manufacturer's full range.
 - 4. Continuous Retainer: Minimum 0.060-inch- (1.5-mm-) thick, one-piece, extruded aluminum.

2.4 MATERIALS

- A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.
- B. Adhesive: As recommended by protection product manufacturer.

2.5 FABRICATION

- A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.
- B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

- C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.6 FINISHES

- A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
 - 1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.
- C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
 - 1. Provide anchoring devices and suitable locations to withstand imposed loads.
 - 2. Adjust end and top caps as required to ensure tight seams.

3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION

SECTION 10 28 00

TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Accessories for toilet rooms, showers, and utility rooms.
- B. Electric hand dryers.
- C. Grab bars.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

1.3 SUBMITTALS

- A. See Section 01 33 00 "Submittal Procedures," for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.
- D. Provide a schedule of locations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Toilet Accessories:
 - 1. AJW: ajw.com.
 - 2. ASI.
 - 3. Bobrick Washroom Equipment.
 - 4. Bradley Corporation.
 - 5. Gamco.
- B. Electric Hand/Hair Dryers:
 - 1. Dyson.
 - 2. World Dryer Corporation.
- C. All items of each type to be made by the same manufacturer.

2.2 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
 - 1. Grind welded joints smooth.
 - 2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.
 - 3. All operating features shall be able to be operated with 5 lbs. of force or less to comply with accessibility requirements.
- B. Keys: Provide 2 keys for each accessory to Owner; master key lockable accessories.
- C. Stainless Steel Sheet: ASTM A666, Type 304.
- D. Stainless Steel Tubing: ASTM A269/A269M, Type 304 or 316.
- E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- F. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- G. Adhesive: Two component epoxy type, waterproof.

- H. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
- I. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.3 FINISHES

- A. Stainless Steel: No. 4 Brushed finish, unless otherwise noted.
- B. Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats epoxy baked enamel.
- C. Galvanizing for Items Other than Sheet: Comply with ASTM A123/A123M; galvanize ferrous metal and fastening devices.
- D. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.
- E. Back paint components where contact is made with building finishes to prevent electrolysis.

2.4 TOILET ROOM ACCESSORIES

- A. Toilet Paper Dispenser: Owner-Furnished, Contractor-Installed.
- B. Paper Towel Dispenser: Owner-Furnished, Contractor-Installed.
- C. Soap Dispenser: Owner-Furnished, Contractor-Installed.
- D. Combination Sanitary Napkin/Tampon Dispenser: Owner-Furnished, Contractor-Installed.
- E. Electric Hand Dryers: Traditional fan-in-case type, with downward nozzle.
 - 1. Operation: Automatic, sensor-operated on and off.
 - 2. Style: Traditional horizontal, rectangular case, fixed nozzle.
 - 3. Mounting: Semi-recessed.
 - 4. Cover: White plastic.
 - a. Tamper-resistant screw attachment of cover to mounting plate.
 - 5. Warranty: 3 years.
- F. Mirrors: Stainless steel framed, 1/4-inch thick annealed float glass; ASTM C1036.
 - 1. Size: Per Drawings.
 - 2. Frame: 0.05-inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; No.4 finish.
 - 3. Backing: Full mirror sized, minimum 0.03-inch galvanized steel sheet and non-absorptive filler material.
 - 4. Product: Series 165 manufactured by Bobrick.
- G. Accessible Mirrors: Stainless steel framed, 1/4-inch thick annealed float glass; ASTM C1036.
 - 1. Size: Per Drawings.
 - 2. Frame: 0.05-inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; No.4 finish.
 - 3. Backing: Full mirror sized, minimum 0.03-inch galvanized steel sheet and non-absorptive filler material.
- H. Grab Bars: Stainless steel, nonslip grasping surface finish.
 - 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force, minimum.
 - b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, concealed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
 - c. Length: 36 and 42 inches.
 - d. Length and Configuration: As indicated on drawings.
 - e. Products: B-6806 manufactured by Bobrick.
- A. Waste Receptacle: Stainless steel, No. 4 finish (satin).
 - 1. Mounting: Semirecessed.
 - 2. Minimum Capacity: 18 gal. (68 L).
 - 3. Liner: Reusable vinyl liner.
 - 4. Lockset: Tumbler type for waste receptacle.
 - 5. Product: Model #0458-DX manufactured by ASI.

- B. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.
 - 1. Product: B-254 manufactured by Bobrick.

2.5 SHOWER ACCESSORIES

- A. Shower Curtain Rod: Stainless steel tube, 1 inch outside diameter, 0.04 inch wall thickness, satin-finished, with 3 inch outside diameter, minimum 0.04 inch thick satin-finished stainless steel flanges, for installation with exposed fasteners.
 - 1. Product: B-6047 manufactured by Bobrick.
- B. Shower Curtain:
 - 1. Size: 42 x 72 inches, hemmed edges.
 - 2. Grommets: Stainless steel; pierced through top hem on 6 inch centers.
 - 3. Color: White.
 - 4. Shower curtain hooks: Chrome-plated or stainless steel spring wire designed for snap closure.
 - 5. Product: B-204.1 Or B-204.2 manufactured by Bobrick.
- C. Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, hinges and mechanical fasteners of Type 304 stainless steel, L-shaped, right hand and L-shaped, left hand seat.
 - 1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of color as selected.
 - 2. Size: ADA Standards compliant.
 - 3. Product: B-5181 manufactured by Bobrick.
- D. Robe Hook: Heavy-duty stainless steel, single-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.
 - 1. Product: B-6717 manufactured by Bobrick.
- E. Shower Grab Bars: Stainless steel, nonslip grasping surface finish.
 - 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force, minimum.
 - b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, concealed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
 - c. Length: 36 and 42 inches.
 - d. Length and Configuration: As indicated on drawings.
 - e. Products: B-6806 manufactured by Bobrick.

2.6 UTILITY ROOM ACCESSORIES

- A. Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, hat-shaped channel.
 - 1. Holders: 3 spring-loaded rubber cam holders; 9 at Kitchen custodial.
 - 2. Length: Manufacturer's standard length for number of holders.
 - 3. Product: B-223 manufactured by Bobrick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.
- D. Verify that field measurements are as indicated on drawings.
- E. See Section 06 10 53 "Miscellaneous Rough Carpentry" for installation of blocking, reinforcing plates, and concealed anchors in walls and ceilings.
- F. Confirm that rough openings are within the required heights for applicable code requirements for accessibility by persons with disabilities. Notify Architect of conflicts.
- G. Beginning of installation means acceptance of existing conditions.

3.2 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.

- B. Provide templates and rough-in measurements as required.

3.3 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on the drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
- D. Locate accessories in order that they do not interfere with door swings or use of fixtures. Install recessed accessories after wall finishes have been completed. Where wall type does not allow for fully recessed condition, submit semi-recessed models instead.
- E. Anchor accessories with bolts, plates, and approved type fasteners. Take down any loose items and repair damaged wall surfaces. Only use expansion shield type anchors in masonry construction. In all other wall constructions, attach to pre-fabricated or solid lumber back-up plates.
- F. Mounting Heights and Locations: As required by accessibility regulations and as indicated on drawings.

3.4 CLEANING

- A. Remove protective film from accessories immediately prior to final acceptance.
- B. Polish and clean all surfaces of the accessories.
- C. Replace any damaged items as directed by Architect.

END OF SECTION

SECTION 10 41 00

FIRE DEPARTMENT ACCESS LOCK AND VAULT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Miscellaneous specialty items as listed herein.

1.2 ACTION SUBMITTALS

- A. Product Data: Including all pertinent performance characteristics and criteria.
- B. Shop Drawings: Indicate materials, construction, sizes, quantities, finishes, and installation details.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Instructions: For installation, maintenance, and repair.

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. Fire Control Key Box: Provide fire department key control box complete with alarm tamper switch at location near main entrance to be determined.
 - 1. Acceptable Product: KnoxBox; 3200 Hinged Door, Recess Mount.
 - 2. Mounting Type: Recessed; provide recess mounting kit for new masonry construction.
 - 3. Finish: Black.
 - 4. 1/2-inch thick steel door with interior gasket seal and stainless steel door hinge.
- B. Gate and Key Switch:
 - 1. Acceptable Product: KnoxBox; 3500 Series Knox Gate & Key Switch, Single Gate & Key Switch on Mounting Plate.
 - a. Provide Fire identification labels.
 - 2. Dimensions: Requires 2-1/4 inches recessed depth by 3/4-inch diameter.
 - 3. Switch: SPDT or DPDT; 7 A resistive, 4 A inductive, key removable two position.
 - 4. Mounting: Recessed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and conditions are ready to receive work of this Section.
- B. Notify Architect of any existing conditions which will adversely affect execution.
- C. Beginning of execution will constitute acceptance of existing conditions.

3.2 PREPARATION

- A. Prepare substrate surfaces as recommended by manufacturer.

3.3 INSTALLATION

- A. Install using skilled workers in accordance with manufacturer's published instructions and recommendations.

3.4 ADJUSTING

- A. Adjust and fit items to be flush with adjacent construction.
- B. Fasten or adhere for tight connections and joints.

END OF SECTION

SECTION 10 43 13

EMERGENCY AID CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Automated external defibrillator (AED) cabinets and equipment.

1.2 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for AED cabinets.
 - 1. Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
 - 2. Show location of knockouts for conduit and wiring.
- B. Samples for Verification: For each type of exposed factory-applied color finish required for AED cabinets, prepared on Samples of size indicated below.
 - 1. Size: 6 by 6 inches square.
- C. Maintenance Data: For AED cabinets to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Fire-Rated AED Cabinets: Listed and labeled to comply with requirements of ASTM E 814 for fire-resistance rating of walls where they are installed.

1.4 COORDINATION

- A. Coordinate size of AED cabinets to ensure that type and size of defibrillators to be provided by the Authority are accommodated.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS), Type B.

2.2 AUTOMATED EXTERNAL DEFIBRILLATOR (AED) CABINET; OWNER-FURNISHED, CONTRACTOR-INSTALLED

- A. Basis-of-Design Product:
 - 1. The design for AED cabinets is based on AED 123, recessed.
 - 2. Subject to compliance with requirements, provide either the named product or a comparable product by another manufacturer including but not limited to the following:
 - a. Larsens.
 - b. Potter-Roemer.
- B. Cabinet Type: Suitable for automated external defibrillator.

2.3 AUTOMATED EXTERNAL DEFIBRILLATOR

- A. Provide on site automated external defibrillator unit.
 - 1. Basis-of-Design Product: Philips Heart Start OnSite AED Package
- B. Cabinet Construction: Non-rated and 2-hour fire rated, as required to match rating of wall in which cabinet is located.
- C. Cabinet Material: Enameled-steel sheet.
- D. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.
 - 1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend) of 1/4 to 5/16 inch.
- E. Cabinet Trim Material: Stainless-steel sheet.
- F. Door Material: Stainless-steel sheet.

- G. Door Style: Fully-glazed panel with frame.
- H. Door Glazing: Acrylic sheet.
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide projecting door pull and friction latch.
 - 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- J. Accessories:
 - 1. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
 - a. Identify each cabinet with the words "EMERGENCY DEFIBRILLATOR."
 - 1) Location: Applied to cabinet glazing.
 - 2) Application Process: Silk-screened, or decals with clear background.
 - 3) Lettering Color: Black.
 - 4) Orientation: Horizontal.
- K. Finishes:
 - 1. Manufacturer's standard baked-enamel paint for interior of cabinet.

2.4 FABRICATION

- A. AED Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 - 1. Weld joints and grind smooth.
 - 2. Construct fire-rated cabinets with double walls fabricated from 0.0428-inch-thick, cold-rolled steel sheet lined with minimum 5/8-inch-thick, fire-barrier material.
 - a. Provide factory-drilled mounting holes.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
 - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
 - 2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish cabinets after assembly.

2.6 STEEL FINISHES

- A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond using manufacturer's standard methods.
- B. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

2.7 STAINLESS-STEEL FINISHES

- A. General: Remove tool and die marks and stretch lines or blend into finish.
 - 1. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- B. Bright, Directional Polish: No. 4 finish.
- C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for cabinets to verify actual locations of piping connections before cabinet installation.
- B. Examine walls and partitions for suitable framing depth and blocking where cabinets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for AED cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. Install AED cabinets in locations and at mounting heights indicated on Drawings. Fasten cabinets to structure, square and plumb.

3.4 INSTALLATION OF FIRE-RATED CABINETS

- A. Install cabinet with not more than 1/16-inch tolerance between conduit OD and knockout OD. Center conduit within knockout.
- B. Seal through penetrations with firestopping sealant as specified in Division 07 Section "Penetration Firestopping."

3.5 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as cabinets are installed, unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by cabinet manufacturer.
- E. Replace cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 10 43 17

FIRST AID KITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. First aid kits.

1.2 ACTION SUBMITTALS

- A. Product Data: Including pertinent performance characteristics and criteria.

PART 2 - PRODUCTS

2.1 AVAILABLE SUPPLIERS

- A. Red Cross.

2.2 FIRST AID KITS

- A. Container: Durable metal cabinet.
 - 1. Hinge: Piano hinge.
 - 2. Latches: Manufacturer's standard.
- B. Supplies: Per 50 person occupancy.
 - 1. 1 Triangular sling/bandage, 40 by 40 by 56 inches
 - 2. 1 CPR face shield with 2 nitrile exam gloves
 - 3. 1 Red Cross first aid guide
 - 4. 25 Adhesive fabric bandages, 1 by 3 inches
 - 5. 10 Patch plastic bandages, 1-1/2 by 1-1/2 inches
 - 6. 25 Adhesive plastic bandages, 3/4 by 3 inches
 - 7. 10 Fingertip fabric bandages
 - 8. 1 Elastic bandage wrap with 2 fasteners, 2 inches by 5 yards
 - 9. 20 Alcohol cleansing pads
 - 10. 20 BZK antiseptic towelettes
 - 11. 10 Castile soap towelettes
 - 12. 10 Antiseptic hand sanitizer packs
 - 13. 2 First aid tape rolls, 1/2 inch by 5 yards per roll
 - 14. 1 Conforming gauze roll, 2 inches by 4 yards
 - 15. 1 Cold pack, 4 by 5 inches
 - 16. 4 Nitrile gloves
 - 17. 2 Sterile eye pads
 - 18. 1 oz eyewash
 - 19. 10 Moleskin (blister prevention), 2 by 2 inches
 - 20. 10 First aid/burn cream packs, 0.9 gm each
 - 21. 1 Burn gel dressing, 4 by 4 inches
 - 22. 10 Antibiotic ointment packs, 0.9 gm each
 - 23. 10 Sterile gauze pads, 3 by 3 inches
 - 24. 2 Trauma pads, 5 by 9 inches
 - 25. Scissors, 1 pair
 - 26. Stainless steel tweezers, 1 pair
- C. Total provisions: For occupancy load indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Store in an easily accessible location where directed by Owner.

END OF SECTION

SECTION 10 44 13

FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fire-protection cabinets for the following:
 - a. Portable fire extinguisher.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
- B. Shop Drawings: For fire-protection cabinets.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
- C. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.3 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - 2. Larsens Manufacturing Company.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

2.3 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
- B. Cabinet Construction: Nonrated and rated to match adjacent wall construction.
 - 1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch- (1.09-mm-) thick cold-rolled steel sheet lined with minimum 5/8-inch- (16-mm-) thick fire-barrier material. Provide factory-drilled mounting holes.
- C. Cabinet Material: Cold-rolled steel sheet.
- D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
 - 1. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.
- E. Cabinet Trim Material: Same material and finish as door.
- F. Door Material: Aluminum sheet.
- G. Door Style: Fully glazed panel with frame.

- H. Door Glazing: Acrylic sheet.
 - 1. Acrylic Sheet Color: Clear transparent acrylic sheet.
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide recessed door pull and friction latch.
 - 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- J. Accessories:
 - 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 - 2. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
 - 3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet door.
 - 2) Application Process: Pressure-sensitive vinyl letters.
 - 3) Lettering Color: Red.
 - 4) Orientation: Vertical.
- K. Materials:
 - 1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
 - a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
 - b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - c. Color: As selected by Architect from manufacturer's full range.
 - 2. Aluminum: ASTM B 221 (ASTM B 221M) for extruded shapes and aluminum sheet, with strength and durability characteristics of not less than Alloy 6063-T5 for aluminum sheet.
 - a. Finish: Clear anodic.
 - 3. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 3 mm thick, with Finish 1 (smooth or polished).

2.4 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 - 1. Weld joints and grind smooth.
 - 2. Miter corners and grind smooth.
 - 3. Provide factory-drilled mounting holes.
 - 4. Prepare doors and frames to receive locks.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
 - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
 - 2. Fabricate door frames of one-piece construction with edges flanged.
 - 3. Miter and weld perimeter door frames and grind smooth.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- C. Identification:
 - 1. Apply vinyl lettering at locations indicated.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 10 44 16
FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.5 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. JL Industries, Inc.
 - b. Larsen's Manufacturing Co.
 - 2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
 - 3. Valves: Manufacturer's standard.
 - 4. Handles and Levers: Manufacturer's standard.
 - 5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb (4.5-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
 - 1. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 - 1. Mounting Brackets: Top of fire extinguisher to be at height to meet requirements of authorities having jurisdiction.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION

SECTION 10 51 00
LOCKERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Metal lockers.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's published data on locker construction, sizes and accessories.
- B. Shop Drawings: Indicate locker plan layout, numbering plan, combination lock code, and details of fillers, trim, base and accessories.
- C. Samples: Submit two samples 12 by 12 inches in size, of each color scheduled.
- D. Manufacturer's Installation Instructions: Indicate component installation assembly.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect locker finish and adjacent surfaces from damage.
- B. Do not deliver products until building is enclosed and ready for locker installation.

1.4 EXTRA STOCK MATERIALS

- A. Provide one bottle of touch-up paint for each color used.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Metal Lockers:
 - 1. ASI Storage Solutions: www.asilockers.com
 - 2. Debourgh Manufacturing Company: www.debourgh.com
 - 3. General Storage Systems: www.generalstoragesystems.com
 - 4. List Industries: www.listindustries.com
 - 5. Lyon Workspace Products: www.lyonworkspace.com
 - 6. Penco Products, Inc: www.pencoproducts.com
 - 7. Republic Storage Systems Co: www.republicstorage.com
 - 8. WEC Manufacturing: www.itswec.com
 - 9. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Basis-of-Design Manufacturer: Penco Products, Inc.

2.2 LOCKER APPLICATIONS

- A. Type A:
 - 1. Size: As indicated on Drawings.
 - 2. Fittings: Hat shelf, 2 single prong coat hooks and rubber bumper per opening.
 - 3. Locking: Padlock hasps, for padlocks provided by Owner.
 - 4. Provide sloped top with closures.
- B. Type F
 - 1. Size: As indicated on Drawings.
 - 2. Locking: Padlock hasps for padlocks provided by Owner.
 - 3. Provide sloped top with closures.

2.3 METAL LOCKERS

- A. Lockers: Factory assembled, made of formed sheet steel, ASTM A653/A653M SS Grade 33/230, with G60/Z180 coating, stretcher leveled; metal edges finished smooth without burrs; baked enamel finished inside and out.
 - 1. Where ends or sides are exposed, provide flush panel closures.
 - 2. Color: To be selected by Architect; allow for contrasting colors for locker bodies and doors.

- B. Locker Body: Formed and flanged; with steel stiffener ribs.
 - 1. Body and Shelves: 24 gage (0.0239 inch).
 - 2. Base: 20 gage (0.036 inch).
 - 3. Metal Base Height: 4 inch.
- C. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
 - 1. Door Frame: 16 gage, 0.0598 inch, minimum.
 - 2. Provide ventilation slots in top and bottom of door frame.
- D. Doors: Hollow channel edge construction, 1-3/16 inch thick; welded construction, channel reinforced top and bottom with intermediate stiffener ribs, grind and finish edges smooth.
 - 1. Door Outer Face: 18 gage, 0.0478 inch, minimum.
 - 2. Form recess for operating handle and locking device.
 - 3. Handles: Stainless steel or zinc alloy.
 - 4. Provide ventilation slots in top and bottom of door.
- E. Hinges: Two for doors under 42 inches high; three for doors over 42 inches high; weld securely to locker body and door.
 - 1. Hinge Thickness: 13 gage, minimum.
 - 2. Hinges: 5 knuckle, with stainless steel pin.
- F. Sloped Top: 20 gage, 0.0359 inch, with closed ends.
- G. Trim: 20 gage, 0.0359 inch.
- H. Coat Hooks: Stainless steel or zinc-plated steel.
- I. Number Plates: Provide oval shaped brass plates. Form numbers 1 inch high of block font style with ADA designation, in contrasting color.
- J. Locking device supplied by Owner.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that prepared bases are in correct position and configuration.
- B. Verify bases and embedded anchors are properly sized.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install lockers plumb and square.
- C. Place and secure on prepared base.
- D. Space fastening 48" o.c. maximum and apply through backup reinforcing plates where necessary to prevent metal distortion. Conceal fasteners wherever possible.
- E. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 lb.
- F. Bolt adjoining locker units together to provide rigid installation.
- G. Install end panels, filler panels, sloped tops, miscellaneous panels, and close off all openings.
- H. Install accessories.
- I. Replace components that do not operate smoothly.
- J. Install benches in accordance with manufacturer's instructions.

3.3 CLEANING

- A. Clean locker interiors and exterior surfaces.

3.4 ADJUSTING

- A. Touch-up marred finishes.
- B. Use only materials and finishes recommended or furnished by locker manufacturer.
- C. Adjust doors and latches to operate easily without bind.

3.5 PROTECTION

- A. Protect lockers from damage and defacement until final acceptance.

END OF SECTION

SECTION 10 71 14

FIXED ALUMINUM SUNSHADES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sunshade.
 - 2. Reinforcing, shims, anchors, and attachment devices.
 - 3. Accessories necessary to complete Work.

1.2 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Manufacturer: Responsible for designing each system, including anchorage to structural system and necessary modifications to meet specified requirements and maintain visual design concepts.
 - 2. Provide aluminum decorative shade systems, including necessary modifications to meet specified requirements and maintaining visual design concepts.
 - 3. Perimeter Conditions: Allow for installation tolerances, expansion and contraction of adjacent materials, structural deflections, and sealant manufacturer's recommended joint design.
 - 4. Drawings: Diagrammatic and do not purport to identify nor solve problems of thermal or structural movement, or anchorage.
 - 5. Requirements Shown by Details: Establish basic dimension of unit, sight lines and profiles of members.
 - 6. Attachments: Account for site peculiarities and expansion and contraction movements so there is no possibility of loosening, weakening and fracturing connection between units and building structure or between units themselves.
 - 7. Anchors, Fasteners and Braces: Structurally stressed not more than 50 percent of allowable stress when maximum loads are applied.
 - 8. Allow for expansion and contraction due to structural movement without detriment to appearance or performance.
 - 9. Accommodate building structure deflections in connections to structure.
- B. Thermal Requirements: Accommodate expansion and contraction movement due to surface temperature differential of 180 degrees F without causing buckling, stress on structural elements, reduction of performance or other detrimental effects.

1.3 ACTION SUBMITTALS

- A. Product Data: Submit for each manufactured product in accordance with Section 01 33 00.
- B. Shop Drawings:
 - 1. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.
 - 2. Submit drawings indicating elevations, detailed design, dimensions, member profiles, joint locations, arrangement of units, member connections, and thickness of various components.
 - 3. Indicate:
 - 4. Details of special shapes.
 - 5. Reinforcing.
 - 6. Anchorage system.
 - 7. Interfacing with building construction.
 - 8. Provisions for expansion and contraction.
 - 9. Clearly indicate locations of exposed fasteners and joints for Architect's acceptance.
- C. Samples: Submit samples indicating quality of finish in required colors on alloys used for work, 12 inches long for extrusions and 6 inches square for sheet materials.

1.4 INFORMATIONAL SUBMITTALS

- A. Informational Submittals: Submit manufacturer's Instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with following:
1. Protect finished surfaces to prevent damage.
 2. Do not use adhesive papers or sprayed coatings which become firmly bonded when exposed to sun.
 3. Do not leave coating residue on surfaces.

1.6 WARRANTY

- A. Submit warranty stating fluorocarbon (PVDF) coating finish will be free from fading more than 10 percent, chalking, yellowing, peeling, cracking, pitting, corroding or non-uniformity of color, or gloss deterioration beyond manufacturer's descriptive standards for 20 years and agreeing to promptly correct defects.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers:
1. The AiroLite Company.
 2. Avadeck Walkway Cover Systems and Canopies.
 3. Blue Croc.
 4. Construction Specialties.
 5. East Texas Canopy.
 6. Enviro Metal Designs.
 7. InPro Fabrication, Sentenal Canopy System.
 8. VIVA Railings.
- B. Basis-of-Design Manufacturer: VIVA Railings.
- C. Acceptable Profile: Refer to Drawings.

2.2 FRAMING MATERIALS AND ACCESSORIES

- A. Aluminum:
1. ASTM B221, alloy 6063-T5 for extrusions; ASTM B209, alloy 5005-H16 for sheets; or other alloys and temper recommended by manufacturer appropriate for specified finish.
 2. Minimum thickness of 0.081 inch for framing members and 0.050 inch for applied stops and similar components.
- B. Inserts and Anchorage Devices:
1. Manufacturer's standard formed or fabricated assemblies, steel or aluminum, of shapes, plates, bars or tubes.
 2. Hot-dip galvanize steel assemblies after fabrication, comply with ASTM A123, 2.0 ounce minimum coating.
- C. Fasteners: Non-magnetic stainless steel or cadmium plated steel coated with yellow or silver iridescence plating, compatible with materials being fastened.
1. Exposed Locations: Series 300 stainless steel.
 2. Concealed Locations: Cadmium plated steel with 0.0005 inch plating thickness and color chromate coated.
 3. Provide nuts or washers of design having means to prevent disengagement; deforming of fastener threads is not acceptable.
 4. Provide concealed fasteners wherever possible.
 5. Exposed Locations: Countersunk flathead fasteners with finish matching item fastened.
- D. Expansion Anchor Devices: Drilled-in, expansion bolt anchors.
- E. Shims: Non-staining, non-ferrous, type as recommended by system manufacturer.
- F. Protective Coatings: Cold applied asphalt mastic, SSPC-Paint 12, compounded for 30 mil thickness for each coat; or alkyd type zinc chromate primer, FS TT-P-645.

2.3 FABRICATION

- A. Take accurate field measurements to verify required dimensions prior to fabrication.
1. Location of exposed joints is subject to Architect's acceptance.

2. Fabricate components in accordance with approved shop drawings. Remove burrs and ease edges. Shop fabricate to greatest extent practicable to minimize field cutting, splicing, and assembly. Disassemble only to extent necessary for shipping and handling limitations.
- B. Welding: Comply with recommendations of American Welding Society (AWS).
1. Performed by AWS qualified welders using recommended electrodes and methods to avoid distortion and discoloration.
 2. Grind exposed welds smooth and flush with adjacent surfaces before finishing; restore mechanical finish.
- 2.4 FINISH
- A. General: Comply with Aluminum Association's (AA) "Designation System for Aluminum Finishes" for finish designations and application recommendations.
- B. Aluminum: Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. Powder coated in colors as selected by Architect from manufacturer's full range of custom colors. Reference Drawings for colors scheduled.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and proceed with Work when substrates are ready.
1. Verify dimensions, tolerances, and method of attachment with other Work.

3.2 INSTALLATION

- A. Align assemblies plumb and level, free of warp or twist, aligning with adjacent Work.
- B. Tolerances: Tolerances are not accumulative.
1. Limit Variations from Plumb and Level:
 - a. 1/8 inch in 20 feet vertically and horizontally.
 - b. 1/4 inch in 40 feet either direction.
 2. Jog in Alignment: 1/16 inch maximum.
 3. Location: 1/4 inch maximum deviation of any member at any location.
- C. Provide attachments and shims to permanently fasten system to building structure.
1. Anchor securely in place, allowing for required movement, including expansion and contraction.
 2. Separate dissimilar materials at contact points, including metal in contact with masonry or concrete surfaces, with protective coating or preformed separators to prevent contact and electrolytic action.

3.3 CLEANING

- A. General: Clean surfaces in compliance with manufacturer's recommendations; remove excess mastic, mastic smears, and other foreign materials.

END OF SECTION

SECTION 10 75 16

GROUND-SET FLAGPOLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes ground-set flagpoles made from aluminum.
- B. Owner-Furnished Material: Flags.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.
- B. Shop Drawings: For flagpoles.
 - 1. Include plans, elevations, and attachment details. Show general arrangement, jointing, fittings, accessories, grounding, anchoring, and support.
 - 2. Include section, and details of foundation system.
- C. Samples for Verification: For each type of exposed finish, in manufacturer's standard sizes.
- D. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain flagpoles as complete units, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design flagpole assemblies.
- B. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand design loads indicated within limits and under conditions indicated.
 - 1. Wind Loads: Determine according to NAAMM FP 1001. Basic wind speed for Project location is 90.
 - 2. Base flagpole design on polyester flags of maximum standard size suitable for use with flagpole or flag size indicated, whichever is more stringent.

2.3 ALUMINUM FLAGPOLES

- A. Aluminum Flagpoles: Cone -tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B 241/B 241M, Alloy 6063, with a minimum wall thickness of 3/16 inch (4.8 mm).
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Acme/Lingo Flagpoles, LLC.
 - b. American Flagpole.
 - c. Baartol Company.
 - d. Concord Industries, Inc.
 - e. Eder Flag Manufacturing Company, Inc.
 - f. Ewing Flagpoles.

- g. Morgan-Francis Flagpoles and Accessories.
 - h. Pole-Tech Company Inc.
 - i. U.S. Flag & Flagpole Supply, LP.
 - B. Exposed Height: 30 feet (9 m).
 - C. Construct flagpoles in one piece if possible. If more than one piece is necessary, comply with the following:
 - 1. Fabricate shop and field joints without using fasteners, screw collars, or lead caulking.
 - 2. Provide flush hairline joints using self-aligning, snug-fitting, internal sleeves.
 - D. Metal Foundation Tube: Manufacturer's standard corrugated-steel foundation tube, 0.060-inch (1.52-mm) wall thickness with 3/16-inch (4.8-mm) steel bottom plate and support plate; 3/4-inch- (19-mm-) diameter, steel ground spike; and steel centering wedges welded together. Galvanize foundation tube after assembly. Furnish loose hardwood wedges at top of foundation tube for plumbing pole.
 - 1. Flashing Collar: Same material and finish as flagpole.
- 2.4 FITTINGS
- A. Finial Ball: Flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.
 - 1. 0.063-inch (1.6-mm) spun aluminum, finished to match flagpole.
 - B. Internal Halyard, Winch System: Manually operated winch with control stop device and removable handle, stainless-steel cable halyard, and concealed revolving truck assembly with plastic-coated counterweight and sling. Furnish flush access door secured with cylinder lock. Finish truck assembly to match flagpole.
 - 1. Halyard Flag Snaps: Chromium-plated bronze swivel snap hooks with neoprene or vinyl covers. Furnish two per halyard.
- 2.5 MISCELLANEOUS MATERIALS
- A. Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.
 - B. Sand: ASTM C 33/C 33M, fine aggregate.
 - C. Elastomeric Joint Sealant: Single-component neutral-curing silicone joint sealant complying with requirements in Section 07 92 00 "Joint Sealants."
 - D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- 2.6 ALUMINUM FINISHES
- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.
- B. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.
- C. Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure and brace forms to prevent displacement during concreting.
- D. Foundation Tube: Place foundation tube, center, and brace to prevent displacement during concreting. Place concrete. Plumb and level foundation tube and allow concrete to cure.
- E. Place concrete, as specified in Section 03 30 00 "Cast-in-Place Concrete."-- Compact concrete in place by using vibrators. Moist-cure exposed concrete for no fewer than seven days or use nonstaining curing compound.
- F. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

3.2 FLAGPOLE INSTALLATION

- A. General: Install flagpoles where indicated and according to Shop Drawings and manufacturer's written instructions.
- B. Foundation Tube: Place flagpole in tube, seated on bottom plate between steel centering wedges, and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch (50-mm) layer of elastomeric joint sealant and cover with flashing collar.

END OF SECTION

SECTION 11 30 13
RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Owner-Furnished, Owner-Installed appliances.
 - 2. Owner-Furnished, Contractor-Installed appliances.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include installation details, material descriptions, dimensions of individual components, and finishes for each appliance.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Product Certificates: For each type of appliance.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain residential appliances from single source.

2.2 PERFORMANCE REQUIREMENTS

- A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Gas-Fueled Appliances: Certified by a qualified testing agency for each type of gas-fueled appliance according to ANSI Z21 Series standards.
- C. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design.

2.3 APPLIANCES

- A. Reference Section 01 10 00 "Summary" for Responsibility Matrix Outlining Scope of Work.

2.4 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.
- C. Examine walls, ceilings, and roofs for suitable conditions where overhead exhaust hoods will be installed.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install appliances according to manufacturer's written instructions.
- B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.
- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
 - 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After installation, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
- B. An appliance will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION

SECTION 11 58 50

ELECTRIC KILN

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electric Kiln to be Owner Provided, Owner Installed.

1.2 SCOPE

- A. Provide Electric Kiln Equipment complete, including electrical cords, anchors, and accessories.

1.3 REFERENCES

- A. UL (EAUED) - Electrical Appliance and Utilization Equipment Directory; Underwriters Laboratories Inc..

1.4 SUBMITTALS

- A. See Section 01 33 00 – Submittal Procedures, for submittal procedures.
- B. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.
- C. Copies of Warranties: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Electric Appliances: Listed and labeled by UL and complying with NEMA standards.

1.6 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Provide five (5) year manufacturer warranty on kiln equipment and accessories.

PART 2 - PRODUCTS

2.1 ELECTRIC KILN

- A. Owner Provided, Owner Installed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify utility rough-ins are present and correctly located.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide competent foreman as supervisor for the installation, and to counsel with other trades in regard to connections and installations.
- C. Anchor built-in equipment in place.

3.3 ADJUSTING

- A. Adjust operating equipment to efficient operation.

3.4 CLEANING

- A. Remove packing materials from equipment.
- B. Wash and clean equipment.

END OF SECTION

SECTION 11 60 01

SPECIALTY MUSIC INSTRUMENT STORAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Specialty casework including the following:
 - a. Musical instrument storage casework.
 - b. Music library system.
 - c. Metal shelving systems.

1.2 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI A208.1 - Particleboard.
- B. American Society of Civil Engineers (ASCE):
 - 1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
- C. ASTM International (ASTM):
 - 1. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - 2. ASTM C503 - Specification for Silvered Flat Glass Mirror.
 - 3. ASTM E488 - Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.
 - 4. ASTM E795 - Practices for Mounting Test Specimens during Sound Absorption Tests.
- D. Audio Engineering Society (AES): AES-4id - AES information document for room acoustics and sound reinforcement systems -- Characterization and measurement of surface scattering uniformity.
- E. Builders Hardware Manufacturers Association (BHMA): ANSI/BHMA A156.9 - Cabinet Hardware.
- F. GREENGUARD Environmental Institute (GEI): GREENGUARD certified low emitting products.
- G. National Electrical Manufacturers Association (NEMA): NEMA LD 3-2000 - High Pressure Decorative Laminates.
- H. U.S. Department of Commerce, National Institute of Standards and Technology: DOC PS 1: U.S. Product Standard for Construction and Industrial Plywood.

1.3 ACTION SUBMITTALS

- A. Product Data: Including all pertinent performance characteristics and criteria.
- B. Shop Drawings: Indicate materials, construction, sizes, quantities, finishes, and installation details.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Instructions: For installation, maintenance, and repair.
- B. Operation and Maintenance Data: For adjusting, repairing and replacing components and accessories.
- C. Warranty: Submit manufacturer's warranty.
- D. As-Built Drawings: For completed work.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 5 years' experience in design and manufacturing of similar products on projects of similar size, scope and complexity, and with the production capacity to meet the construction and installation schedule.
- B. Electrical Components: Listed and labeled per NFPA 70, Article 100 by a testing agency acceptable to Authorities Having Jurisdiction (AHJ).

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original unopened containers with manufacturer's labels attached. Do not deliver material until spaces to receive them are clean, dry, and ready for their installation. Ship to jobsite only after roughing-in, painting and other finishing work has been completed, installation areas are ready to accept work.
- B. Handle and install materials to avoid damage.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install materials until spaces are enclosed and weather tight, wet work in spaces is complete and dry, HVAC system is operating and maintaining ambient temperature at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify field measurements as indicated on Shop Drawings. Where measurements are not possible, provide control dimensions and templates.
- C. Coordinate installation and location of blocking and supports as requested.
- D. Verify openings, clearances, storage requirements and other dimensions relevant to the installation and final application.
- E. Where applicable, coordinate locations of electrical junction boxes.
- F. Field Measurements: Verify field measurements as indicated on Shop Drawings. Where measurements are not possible, provide control dimensions and templates.
- G. Coordinate locations of electrical junction boxes.
- H. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.8 WARRANTY

- A. Special Warranty for Specialty Casework: Manufacturer's written warranty indicating manufacturer's intent to repair or replace components of specialty casework that fail in materials or workmanship within 10 years from date of Substantial Completion. Failures are defined to include, but are not limited to, the following:
 - 1. Fracturing or breaking of casework components including doors, panels, shelves, or hardware resulting from normal wear and tear and normal use other than vandalism.
 - 2. Delamination or other failures of glue bond of components.
 - 3. Warping of casework components not resulting from leaks, flooding, or other uncontrolled moisture or humidity.
 - 4. Failure of operating hardware.

PART 2 - PRODUCTS

2.1 MUSICAL INSTRUMENT STORAGE CASEWORK

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Wenger Corporation.
- B. Basis-of-Design Products:
 - 1. Wenger Corporation; UltraStor Storage Cabinets.
 - a. Description: Modular instrument storage casework with integral bases, adjustable levelers, and through-bolted fastening, enabling owner reconfiguration of unit layout.
 - 2. Wenger Corporation; AcoustiCabinets.
 - a. Description: Modular instrument storage casework with integral bases, adjustable levelers, and through-bolted fastening, enabling owner reconfiguration of unit layout.
 - 1) Acoustically enhanced instrument storage casework finished with interior lining of sound-absorbent material providing sound absorption and noise reduction properties.
 - 2) Sound Absorption Average: Minimum SAA of 0.80, based upon sound absorption coefficient for twelve one-third octave bands from 200 to 2500 Hz, inclusive, with a minimum Noise Reduction Coefficient (NRC) of 0.75, per ASTM C 423 and ASTM E 795.

- 3) Acoustical Performance: Comply with manufacturer's published sound absorption data.
 - 4) Wave grille doors in 5/16 inch (24 mm) and 1/4 inch (6.4 mm) diameter designed to reduce vibration.
- C. Storage Casework Component Load Capacities:
1. Storage Casework Wire-Grille Door Hinge: Each weld capable of resisting 400 lbf (1779 N) pull test without visible damage or permanent deformation.
- D. General: Provide through-ventilating instrument storage casework meeting requirements in System Description and Performance Requirements Articles.
- E. Side Panels and Divider Panels: Particleboard thermoset panel with no urea formaldehyde added, 3/4 inch (19 mm) thick. Side panels machined to accept unit-to-unit through-bolting.
- F. Grille Doors: Bright basic steel wire, 5/16 and 3/16 inch (7.9 and 4.8 mm) diameter, or 5/16 and 1/4 inch (7.9 and 6.3 mm) diameter for acoustical cabinets, with full 360 degree welds at T-joints.
1. Provide for instrument storage casework.
- G. Panel Edge Banding: 3 mm thick, heat-bonded, with radiused and profiled edges and corners.
- H. Shelving: Sized with adequate gap between shelving and casework side panels to allow air movement inside casework.
1. Up to 27 inches (686 mm) wide: Removable molded polyethylene shelf, with impact-resistant, radiused front edge, mounted to cabinet wall with self-locking clip.
 2. Over 27 inches (686 mm) wide: For large instrument casework: Removable formed polyethylene shelf, ribbed, with high-impact-resistant, radiused front edge, supported by steel tube frame.
 3. Tubular steel supports are included for shelves over 19 inches (483 mm) wide.
- I. Casework Panel Color: As selected by Architect from manufacturer's standard colors.
- J. Butt Hinges: 2-3/4 inches (70 mm), 5-knuckle steel hinges made from 0.090 inch (2.29 mm) thick metal, ANSI/BHMA A156.9, Grade 1, with powder-coated finish, through-bolted to door and side panels and welded to grille door frames. Provide 2 hinges on compartment doors, and 4 hinges on full-height doors.
- K. Slide Latch: 0.105 inch (2.67 mm) min. thickness steel, with padlock eye, powder-coat finish, through-bolted to panel door and side panel and welded to grille door frames. Latches securely without padlock. Provide with clear plastic label holder for use with standard size labels; number system available for user to print. Padlocks furnished by Owner.
- L. Panel Connectors: 1/4 - 20 by 1.77 inch (45 mm) panel connectors, with steel thread inserts, powder coated to match panels.
- M. Cabinet Levelers: Leveling glides with 3/8 inch (9.5 mm) diameter threaded steel rod in steel corner brackets, minimum two each per cabinet side, accessible from within unit, and concealed in completed installation.
- N. Carcass joinery includes lag screws powder coated to match substrate.
- O. Back panel 7/32 inch (5.6 mm) reinforced with 3/4 inch (19 mm) stretchers panels held in a dado groove and lag screwed in place.
- P. Fasteners: Manufacturer-recommended fasteners as required for casework substrate and project performance requirements, consisting of one or more of the following:
1. Sheet Metal Screws: SAE J78, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
 2. Wood Screws: ASME B18.6.1.
 3. Expansion Anchors in Concrete and Concrete Masonry Units: Carbon-steel, zinc plated.
 4. Hardware supplied to anchor the cabinets to the wall and to adjacent casework.
- Q. Finish: Steel Sheet, Steel Wire, and Exposed Fasteners. Urethane-based electrostatic powder coating, color as indicated. Refer to Drawings.
- R. Materials Meeting Sustainable Design Requirements:
1. No Added Urea Formaldehyde Products: Provide music education storage casework made with composite products and adhesives with no urea formaldehyde added.
- S. Particleboard: ANSI A208.1, minimum 43 lb/cu. ft. (689 kg/cu. m) density, composite products and adhesives, with no urea formaldehyde added.
- T. Fire Rated Particle Board: ANSI A208.1, minimum 45 lb/cu. ft. (720 kg/cu. m) density ASTM E-84 class 1.

- U. Plywood: APA standards PS1-98 section 5.7.4 or 5.7.1 or ANSI /HPVA HP-1-2004 Panel provide with HDF skins to prevent grain telegraphing.
- V. Polyethylene Shelves: High-density, one-piece, blow-molded or polyethylene, with radiused front edge, for abuse-resistant shelves. Same color throughout will not show scratches.
- W. PVC Edge Banding: Radiused PVC extrusions, 1/8 inch (3 mm) thick.

2.2 MUSIC LIBRARY SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Wenger Corporation.
- B. Basis-of-Design Product: Wenger Corporation; Music Library System.
 - 1. Standard Width 7-Shelf Unit: 173G700 S, 16 inches (41 cm) wide; 12 inches x 34-1/2 inches x 10-1/2 inches (30 x 88 x 27 cm) of shelf space available; 4 shelves adjustable, 3 shelves fixed.
- C. Design and Construction:
 - 1. Pull-out design, equally spaced shelves provide 10-1/2 inches (27 cm) of available height per shelf.
 - 2. Units are constructed of 3/4 inch (19 mm) thick industrial grade composite wood with no added formaldehyde and polyester laminate finish in Wenger standard colors.
 - 3. Shelves are reinforced with an aluminum extrusion that includes a slot with vinyl material for labeling with dry-erase markers.
 - 4. Frame is 16-gauge, 1 inch (2.54 cm) square tubular steel, painted black.
 - 5. Back panel is designed to fit on either side of unit for left or right hand use.
 - 6. Includes four 8 inch (20 cm) diameter casters.
 - 7. Each unit contains bumpers for control of side and outward movement.
 - 8. Unit requires anchoring to floor and wall.
 - 9. Each shelf rated at 100 lbs. (45 kg) maximum capacity.
 - 10. Ten-year warranty.
 - 11. Top closure, constructed particleboard that matches the end covers, supports up to 50 lb/lin.ft. (74 kg/m) loading.
- D. Substrate and Loading: Verify substrate is concrete or epoxy coated concrete; not recommended for installation on padded carpet or vinyl flooring.
 - 1. Floor point load for a 7-shelf unit at rated load is 800 psi (5516 kpa) per caster.

2.3 METAL SHELVING SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Wenger Corporation.
- B. Basis-of-Design Product: Wenger Corporation; GearBoss Metal Shelving Systems, Shelf Starter Bay, Shelf Add-On Bay, and Shelves.
 - 1. Description: Cantilever-type modular metal storage shelving system comprised of the following components:
 - a. Structural Performance:
 - 1) Allowable Load Rating: 1000 lb. (373 kg) per 4 by 8-foot (1219 by 2438-mm) bay.
 - 2) Load-Carrying Capacity per 48 inch (1219 mm) Shelf: 250 lb. (113 kg).
 - b. Shelf Unit Uprights: Steel tube, metallic-coated, 2-inch (50.8 mm) square, 0.109-inch (2.76 mm) thick, with perforations on all four sides at 1 inch (25 mm) on center.
 - c. Horizontal Stringer: Formed sheet steel, metallic-coated, 0.075-inch (1.9-mm) thick.
 - d. Shelf Cross Tubes: 14 gauge steel tube, metallic-coated, 5/8-inch (22-mm) square.
 - e. Shelf Brackets: Formed steel, 0.015-inch (0.38-mm) thick.
 - f. Laminate-Clad Wood Panels: Core material and thickness indicated, finished with thermally-fused anti-microbial polyester surfacing on both sides.
 - g. Unit Width: 48 inch (1219 mm) center-to-center unless otherwise indicated.
 - h. Unit Height: 96 inches (2438 mm).
 - i. Shelves can be adjusted in 1 inch (25 mm) increment without tools.
- C. Metal Shelving Materials:
 - 1. Aluminum Extruded Bars, Profiles, and Tubes: ASTM B221.
 - 2. Sheet Steel: Cold-rolled, ASTM A1008, commercial steel, type B.
 - 3. Steel Tube: ASTM A501, hot-formed steel tubing.
 - 4. Steel Wire: ASTM C510, cold drawn steel wire.

5. Particleboard: To ANSI A208.1, minimum 43 lb/cu. ft. (689 kg/cu. m) density.
 6. Plywood: APA standards PS1-98 section 5.7.4 or 5.7.1 or ANSI /HPVA HP-1-2004 Panel provide with HDF skins to prevent grain telegraphing.
 7. Steel Tube: ASTM A500, cold-formed steel tubing.
 8. Laminate Finish: Composite, of thickness indicated, finished with thermally-fused anti-microbial polyester surfacing on both sides, meeting performance properties of NEMA LD3 for VGS grade, with heat bonded, radiused, 3 mm thick extruded PVC edge banding.
 - a. Surface Abrasion Resistance: Taber Wheel, 400 cycles, for solid colors.
 9. PVC Edge Banding: LMA EDG-1, radiused PVC extrusions, 3 mm thick, heat-bonded.
 10. Anchors and Fasteners:
 - a. Factory Provided: Material, type, and size recommended by manufacturer for secure anchorage to substrate.
 - b. Field Installed: Manufacturer-recommended fasteners furnished by Contractor as required for locker substrate and project requirements.
- D. Metal Shelving Fabrication:
1. Fabricate components square, and rigid. Make exposed metal safe to touch and free of sharp ends or burrs.
 2. Form frames, panels, doors, and accessories from one-piece, or one rigid assembly, unless specifically shown on Shop Drawings.
 3. Factory preassemble metal components by welding all joints, and connections; with no bolts, nuts, screws, or rivets used in assembly, except as required for knock down shipping and attachment to mounting surfaces.
- E. Metal Shelving Accessories:
1. Shelf Depth: 30.5 inches (775 mm) with 4 cross tubes.
 2. Work Surface: Particleboard laminate-clad panel with graphite high wear laminate with black edge band, 1-1/8-inch (28.6-mm) thick, inserted into 30-1/2 inch (775 mm) cantilever shelf bracket over cross tubes. Quantity of work surfaces as indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine installation areas and mounting surfaces with Installer present, for compliance with manufacturer's installation tolerances including required clearances, floor level, location of blocking and anchoring reinforcements, and other existing conditions that may affect installation or performance.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Proceed with installation only after correction of unsatisfactory conditions.

3.2 INSTALLATION OF SPECIALTY CASEWORK

- A. Install plumb, level, and true; using integral levelers. Install in accordance with manufacturer's recommendations and approved submittals.
 1. Install fastening in accordance with approved shop drawings.
- B. Install hardware uniformly and precisely. Set hinges snug and flat. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.
- C. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind and close with uniform reveals.
- D. Metal Shelving Requirements:
 1. Anchor uprights to walls using anchors of type, size, and spacing recommended by manufacturer.
 2. Install shelves in each unit.
 3. Erect cantilever adjustable uprights to substrate with a maximum tolerance from vertical of 1/4 inch (6 mm).
 4. Adjust metal shelving so connectors and other components engage accurately and securely. Verify modular components fit easily into alternate locations without force or use of tools.

3.3 CLEANING AND PROTECTION

- A. Repair or replace defective work as directed by Architect upon inspection.
- B. Clean surfaces. Touch up marred finishes, or replace damaged components that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by manufacturer.
- C. Protect installed products from damage, abuse, dust, dirt, stain, or paint until completion of project. Do not permit use during construction.

END OF SECTION

SECTION 11 61 00

STAGE EQUIPMENT

1. EQUIPMENT

1.1 THEATRICAL RIGGING EQUIPMENT

A. GENERAL STANDARDS

1. Paint as required under this section shall be the manufacturer's standard finish and color except as noted.
2. All equipment items shall be new and conform with applicable provisions of Underwriters' Laboratories and American Standards Association.
3. Where acceptable equipment items are specified by catalog number only, device shall meet all published manufacturer's specifications. Where quantities are not given, refer to drawings. Where two or more products are listed, contractor may use either, at his discretion. Equipment shall not be substituted without specific written approval by the Architect/Architect's Representative under the substitution paragraphs of these specifications.

B. GENERAL RIGGING STANDARDS

1. All turnbuckles, clips, tracks, chains and other items of incidental hardware shall be furnished plated or painted. Wire rope shall be galvanized. Fasteners, chain, and other miscellaneous hardware shall be either cadmium or zinc plated.
2. All materials used in this project shall be new, unused and of the latest design. Refurbished materials are not permitted.
3. In order to establish minimum standards of safety, a minimum factor of 8 shall be used for all equipment and hardware used on this project. In addition, the following factors shall be used:

Cables and fittings 8 Safety Factor

C. Support Cables And Fittings

1. All support cables unless otherwise noted shall be 7 x 19 construction, galvanized aircraft cable with a breaking strength of 7000 lbs.
2. Damaged or deformed cable shall not be used.
3. Cable fittings and clips shall conform with wire rope manufacturer's recommendations as to size, number, and method of installation.
4. Clips shall be drop forged "Crosby" or "Malleable".
5. There shall be two cable clips for each lift line tie-off.
6. Pressed sleeve fittings shall be Nicopress.
7. Eyes shall be formed over wire rope thimbles of correct sizes.
8. All wire rope rigging shall be installed so as to prevent abrasion or rubbing of the wire rope against any part of the building construction or other equipment; pulleys and sheaves shall be so aligned as to provide a maximum fleet angle of two degrees; mule blocks, cable rollers, guides and sag bars shall be installed as required to provide proper alignment.

D. Trim Chains

1. Trim chains shall be 1/4" grade 30 proof coil chain 30" long with a 1/4" threaded chain connector (Quick link) on one end.
2. The threaded connector shall be rated at not less than 800 lbs. capacity and shall have the rating stamped on each unit.
3. Trim chains shall be installed on batten end of each support line.

E. Pipe Battens

1. Pipe battens shall be 1-1/2" in diameter schedule 40 pipe.
2. All battens shall be painted black to prevent rusting.
3. Where splicing is required, a pin, 18" long and the same diameter as the inside diameter as the pipe shall be used. This pin shall be held in place with no less than four (4) rivets.
4. Mark the center of each batten with a 1" wide yellow stripe
5. Paint the last 3'0" of each end of each pipe batten yellow.

1.2 PIPE GRID

STAGE EQUIPMENT

- A. Provide stationary 4' x 4' pipe grid.
 - 1. Pipe grid spacing is to be 4'-0" by 4'-0" on center and installed as shown on drawings off the finished floor.
 - 2. Grid pipe is to be 1-1/2" schedule 40 pipe painted black. Where splices are required, provide sleeve of the same diameter as the inside of the pipe, minimum 18" long. The sleeve will be held in place by four (4) bolts.
 - 3. Hanger spacing will not exceed 8'-0" and each pipe will be supported by a hanger at least 2'-0" from the end of each pipe. Each hanger will be constructed from 3/8" all thread rod and power strut #3200-1-1/2" pipe hanger. Each hanger will be designed for a 300 pound load with a 5 to 1 safety factor. All beam clamps are to have a safety anchor and shall be B-Line #B3690-1-1/2" pipe hanger or equal.
 - 4. Grid brackets will be required at each joint where the sections of 1-1/2" pipe cross around the perimeter of the grid and at every other junction on the interior. Brackets are to be #308 1-1/2' by 1-1/2" grid brackets or Roto Lock by Upright Scaffolding.
 - 5. The entire grid will be attached to the vertical side walls by extending the pipe to the side wall and attaching it to a wall flange. The mounting shall be rigid and in such a way as to secure the entire grid from movement.

1.3 STAGE CURTAINS

- A. FABRICS
 - 1. 23 -25 ounce fabrics shall be KM Fabrics Charisma or Liba Fabrics, black in color. Muslin shall be seamless FR fabric.
- B. FLAMEPROOFING
 - 1. Fabrics used in fabrication of draperies shall be chemically flameproof with a formula approved Bureau of Standards U.S. Department of Commerce, and finished fabric, after treatment, shall pass such tests as are required by the Fire Marshall of the local Fire Dept. and Owner.
 - 2. A certificate for each type and color of cloth used shall be furnished to the Owner when request for final payment is made.
 - 3. Certificate shall state name of Stage Equipment Contractor, name of firm doing flameproofing treatment, date of treatment, date re-treatment will be required, method of treatment, and the certificate shall be affixed the signature of an officer or authorized representative of the firm furnishing the draperies.
 - 4. The information on certificate shall be notarized by a Notary Public in the State of Texas.
- C. FABRICATION OF STANDARD STAGE DRAPERIES
 - 1. Sew fabrics with box-pleats to 3-1/2" wide heavy-duty upholstery jute webbing, pleats spaced 12" on centers, unless otherwise specified. Use mercerized cotton thread, minimum weight #16, color to match cloth shall be full length and shall be without splices for entire length of the curtain.
 - 2. Properly join panels smooth and free of puckering at seams, hems, and turnbacks.
 - 3. Where completed curtains are to be operated on a traveler track, equip each pleat with a 2" plated harness snaphook mounted to curtain by means of a strap of web-belting to curtain by riveting with not less than 2 tubular rivets per snaphook. Web-belting straps shall pass over front and back sides of pleats, and rivets shall go completely through the web-belting, jute webbing, and all thickness of curtain fabric. Canvas straps, leather straps, grommets and s-hooks, cotter key hooks, etc., shall not be acceptable.
 - 4. Where completed curtains are to be tied to a pipe batten, each pleat shall be equipped with a 30" long #4 braided nylon tieline through a No. 2, or larger brass grommet, each to be on 12" centers located in the box pleats at the webbing.
 - 5. Bottom hems of all curtains shall be 5" and shall be equipped with a separate canvas pocket sewn inside bottom hems in such manner as to have the bottom of the canvas pocket at least 1-1/2" above bottom of curtain hem. Load canvas pocket with #6 galvanized pump chain, secured to prevent bunching and shifting within the pocket.
 - 6. Off-stage vertical hems and center-facing turnbacks of the front curtain and mid-stage shall be one-half width (27") of material faced back and no sewn hem shall be permitted within these hems. Vertical hems of all masking borders, travelers, and cyclorama curtains shall be 6".

7. Finish curtains properly in the best manner and method of the industry, and after hanging, thoroughly brush to remove dust, visible dirt, loose threads, loose fabric lint, etc. Wrinkles shall be allowed to fall out naturally.

8. Fullness desired for each panel of curtains is indicated by the number of widths specified for each item. Any number of widths less than the number specified will result in re-fabrication of curtains.

D. FABRICATION OF MUSLIN SKY DROP

1. Across the top of each unit the fabric shall sewn flat to a 3-1/2" webbing double stitched with #16 mercerize cotton thread.

2. Provide No. 2 brass grommet 12" on center across webbing. In each grommet provide a 30" long #4 braided nylon tie.

3. Sew a 6" bottom hem. In the bottom hem, sew in a canvas pipe pocket large enough to accommodate a 1" pipe. Provide bottom 3/4" rigid conduit in 10' sections with threaded couplings for joints.

4. Side hems shall be 3" wide double folded, double stitched hems.

1.4 CURTAIN TRAVELER TRACKS

A. Tracks shall be by H&H Specialties. Manufacturer's recommendations on installation of all tracks and related hardware shall be followed. Automatic Devices Inc. of Allentown, PA shall be considered equal.

B. Track shall be H&H Model #300 series walk along black in color. Use only pipe brackets to secure tracks to battens.

2. INSTALLATION

2.1 GENERAL

A. Verify that job conditions are ready to receive work of this section. Notify Architect of any existing condition which will adversely affect execution. Beginning of execution will constitute acceptance of existing conditions.

B. Verify that field measurements are as shown on shop drawings.

C. Verify that mechanical, electrical, and other items affecting work of this section are in place and ready to receive the work.

2.2 INSTALLATION

A. Install using skilled workmen in accordance with manufacturer's printed instructions and recommendations.

B. Install work in accordance highest industry standards. Handle materials to avoid dents and other damages.

C. Set and secure materials and components rigid, plumb, and square.

END OF SECTION

SECTION 11 66 23
GYMNASIUM EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Basketball equipment.
 - 2. Volleyball equipment.
 - 3. Safety pads.
 - 4. Equipment control systems.
 - 5. Equipment legend.

1.2 DEFINITIONS

- A. FIBA: Federation Internationale de Basketball (The International Basketball Federation).
- B. FIVB: Federation Internationale de Volleyball (The International Volleyball Federation).
- C. NBA: National Basketball Association.
- D. NCAA: The National Collegiate Athletic Association.
- E. NFHS: National Federation of State High School Associations.
- F. WNBA: Women's National Basketball Association.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include assembly, disassembly, and storage instructions for removable equipment.
- B. Shop Drawings: For gymnasium equipment.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of field assembly for removable equipment, connections, installation, mountings, floor inserts, and operational clearances.
 - 3. Include transport and storage accessories for removable equipment.
 - 4. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For each type of gymnasium equipment.
- D. Samples for Verification: For the following products:
 - 1. Basketball Net: Full size.
 - 2. Volleyball Floor Insert: Full-size unit.
 - 3. Pad Fabric: Wall padding minimum 3 inches (76 mm) square, and corner and column Samples minimum 3 inches (76 mm) long, with specified treatments applied. Mark face of material.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Court layout plans, reflected ceiling plans, and other details, drawn to scale, and coordinated with ceiling-suspended gymnasium equipment, floor inserts, game lines, and markers applied to finished flooring, and coordinated with each other, using input from installers of the items involved:
 - 1. Structural members to which overhead-supported gymnasium equipment will be attached.
 - 2. Suspended ceiling components, if any.
 - 3. Items supported from building structure above the courts, including the following:
 - a. Luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Smoke detectors.
 - f. Acoustical treatments or panels.

- g. Access panels.
 - B. Setting Drawings: For embedded items and cutouts required in other work.
 - C. Qualification Data: For Installer.
 - D. Product Certificates: For each type of gymnasium equipment.
- 1.6 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For gymnasium equipment to include in operation and maintenance manuals.
- 1.7 QUALITY ASSURANCE
- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- 1.8 FIELD CONDITIONS
- A. Field Measurements: Verify position and elevation of floor inserts and layout for gymnasium equipment.
- 1.9 WARRANTY
- A. Special Warranty: Manufacturer agrees to repair or replace components of gymnasium equipment that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Basketball backboard failures, including glass breakage.
 - b. Faulty operation of basketball backstops.
 - 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

- 2.1 BASKETBALL EQUIPMENT
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AALCO Manufacturing.
 - 2. ADP Lemco.
 - 3. Arizona Courtlines, Inc.
 - 4. Draper Inc.
 - 5. Performance Sports Systems.
 - 6. Porter Athletic Equipment Company.
 - B. Source Limitations: Obtain from single source from single manufacturer.
 - C. Standard Rules: Provide equipment according to the requirements of NFHS's "Basketball Rules Book."
 - D. Protruding fasteners or exposed bolt heads on front face of backboards are not permitted.
 - E. Connections: Manufacturer's standard connections or connections recommended in writing by manufacturer and complying with Section 05 50 00 "Metal Fabrications" of size and type required to transfer loads to building structure.
 - F. Ceiling-Suspended Backstop Assemblies: Capable of mounting both rectangular and fan-shaped backboards.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ADP Lemco Inc.
 - b. Arizona Courtlines, Inc.
 - c. Draper.
 - d. Porter Athletic Equipment Company.
 - e. Spalding Equipment Company.
 - 2. Basis-of-Design Manufacturer: Porter Athletic Equipment Company.
 - a. Main Goals: Forward-fold, front-braced: Porter 90949.
 - 1) Acceptable Substitution:
 - a) ADP Lemco Inc.; 1325 Basketball Frame.
 - b) Draper; TF-20.
 - b. Side Goals: Side-Fold, Side-Braced: Porter Athletic Equipment Company; Model No. 956, with Mast Offset.

3. Folding Control System: Electric hoist that folds backstop with 115 volt actuator, integral limit switches that provide automatic shut-off in both positions, and safety catch with automatic reset.
 4. Framing: Steel pipe, tubing, and shapes designed to minimize vibration during play.
 - a. Finish: Manufacturer's standard.
- G. Winch System:
1. Basis-of-Design Product: Porter Athletic Equipment; Model No. 708 – 3HP Electric Winch.
 - a. Location: All backstops.
 2. Top speed of cable pull from winch shall meet 32 feet per minute.
 3. Electric Motor: Individually operate units by 3HP/ 10 amp/ 208VAC/ 3-Phase electric motor with automatic thermal-overload protection, manufactured to NEMA specifications. Single phase winches shall not be considered equal.
 4. Cable Drum: Grooved to provide neat and consistent cable tracking.
 5. Winch shall include a pre-configured variable frequency drive (VFD) to provide smooth starting and stopping cycles of backstop
 6. Saf Strap (Model No. 797): Provide speed sensitive automatic lock designed to engage in the event of an over-speed occurrence. Must be able to withstand test using 1750 lb fall weight. Must be able to provide independent lab test results. Capable of being automatically reset without the use of poles, ropes, levers, or buttons.
 7. Gym Controller Stations: Controller stations to be provided under this section. Wiring and other work described on the electrical drawings to be provided by the electrical contractor.
- H. Basketball Backboards:
1. Basis-of-Design Product: Porter Athletic Equipment; Model No. 208 – Center-Strut Rectangular Glass Backboard.
 2. Shape and Size:
 - a. Rectangular, 72 by 42 inches (1830 by 1070 mm) width by height.
 3. Backboard Material: Provide with predrilled holes or preset inserts for mounting goals, and as follows:
 - a. Glass: Minimum 1/2-inch- (13-mm-) thick, transparent tempered glass according to ASTM C 1048 Kind FT (fully tempered) and with impact-testing requirements in 16 CFR 1201 Category II or ANSI Z97.1 Class A for safety glazing. Provide glass and framing system manufactured according to FIBA Level 1 or Level 2 requirement that glass does not split off if broken.
 - a) Frame: Provide glass with impact-absorbing resilient rubber or PVC gasket around perimeter in a fully welded, painted steel frame, with steel subframe, reinforcement, bracing, and mounting slots for mounting backboard frame to backstop.
 - b) Standard Mount: Provide steel corner reinforcement with mounting slots for mounting backboard frame to backstop at standard mounting centers. Provide center-strut frame reinforcement.
 - c) Rim-Restraining Device: According to NCAA and NFHS rules and designed to ensure that basket remains attached if glass backboard breaks.
 4. Target Area and Border Markings: Permanently etched in white color, marked in manufacturer's standard pattern and stripe width.
 5. Finish: Manufacturer's standard factory-applied, white background.
- I. Goal-Mounting Assembly: Compatible with goal, backboard, and backstop; with 5-inch (127-mm) o.c. horizontally and vertically hole pattern for goal attachment.
1. Glass Backboard Goal-Mounting Assembly: Goal support framing and reinforcement designed to transmit load from goal to backstop and to minimize stresses on glass backboard.
 2. Direct Mount: Designed for mounting goal directly and independently to center mast of backstop, so that no force is transmitted by ring directly to backboard, and rigidity and stability of goal are maximized.
- J. Basketball Goals: Basket ring complete with flanges, braces, attachment plate, and evenly spaced loops welded around underside of ring.
1. Basis-of-Design Product: Porter Athletic Equipment; Model No. 280180 – TFX Elite Adjustable Goal.
 2. Single-Rim Basket Ring Competition Goal: Materials, dimensions, and fabrication per manufacturer's standard design.
 3. Type:

- a. Fixed: Nonmovable.
4. Pressure-Release Characteristics: Positive-lock movable breakaway design, with manufacturer's standard mechanism, including preset pressure release, set to release between 181- and 231-lb (82- and 105-kg) load, and automatic reset. Provide movable ring with rebound characteristics identical to those of fixed, nonmovable ring.
5. Field Adjustment: Provide ring that is field adjustable for rebound elasticity without being removed from the backboard.
6. Mount: Rear.
7. Net Attachment: Tube tie for attaching net to ring.
8. Finish: Polyester powder-coat finish.
 - a. Color: As selected by Architect from manufacturer's full range.
- K. Basketball Nets: 12-loop-mesh net, between 15 and 18 inches (380 to 460 mm) long, sized to fit ring diameter, and as follows:
 1. Cord: Made from white nylon.
- L. Backboard Safety Pads: Designed for backboard thickness and extending continuously along bottom and up sides of backboard and over backstop according to manufacturer's standard design.
 1. Basis-of-Design Product: Porter Athletic Equipment; Model No. 326 – Bolt on Pad.
 2. Attachment: Manufacturer's standard.
 3. Thickness: 2 inches.
 4. Color: As selected by Architect from manufacturer's full range.
- M. Scorer's Table: Owner-Furnished, Owner-Installed.

2.2 VOLLEYBALL EQUIPMENT

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. AALCO Manufacturing.
 2. ADP Lemco.
 3. Arizona Courtlines, Inc.
 4. Draper Inc.
 5. Performance Sports Systems.
 6. Porter Athletic Equipment Company.
 7. Sports Imports.
- B. Source Limitations: Obtain from single source from single manufacturer.
- C. Standard Rules: Provide equipment according to the requirements of NFHS's "Volleyball Rules Book."
- D. Safety Pads: Owner-Provided, Owner-Installed.
- E. Volleyball Poles: Owner-Provided, Owner-Installed.
- F. Floor Plate and Sleeves:
 1. Basis-of-Design Products:
 - a. Porter Athletic Equipment Company; Model No. KA25 Floor Sleeves with Cover Plates.
 - b. Sports Imports; Model KA25.
 2. Floorplate shall be solid brass of 6 5/8 inches diameter with hinged access cover and a 3 11/16 inch opening. Removable, threaded, or pin swivel covers are unacceptable. Plate shall be 0.25 inch thick and shall be designed to be compatible with all floor surfaces. In a wood floor, the plate shall be fastened only to the wood floor so that it can move with any expansion or contraction of the floor. Sleeve shall be DOM tubular steel of 0.140 inch thickness, 8 7/8 inches long and 3 1/16 inches internal diameter. Seamed tubing or pipe is unacceptable. Sleeve shall have three pre-drilled flanges for attachment to the plate during the installation in accordance with manufacturer's instructions and shall have a nitrated finish to resist corrosion. The bottom of the sleeve shall be 10 inches from the floor surface.
- G. Volleyball Pole Protective Padding: Owner-Provided, Owner-Installed.
- H. Volleyball Net: Owner-Provided, Owner-Installed.
- I. Top Net Tape: Owner-Provided, Owner-Installed.
- J. Volleyball Net Antenna: Owner-Provided, Owner-Installed.
- K. Volleyball Official Stand: Owner-Provided, Owner-Installed.

- L. Wrap for Volleyball Official Stand: Owner-Provided, Owner-Installed.

2.3 SAFETY PADS

- A. Manufacturers: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Arizona Courtlines, Inc.
 - 2. Draper, Inc.
 - 3. Porter Athletic Equipment Company.
- B. Basis-of-Design Product: Draper, Inc.; Graphic Wall Pads.
- C. Size: 24 by 72 inches.
- D. Cushioning Material: 2 inches thick polyurethane filler with 6 pounds density.
- E. Backer: 7/16-inch Wafer Board.
- F. Source Limitations: Obtain from single source from single manufacturer.
- G. Pad Coverings: Provide safety pad fabric covering that is fabricated from puncture- and tear-resistant, PVC-coated polyester or nylon-reinforced PVC fabric, minimum 14-oz./sq. yd. (475-g/sq. m) and treated with fungicide for mildew resistance; with surface-burning characteristics indicated, and lined with fire-retardant liner.
- H. Cutout Trim: Manufacturer's standard flanged cutout trim kits for fitting pads around switches, receptacles, and other obstructions.
- I. Graphics: Standard graphic design, provided by Owner, in suitable format. Graphics to be printed on pads by a digital 4-color process. Graphic Pads that are silk-screened or made with adhesive vinyl shall not be considered equal. Graphics protected by a clear 3 mil laminate coating to protect against abrasion and fading.
- J. Mounting: Provide 1-inch wide fabric flanges at panel bottom and top Channel System for wall mounting panels.

2.4 EQUIPMENT CONTROL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Porter Athletic Equipment Company.
- B. Basis-of-Design Product: Porter Athletic Equipment Company; Model No. XELE00791162, Six Key Switch on a 12-Gang Plate.
- C. Wall-Mounted Dual Key Switch: Switch with separate "up" and "down" keys to prevent improper operation of system. Single key systems or "toggle" type switches are not equal.
- D. Momentary Switch: Switch automatically returns to "off" position if released.
- E. Cover Plate: Flush-mounted stainless steel cover plate with manufacturer's label including operating instructions.
- F. Provide one key switch for each backstop.

2.5 EQUIPMENT LEGEND

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Porter Athletic Equipment Company.
- B. Basis-of-Design Product: Porter Athletic Equipment Company; Model No. 92500000 – Custom Equipment Legend.
 - 1. Wall Mounted: Detailed equipment legend to be wall mounted at key switch or touch pad location to allow user to identify each piece of equipment and its corresponding number on control system.
 - 2. Cardstock, 11 inches by 17 inches, preprinted with accurate floor plan and equipment layout of gymnasium or facility. Equipment to be clearly labeled and identified.
 - 3. Legend to be securely fastened to wall and protected behind 1/4-inch thick clear acrylic sheet, 11 inches by 18 inches.
 - 4. Mounting Hardware: Hardware to mount equipment legend to masonry walls.

2.6 MATERIALS

- A. Support Cable: Manufacturer's standard galvanized-stranded-steel wire rope with a breaking strength of 7000 lb (3175 kg). Provide fittings according to the wire rope manufacturer's written instructions for size, number, and installation method.
- B. Support Chain and Fittings: For chains used for overhead lifting, provide Grade 80 heat-treated alloy-steel chains, according to ASTM A 391/A 391M, with commercial-quality, hot-dip galvanized steel connectors and hangars.
- C. General-Purpose Chain: For chains not used for overhead lifting, provide carbon steel chain, according to ASTM A 413/A 413M (Grade 30 proof coil chain or higher grade recommended by gymnasium equipment manufacturer). Provide coating type, chain size, number, and installation method according to manufacturer's written instructions.
- D. Castings and Hangers: Malleable iron, according to ASTM A 47/A 47M; grade as required for structural loading.
- E. Softwood Plywood: DOC PS 1, exterior.
- F. Particleboard: ANSI A208.1.
- G. Anchors, Fasteners, Fittings, and Hardware: Gymnasium equipment manufacturer's standard corrosion-resistant or noncorrodible units; concealed; tamperproof, vandal- and theft-resistant design.
- H. Grout: Nonshrink, nonmetallic, premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout, according to ASTM C 1107/C 1107, with minimum strength recommended in writing by gymnasium-equipment manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for court layout, alignment of mounting substrates, installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance of the Work.
 - 1. Verify critical dimensions.
 - 2. Examine supporting structure, subgrades, subfloors, and footings below finished floor.
 - 3. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements are clearly marked. Locate reinforcements and mark locations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions and competition rules for each type of gymnasium equipment.
- B. Install gymnasium equipment after other finishing operations, including painting, have been completed unless otherwise indicated.
- C. Permanently Placed Gymnasium Equipment and Components: Install rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated; in proper relationship to adjacent construction; and aligned with court layout.
 - 1. Floor-Insert Locations: Coordinate locations with application of game lines and markers, and core drill floor for inserts after game lines are applied.
 - 2. Floor-Insert Elevation: Coordinate installed heights of floor inserts with installation and field finishing of finish flooring and floor-plate type.
 - 3. Operating Gymnasium Equipment: Verify clearances for movable components of gymnasium equipment throughout entire range of operation and for access to operating components.
- D. Floor-Insert Setting: Clean oversized, recessed voids in concrete substrate of debris. Position each sleeve, and fill void around sleeve with grout, mixed and placed according to grout manufacturer's written instructions. Protect portion of sleeve above subfloor and footing from splatter. Verify that sleeves are set plumb, aligned, and at correct height and spacing; hold in position during placement and finishing operations until grout is sufficiently cured. Set insert so top surface of completed unit is flush with finished flooring surface.

- E. Anchoring to In-Place Construction: Use anchors and fasteners where necessary to secure built-in and permanently placed gymnasium equipment to structural support and to properly transfer load to in-place construction.
- F. Removable Gymnasium-Equipment Components: Assemble in place to verify that equipment and components are complete and in proper working order. Disassemble removable gymnasium equipment after assembled configuration is approved by Architect, and store units in location indicated on Drawings.

3.3 INSTALLATION OF SAFETY PADS

- A. Mount with bottom edge at 4 inches (102 mm) above finished floor.
- B. Cutout Trim: Limit cuts in face of padding so that cuts are securely and fully concealed behind trim-kit flange.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Perform visual inspections and operational tests as recommended by referenced standard rules of each sport and the equipment manufacturer.
 - 2. Test rebound elasticity of basketball goals.
 - 3. Test basketball goal pressure-release characteristics and adjustability.
- C. Gymnasium equipment will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION

SECTION 11 66 43

INTERIOR SCOREBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the following:
 - 1. Sports Scoreboards and Control Systems for basketball and volleyball.

1.2 PERFORMANCE REQUIREMENTS

- A. Provide a scoreboard ETL or ETL-C tested to UL standard.

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- B. Shop Drawings: Submit plan, section, elevation, and perspective view details as necessary to depict proper field fabrication and installation, and provide details on connections, terminations and joints.
- C. Samples for Initial Selection: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors.
- D. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For scoreboards and operating equipment to include in emergency, operation, and maintenance manuals.
- B. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain scoreboards, controllers, and accessories from the same source from a single manufacturer.
- B. Manufacturers Qualifications: Manufacturers must have five years of experience in the manufacturing of scoreboards and message displays of the type specified.
- C. Installer Qualifications: Factory-trained and experienced in the proper installation of scoreboards and message displays.
- D. UL and NEMA Compliance: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards.
- E. Welders: AWS certified.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Physical inspection of items required at time of delivery; any shipping damages must be reported at delivery prior to storage.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 COORDINATION

- A. Coordinate locations with other work to prevent interference with clearances required for access to facilitate proper installation, adjustment, operation, cleaning, and servicing of scoreboards and accessories.

- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.
- C. Coordinate with electrical requirements.

1.8 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 EXTRA MATERIALS

- A. Contractor is responsible for providing all hardware, sealants, welding materials and other secondary installation products required for installation. Architect shall approve each product before or during the pre-installation conference.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Daktronics, Inc.
 - 2. Fair-Play Scoreboards.
 - 3. Nevco Scoreboard Company.
 - 4. Spectrum Corporation.

2.2 ELECTRONIC SCOREBOARDS

- A. Competition Gym Scoreboard:
 - 1. Basis-of-Design Product: Fair-Play Scoreboards; Model BB-1670-4.
 - 2. Dimensions: 9 feet by 5 feet by 4 inches.
 - 3. Clock and Score Digit Size: 12 inches (305 mm).
 - 4. Other Digit Size: 10 inches (254 mm).
 - 5. Power Usage: 127 Watts.
- B. Accessories:
 - 1. Provide manufacturer's standard wireless controller.
 - 2. Provide personalized vinyl home team name.
 - 3. Provide custom, unique signage options, as selected by Architect.

2.3 FINISH

- A. Cabinet Color: As selected by Architect from manufacturer's standard colors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for alignment of mounting substrates, installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance.
 - 1. Verify critical dimensions.
 - 2. Examine supporting structure.
 - 3. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements have been clearly marked. Locate reinforcements and mark locations.
- B. Notify Architect of any existing conditions which will adversely affect execution.
- C. Do not begin installation until substrates have been properly prepared.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.

- B. Prepare surfaces using the methods recommended by scoreboard manufacturer to achieve the best result based on project conditions.

3.3 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Complete field assembly, where required.
- B. Unless otherwise indicated, install interior scoreboards after other finishing operations, including painting, have been completed.
- C. Use fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- D. Connections: Connect automatic operators to building electrical system. Install electrical equipment in accordance with all federal, state and local building codes.
 - 1. Where manufacturer's requirements and building codes are in direct conflict, the more restrictive method of application shall prevail.

3.4 CLEANING AND PROTECTION

- A. Remove temporary labels and protective coatings.
- B. Clean and polish exposed surfaces according to manufacturer's written recommendations.
- C. Initiate and maintain protection and other precautions required through the remainder of the construction period, to ensure that units will be free of damage or deterioration at the time of Substantial Completion.
- D. Replace scoreboard and controller components and finishes that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION AND TRAINING

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain interior scoreboards and controllers. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 11 73 00

PATIENT CARE EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Adult changing station.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details.
 - 2. Include details of components. Indicate location and size of each field connection.
 - 3. Include diagrams for service connections and power, signal, and control wiring.
- C. Product Schedule: For patient care equipment. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For products to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 ADULT CHANGING STATION

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Astor Bannerman.
 - 2. Koala Kare Products, a Division of Bobrick.
- B. Basis-of-Design Product: Koala Kare Products; Model KB3000-AHL.
 - 1. Description and Requirements: Wall mounted, height adjustable, no exposed wires, fixings, or controls, non-tamper embedded control panel, emergency stop button.
 - a. Maximum Working Load: 500 lbs (227 kg).
 - b. Height Adjustable Range: 12 inches (300 mm) to 41 inches (1041 mm).
 - c. Cut and graffiti resistant bed/stretcher.
 - d. Power operated with battery backup.
 - e. Split front guard.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ADULT CHANGING STATION INSTALLATION

- A. Install products in strict compliance with manufacturer's written instructions and recommendations, including the following:
 - 1. Verify wall blocking has been installed properly.
 - 2. Verify required electrical services have been installed properly.
 - 3. Verify wall location does not interfere with door swings or use of fixtures.
 - 4. Use fasteners and anchors suitable for wall substrate and project conditions.
 - 5. Install units at location and height indicated on the drawings.
 - 6. Install units level, plumb, and in proper relationship with adjacent construction.
 - 7. Adjust for proper operation.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: For patient-bed service walls, perform periodic installation inspections to ensure that products are installed according to manufacturer's written instructions.
 - 1. Installation Inspections: Inspect product installations when installation work is 25, 60, and 100 percent complete.
 - 2. Installation Inspection Reports: Indicate if product installations comply with manufacturer's written instructions and corrective actions required if any.

3.4 ADJUSTING

- A. Adjust products for proper function and operation to comply with manufacturer's written instructions.

3.5 PROTECTION

- A. Protect installed products from damage for the remainder of the construction period.
- B. Repair damaged products according to manufacturer's written instructions. If damaged products cannot be successfully repaired, as determined by Architect, remove and replace damaged products.

END OF SECTION

SECTION 12 24 13

ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Manually operated roller shades with single rollers.
 - 2. Motor-operated roller shades with single rollers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.
- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
 - 1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.
- C. Samples for Verification: For each type of roller shade.
 - 1. Shadeband Material: Not less than 10 inches (250 mm) square. Mark interior face of material if applicable.
 - 2. Installation Accessories: Full-size unit, not less than 10 inches (250 mm) long.
- D. Product Schedule: For roller shades. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of shadeband material.
- C. Product Test Reports: For each type of shadeband material, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Draper Inc.
 - 2. Lutron Electronics Co., Inc.
 - 3. MechoShade Systems, Inc.
- B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
 - 1. Bead Chains: Manufacturer's standard .
 - a. Loop Length: Full length of roller shade .
 - b. Limit Stops: Provide upper and lower ball stops.
 - c. Chain-Retainer Type: Clip, jamb mount.
 - 2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.
 - a. Provide for shadebands that weigh more than 10 lb (4.5 kg) or for shades as recommended by manufacturer, whichever criterion is more stringent.
- C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
 - 1. Roller Drive-End Location: Right side of interior face of shade.
 - 2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
 - 3. Shadeband-to-Roller Attachment: Manufacturer's standard method.
- D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
- F. Shadebands:
 - 1. Shadeband Material: Light-filtering fabric .
 - 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Enclosed in sealed pocket of shadeband material .
 - b. Color and Finish: As selected by Architect from manufacturer's full range.
- G. Installation Accessories:
 - 1. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
 - a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than 6 inches (152 mm).
 - b. Provide pocket with lip at lower edge to support acoustical ceiling panel.

2. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
 - a. Closure-Panel Width: 2 inches (51 mm) unless indicated otherwise.
3. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 MOTOR-OPERATED, SINGLE-ROLLER SHADES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Draper Inc.
 2. Lutron Electronics Co., Inc.
 3. MechoShade Systems, Inc.
- B. Motorized Operating System: Provide factory-assembled, shade-operator system of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
 1. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Electric Motor: Manufacturer's standard tubular, enclosed in roller.
 3. Remote Control: Electric controls with NEMA ICS 6, Type 1 enclosure for surface mounting. Provide the following for remote-control activation of shades:
 - a. Individual Switch Control Station: Maintained -contact, wall-switch-operated control station with open, close, and center off functions.
 - 1) Switch Positions: Three.
 - 2) Switch Style: Toggle.
 - b. Color: As selected by Architect from manufacturer's full range.
 4. Crank-Operator Override: Crank and gearbox operate shades in event of power outage or motor failure.
 5. Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.
- C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
 1. Roller Drive-End Location: Right side of interior face of shade.
 2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
 3. Shadeband-to-Roller Attachment: Manufacturer's standard method.
- D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers that are operated by one roller drive-end assembly.
 1. Location: At room darkening side, sill channels, and center supports.
- F. Shadebands:
 1. Shadeband Material: Light-filtering fabric.
 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Enclosed in sealed pocket of shadeband material .
 - b. Color and Finish: As selected by Architect from manufacturer's full range.
 - c. Include Snaploc fascia, mounted between jambs inside window openings or window box, and with channels at jamb side of blackout shades.
- G. Installation Accessories:
 1. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
 - a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than height indicated on Drawings.
 - b. Provide pocket with lip at lower edge to support acoustical ceiling panel.

2. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
 - a. 2 inches (51 mm) unless otherwise indicated.
3. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.4 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
 1. Source: Roller shade manufacturer.
 2. Type: PVC-coated fiberglass.
 3. Orientation on Shadeband: Up the bolt.
 4. Color: Silver Birch.

2.5 ROLLER SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch (6 mm) per side or 1/2-inch (13-mm) total, plus or minus 1/8 inch (3.1 mm). Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm).
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
 1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, locations of connections to building electrical system, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
 1. Opaque Shadebands: Located so shadeband is not closer than 2 inches (51 mm) to interior face of glass. Allow clearances for window operation hardware.
- B. Electrical Connections: Connect motor-operated roller shades to building electrical system.
- C. Roller Shade Locations: As indicated on Drawings.

3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION

SECTION 12 35 53.19

WOOD LABORATORY CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. The following specifications for Wood Laboratory Casework and related equipment outline the minimum requirements expected by the Owner and Architect on this project.
- B. Section Includes:
 - 1. Furnishing, delivering to the building, uncrating, setting in place, leveling, and anchoring all casework, countertops, equipment, and technical products listed in the specifications, equipment list or shown on the drawings.
 - 2. Furnishing and installing filler panels and scribes as required for finished installation.
 - 3. Furnishing laboratory service fixtures and fittings, as described in the specifications, equipment list or shown on the drawings, that are directly attached to the casework or equipment, complete with tank nipples and lock nuts for mounting on tops or curbs. Installation and final connections will be by other respective trades as part of their work.
 - 4. Furnishing laboratory sinks and cup sinks, complete with threaded sink outlets, and required overflows, plugs, and strainers as described in the specifications, equipment list or shown on the drawings. Installation and final connections will be by other respective trades as part of their work.
 - 5. Furnishing electrical service fixtures, as described in the specifications, equipment list or shown on the drawings, that are directly attached to the casework or equipment. Installation and final connections will be by other trades as part of their work.
 - 6. Removal of all debris, dirt, and rubbish accumulated as a result of installation of this equipment, to an onsite container provided by others.

1.2 REFERENCES

- A. ADAAG: 2004 Americans with Disabilities Act Accessibility Guidelines; Revised 2010 ADA Standards for Accessible Design.
- B. ANSI/ISEA Z358.1-2014: Emergency Eyewash and Shower Equipment.
- C. NFPA 30: Flammable and Combustible Liquids Code.
- D. NFPA 45: Standard on Fire Protection for Laboratories Using Chemicals.
- E. SEFA: Scientific Equipment and Furniture Association Recommended Practices. Desk Reference, 5th Edition, 2014. www.sefalabs.com
 - 1. SEFA 2-2010: Recommended Practices for Installation.
 - 2. SEFA 3-2010: Recommended Practices for Work Surfaces.
 - 3. SEFA 7-2010: Recommended Practices for Laboratory Service Fixtures.
 - 4. SEFA 8-W-2014: Recommended Practices for Wood Laboratory Grade Casework.
- F. California Air Resources Board; CARB Phase 2 Compliant.
- G. ANSI/HPVA HP-1 2009: Hardwood Veneer Core Plywood.
- H. ANSI A208.1-2009: Particleboard; Composite Panel.
- I. ANSI A208.2-2009: Medium Density Fiberboard (MDF); Composite Panel.

1.3 SUBMITTALS

- A. Shop Drawings: Submit shop drawings showing plans, service rough-Ins, elevations, sections, end views, service chases, countertop details, location and type of sinks and service fixtures, installation details, and location of grounds/blocking within walls for adequate wall cabinet reinforcement.
- B. Manufacturer's Data:
 - 1. Provide data indicating compliance with SEFA 8-W-2014, Laboratory Furniture Certificate of Performance Test from SEFA approved, Independent Test Facility.
 - 2. Provide Test Report from SEFA approved, Independent Test Facility certifying that wood casework finish complies with SEFA 8-W-2014, Chemical Resistance Testing requirements.
- C. Selection Samples: Submit (1) set of manufacturer's standard color chips for wood casework.

1.4 QUALITY ASSURANCE

- A. All laboratory casework, including cabinetry, work surfaces, sinks, and accessories, service fixtures and fittings, fume hoods, and technical products should be provided by the Wood Laboratory Casework Manufacturer.
- B. Provide certification that laboratory casework shall meet the performance requirements described in SEFA 8-W-2014.
- C. Provide certifications required in the specifications with submittal package.

1.5 PROJECT SITE CONDITIONS

- A. Building should be enclosed, windows and doors sealed, and weather-tight. HVAC system should be in operation and maintaining a temperature range of 65-80 degrees F. and relative humidity range of 25-55% in most parts of the U.S. The recommended relative humidity in the Damp Southern Coastal areas is 43-70% and the Dry Southwestern region is 20-50%.
 - 1. These ranges are needed in order to keep the moisture content of the wood casework at 5-10% and to prevent moisture problems such as drawers swelling or doors warping.
- B. Additional Conditions:
 - 1. Required grounds/blocking in walls for reinforcement of wall-mounted cabinets must be in place.
 - 2. If floor tile is required under casework, it must be in place.
 - 3. Overhead ductwork, ceiling grid, tile, and light fixtures must be in place.
 - 4. Wet operations complete.
 - 5. Painting complete.
 - 6. Service lines for water, gas, etc. must be flushed clean of dirt and chips, capped and tested for leaks prior to the Plumber's final connection of service fixtures and fittings.
 - 7. Electrical service and lighting should be available in each room where casework will be installed.

1.6 DELIVERY, STORAGE, HANDLING

- A. Delivery: Products shall be delivered to the project site in undamaged condition, unloaded by casework installer, distributed to required rooms, unpackaged, and made ready for installation.
- B. Storage: If rooms are not ready for installation, store product indoors, in ventilated areas with constant temperature range of 65-80 degrees F, and range of relative humidity as noted in Para 1.06, sub-para A. Do not remove wrapping or packaging material.
- C. Handling: Use proper moving equipment to unload and distribute equipment and utilize personnel that are experienced in moving furniture and equipment.
- D. Waste Disposal: Casework installers shall remove waste or refuse resulting from their casework installation and place in trash container and leave installation site clean and free of debris. Trash container shall be provided by others.

1.7 WARRANTY

- A. Casework Manufacturer Warranty: Provide written warranty with close-out documents stating that this contractor shall guarantee that all Wood Casework provided on this contract to be free from defects in material and workmanship for a period of (1) year from the date of final acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The products of Diversified Casework, Crystal Springs, MS are specified herein as the standard of quality required on this project.
- B. The following Manufacturers are approved to Bid this project based on providing Wood Laboratory Casework and Technical Products as specified, unless they submit a list of Product Deviations to the architect at least (10) days prior to Bid Date, and receive written approval by addendum to Bid on their deviations.
 - 1. Diversified Casework
 - 2. Kewaunee Scientific Corporation
 - 3. Hamilton Scientific

4. Campbell Rhea
 5. J&S Equipment Company.
- C. Qualifications of other Manufacturers seeking prior approval to bid this project.
1. Submit request to Architect at least (10) days prior to project bid date to allow adequate time for review.
 2. Provide name, location, and description of Wood Laboratory Casework Manufacturer, including source and data of laboratory grade service fixtures, work surfaces and sinks, fume hoods, and technical products.
 3. Provide list of (5) installations of comparable size and scope completed within the past (5) years, along with a contact name and phone number for each project.
 4. Provide a list of product deviations to the Architect describing any differences between proposed products and specified products.
 5. Provide products as specified, unless Deviations are approved in writing.
 6. Failure to submit product deviation list will result in Architect's assumption that proposed products do not deviate from specified products.
 7. Provide certification that manufacturer's product complies with standards and test performance of SEFA 8-W-2014.

2.2 MATERIALS

A. General

1. All casework shall be of modern design and shall be constructed in accordance with the recommended practices of the Scientific Equipment and Furniture Association. First class quality casework shall be established by use of modern machinery, tools, fixtures, and skilled workmanship.
2. The following definitions apply to wood laboratory casework units. Size and type of units is indicated on the drawings or equipment list.
 - a. Exposed surfaces of casework include exterior surfaces visible after installation when all doors and drawer fronts are closed. Visible surfaces in open cases or behind clear glass doors shall be considered as exposed portions. Back of drawer fronts and panel doors shall be considered as exposed surfaces. Bottoms of wall hung cabinets shall be considered as exposed.
 - b. Semi-exposed surfaces of casework shall include interior surfaces exposed to view only when opaque doors are open.
 - c. Unexposed surfaces not visible after installation include back rails, top side rails, stretchers, web frames, blocking, and components concealed by drawers. Also included is the underside of knee spaces and drawer aprons, as well as tops of 82" high tall cabinets and wall hung cabinets.

B. Casework Materials

1. Materials used for construction of cabinets, cases and tables as specified herein shall meet or exceed the minimum standards as described.
 - a. All exterior surfaces exposed to view after installation, and cabinet interior surfaces shall be Red Oak with the exception of drawer boxes which shall be Birch.
 - b. All wood panels made of plywood, particleboard, and medium density fiberboard shall be CARB Phase 2 Compliant.
 - c. Exposed solid wood: Plain sawn Red Oak lumber, Grade FAS or better, clear and free of defects. Lumber shall be air dried, then kiln dried, and tempered to moisture content of 6-9% before use.
 - d. Unexposed solid wood: Other hardwoods may be used that are Grade FAS or better, clear and free of defects, and properly dried same as Exposed solid wood.
 - e. Plywood: Hardwood Veneer Core Plywood shall be minimum 3-ply (1/4"), 5-ply (1/2"), 7-ply (3/4"), or 9-ply (1"), with select Red Oak, Grade A-1, plain sliced, book matched veneer face and back, and shall be ANSI/HPVA HP-1 2009 compliant. Use of other unexposed hardwood veneer is acceptable. Combination Core with composite crossbands is acceptable in lieu of Veneer Core.
 - f. Plywood: Composite Core Plywood for cabinet drawer fronts and panel doors shall be 3-ply, 3/4" thick with select Red Oak, Grade A-1, plain sliced, book matched veneer face and back, and shall be compliant with ANSI A208.1-2009 and/or ANSI A208.2-2009.
 - g. Banding: Plywood panels shall be edge banded where specified herein with 3mm solid oak edge band.

- h. Hardboard: Tempered Hardboard shall be 1/4" thick. All hardboard shall be composed of wood fibers and resinous binder compressed under heat and pressure.
- i. Glass: Wall Case framed swinging and framed sliding doors shall have 1/8" float glass. Wall Case unframed sliding doors shall have 1/4" float glass with polished edges. Tall Case framed swinging and framed sliding doors shall have 1/4" float glass.
- j. Tempered Glass: Tempered safety glass will be provided when specifically called for on the drawings or equipment list.

2.3 FABRICATION

A. Basis-of-Design Products:

- 1. Tall Cabinets: Diversified Casework: 353-4822.
- 2. Sink Cabinet: Diversified Casework: 581-4822.
- 3. ADA Sink Cabinet; 582-3622.
- 4. Base Cabinet: Diversified Casework; 506-3022.
- 5. Upper Wall Cabinet – Framed Glass Doors: Diversified Casework; D06-3616.
- 6. Drawer Cabinet: Diversified Casework; 522-1822.

B. General

- 1. The Wood Cabinetry selected for this project shall be as follows.
 - a. Cabinet Front Style: CLASSIC SERIES - Red Oak.
 - b. Cabinet drawer fronts and panel doors feature a square edge with slight radius, partial overlay style with plastic laminate fronts and Red Oak band.
- 2. Cabinets, tables, and other units shall be of the size and configuration indicated on the drawings and/or equipment list. Wood cabinetry is bored, doweled, grooved, and rabbeted construction.
- 3. Base Cabinet Construction
 - a. Cabinet End Panels shall be 3/4", Red Oak, veneer core plywood. End panels shall be doweled and glued to top frame members, intermediate rails, and bottoms.
 - b. Vertical Partitions shall be 3/4", Red Oak, veneer core plywood.
 - c. Exposed or Semi-exposed Edges of end panels, partitions, bottom panels, and shelves shall be edged with 3mm solid Oak edge banding.
 - d. Two-Piece Top Frame consists of nominal 1" X 3" solid Oak front rail, with back edge grooved to receive cross rails, and similar 1" X 3" solid Red Oak back rail, both set flush with cabinet ends, doweled and glued into place.
 - e. Top Frame Cross Rails are nominal 1" X 2-1/4" solid hardwood fully housed into front and back rails with tongue and groove joints to form a full four-sided top frame.
 - f. Intermediate Rails are provided on all base cabinets between drawer/drawer configurations and drawer/door configurations. Rails are nominal 1" X 3" solid Oak with back grooved to receive lock security panels (when panels are required). Rails shall be set flush with cabinet ends, doweled and glued into place.
 - g. Bottom Panel shall be 3/4", Red Oak, veneer core plywood. Panel shall be set flush with cabinet ends, doweled and glued into place.
 - h. Back Panel shall be 1/4" thick Red Oak plywood when cabinet interior is Exposed and 1/4" hardboard when cabinet interior is Semi-exposed. Backs are recessed into grooved end panels and secured on (4) sides.
 - i. Recessed Front Toe Rail shall be 4"x 3/4" hardwood veneer core plywood.
 - j. Cabinet Shelves shall be 1", Red Oak, veneer core plywood. Shelves are adjustable on 32mm centers, supported by (4) nickel-plated steel pin and socket type shelf clips.
 - k. Security Panels are 1/4" thick hardboard. Panel is provided between drawer/drawer and drawer/door base cabinets only when called for, or when locks are specified to be keyed differently.
- 4. Wall Cabinet Construction
 - a. Cabinet End Panels shall be 3/4", Red Oak, veneer core plywood. End panels shall be doweled and glued to top and bottom panels.
 - b. Vertical Partitions shall be 3/4", Red Oak, veneer core plywood.
 - c. Exposed or Semi-exposed edges of end panels, top and bottom panels, partitions, and shelves shall be edged with 3mm solid Oak edge banding.
 - d. Top and Bottom Panels shall be 1", Red Oak, veneer core plywood. Panels shall be set flush with cabinet ends, doweled and glued into place.

- e. Back Panel shall be 1/4" Red Oak plywood when cabinet interior is Exposed and 1/4" hardboard when interior is Semi-exposed. Back panels shall be rabbeted into ends and secured on all (4) sides.
 - f. Cabinet Shelves shall be 1", Red Oak, veneer core plywood. Shelves are adjustable on 32mm centers, supported by (4) nickel-plated steel pin and socket type shelf clips.
 - g. Top and Bottom Back Rail shall be 4" x 1/2" hardwood plywood pinned to rear of top and bottom panel.
 - h. Each wall cabinet will be provided with (2) heavy-duty, angled steel, mounting brackets screwed to the interior of the rear upper end panels, and shall be used for mounting cabinet through back panel and top back rail into wall structure. See para 3.02 Installation, sub-para C.1.c. for install method.
5. Tall Cabinet Construction
- a. Cabinet End Panels shall be 3/4", Red Oak, veneer core plywood. End panels shall be doweled and glued to top and bottom panels.
 - b. Vertical Partitions shall be 3/4", Red Oak, veneer core plywood.
 - c. Exposed edges of end panels, top and bottom panels, partitions, and shelves shall be edged with 3mm solid Oak edge banding.
 - d. Cabinet Top Panel shall be 1", Red Oak, veneer core plywood. Panel shall be set flush with cabinet ends, doweled and glued into place.
 - e. Cabinet Bottom Panel shall be 3/4", Red Oak, veneer core plywood. Panel shall be set flush with cabinet ends, doweled and glued into place.
 - f. Top Back Rail and Center Back Rail shall be 3" x 1" solid hardwood doweled and glued into end panels.
 - g. Bottom Back Rail shall be 4" x 3/4" hardwood veneer core plywood doweled and glued into end panels.
 - h. Recessed Bottom Front Toe Rail shall be 4" x 3/4" Red Oak plywood doweled and glued into end panels.
 - i. Back Panel shall be 1/4" Red Oak plywood when cabinet interior is Exposed and 1/4" hardboard when interior is Semi-exposed. Backpanels are recessed into grooved end panels and secured on (4) sides.
 - j. Shelves shall be 1", Red Oak, veneer core plywood with (1) center fixed shelf and (4) adjustable shelves that are adjustable on 32mm centers, supported by (4) nickel-plated steel pin and socket type shelf clips.
 - k. Each tall cabinet shall be provided with (2) heavy-duty, angled steel, mounting brackets screwed to the interior of the rear upper end panels, and shall be used for mounting cabinet through back panel and top back rail into wall structure. See para 3.02 Installation, sub-para C.1.c. for install method.
6. Drawers and Doors
- a. Drawer Fronts: CLASSIC SERIES - Square Edge Partial Overlay Style. 3/4", Red Oak, composite core plywood and 3mm solid Oak edge band with a slight radius. Face shall be Plastic Laminate Oak Veneer; color selected by Owner.
 - b. Drawer Box Body: Front, sides, and back are 1/2" thick 9-ply birch plywood. Concealed chuck and bore joinery with sides glued and pinned to front and back. 1/4" thick hardboard bottom with white melamine surface. Bottom set in grooves on (4) sides, hot-melt glued on underside. Drawer box has clear chemical resistant finish. Top edge of box provided with finished top cap to conceal edge of veneer core.
 - c. Panel Doors - Base Cabinets: CLASSIC SERIES - Square Edge Partial Overlay Style. 3/4", Red Oak, composite core plywood and 3mm solid Oak edge band with a slight radius. Face shall be Plastic Laminate Oak Veneer; color selected by Owner.
 - d. Panel Doors - Wall and Tall Cabinets: CLASSIC SERIES - Square Edge Partial Overlay Style. 3/4" Red Oak, composite core plywood and 3mm solid Oak edge band with a slight radius. Face shall be Plastic Laminate Oak Veneer; color selected by Owner.
 - e. Framed Glass Doors - Wall and Tall Cabinets: Shall have 3/4" X 3" solid Red Oak top, bottom, and side rails, doweled and glued together; sanded for smooth fit, and edge detailed to match door selection. Tall Cabinet doors shall also have a 3/4" x 6" solid Red Oak center rail.

7. Utility Tables

- a. Tables shall be fully framed with 3/4" x 4" radius edged solid Oak apron rails with diagonal heavy-duty steel corner braces locked into grooves and screwed with four (4) screws to inner face of rails. Intermediate rails shall be solid hardwood. Table legs shall be properly fitted into position and securely fastened to diagonal corner braces with nut, washer and 3-1/2" x 5/16" carriage bolt, completely running through the leg providing a positive system, whereby bolt can be tightened without depending upon screw holding power of the table legs. Legs shall be 2-1/4" square, laminated solid Oak, thoroughly glued, and radius edged. Legs shall be equipped with rubber leg shoes, and adjustable nylon glides.

2.4 LABORATORY GRADE WOOD FINISH

- A. Prior to application of wood finish, component parts shall be carefully sanded and buffed in preparation for the finishing process.
 1. Exposed surfaces shall receive a stain and sealer coat of synthetic resin. The product is then cured at elevated temperatures. After the sealer coat, the product shall be sanded, wiped clean, and then a double pass coat of chemical resistant synthetic resin shall be applied and cured at elevated temperatures.
 2. Semi-exposed surfaces receive sealer coat and a double pass coat of chemical resistant synthetic resin.
 3. Unexposed cabinet end panels receive a sealer coat.
- B. Cabinet Surface Finish Tests and Evaluation.
 1. The final finished wood product shall meet the performance test requirements and evaluations described under Paragraph 8.0 Cabinet Surface Finish Tests found in Section 8-W-2014 of the SEFA Recommended Practices for Laboratory Grade Wood Casework.
 2. Paragraph 8.1 Chemical Spot Test and 8.1.1 thru 8.1.3. This Test Procedure describes the testing of a Red Oak wood veneer panel, without stain, using (49) chemical reagents with each given a final rating system of Level 0, Level 1, Level 2, or Level 3. After testing, panel shall have no more than (4) Level 3 conditions.
 3. Paragraph 8.2 Hot Water Test and 8.2.1 thru 8.2.3. This Test Procedure describes the testing of a Red Oak wood veneer panel using hot water with no visible effect.
 4. The above Test Procedure shall be performed for Wood Casework Manufacturer by an Independent third party, SEFA approved, testing facility.
- C. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications and as follows:
 1. Vertical Surfaces: VGS, 0.028 inch nominal thickness, through color, colors as scheduled in finish schedule.

2.5 CASEWORK HARDWARE AND ACCESSORIES

- A. Hinges: Institutional type, ground tip, five-knuckle, with pins of not less than 0.177" in diameter and leaves of not less than 0.095" thick. Hinges shall be 2-3/4" long wrought steel with chemical resistant epoxy powder coating. Two (2) hinges shall be provided on doors under 36" in height and three (3) hinges for doors 36" and over. Standard color of epoxy powder coat is Black.
- B. Pulls: Solid metal, wire type, 4" long mounted with two (2) screws fastened from back. Pulls shall have chemical resistant epoxy powder coating to match hinges. Provide two (2) pulls for drawers over 24" wide. Standard color of epoxy powder coat is Black.
- C. Drawer Slides: Slides for standard drawers shall be 3/4 extension, epoxy powder coated, cold rolled steel, side/bottom mounting, nylon rollers, positive stop, and with 100 lb. load capacity. Slides for file drawers shall be full extension, zinc plated anochrome finish, ball bearing, side mount with lever release disconnect.
- D. Door Catches: Provide two (2), top and bottom, dual, self-aligning magnetic catches on base and wall cabinet doors, and two (2) heavy-duty magnetic catches on tall cabinet doors.
- E. Elbow Catches: Brass with latch held by coiled compressing spring. Catch plates of 16 gauge plated steel. Provide on base and wall cabinets with double doors where locks are specified.
- F. Spring Actuated Latch: Latch has 4-5/8" bevel slide bolt with 2-1/4 lb./in. actuated spring. Provide on tall cabinets with double doors where locks are specified.
- G. Leg Shoes: Molded vinyl or rubber, black, coved bottom type.

- H. Glass: Type I, Class I, float glass.
- I. Locks: Locks are provided only if specifically shown on drawings, or indicated on the equipment list, or where included in a product catalog number. Locks are laboratory grade, cylinder cam locks, with 5-disc tumbler mechanism, and a dull chrome-plated face. Tumblers and keys are brass, while plug and cylinder are die cast zinc alloy. Locks are equipped with RemovaCore™ keying control. With the use of a control key, the key core of the lock assembly can be removed and a new key core inserted, changing the entire locking system.
 - 1. Keying Option - 2
 - a. Locks are keyed alike per room, but each room different and master keyed. Each lock in a room can be opened with (1) key, but each room would have a different key, and all rooms can be opened with a single master key. Provide a minimum of (2) master keys per project.
- J. Sliding Doors (Frameless Glass): 1/4" thick float glass with polished edges. Doors operate on metal track applied at top and bottom front horizontal rails of cabinet. Doors are easily removable for cleaning. Locks, when indicated, shall be showcase type.
- K. Sliding Doors (Framed Glass/Wood Tall Cabinets): 1/4" thick float glass. Doors operate in overhead metal track with ball bearing rollers and nylon wheels. Plastic tracks applied to bottom and sized to allow cleaning space at each end. Locks, when indicated, shall be plunger bolt type.
- L. Sliding Doors (Framed Glass/Wood Wall Cabinets): 1/8" thick float glass. Doors operate in overhead plastic track. Plastic tracks applied to bottom and sized to allow cleaning space at each end. Locks, when indicated, shall be plunger bolt type.
- M. Tote Trays: High impact molded plastic tray with high gloss.

2.6 WORK SURFACES, SINKS, AND ACCESSORIES

- A. General
 - 1. Comply with physical and chemical resistance requirements for materials for tops, sinks, and accessories as specified herein and in accordance with SEFA 3-2010 Laboratory Work Surfaces.
 - 2. Provide tops with smooth, clean, exposed surfaces and edges, in uniform plane, free of defects. Provide 4" high x 1" thick back splash and end splash where tops abut walls, or where shown on drawings.
 - a. Top sizes: Furnish tops in longest practical lengths, in configuration indicated on the drawings.
- B. Work Surfaces
 - 1. Epoxy Resin Tops (Shelresin): Shall consist of sheets cast from modified epoxy resin and non-asbestos inert fillers; compounded mixture cured and thermoset specifically from formulation to provide exceptional physical and chemical resistance required in medium to heavy duty laboratory environments.
 - a. Wall Counters: Shall be monolithic throughout without surface coating application, and shall be flat and 1" thick with 1/8" chamfered exposed edges. Provide drip grooves under all exposed edges. Exposed corners shall be eased slightly for safety. Bond joints of tops and splashes with highly chemical resistant cement with properties and color similar to base material. Standard color is Black.
 - b. Minimum Physical Properties and Test Results.

1)	TEST	ASTM	METRIC
2)	Rockwell Hardness	D785-08	110 (M scale)
3)	Density	D792-00	2.16 (g/cm ³)
4)	Compressive Strength	D695-02	265 (MPa)
5)	Flexural Strength	D790-07	103 (MPa)
6)	Fire Resistance	D635-06	Self Extinguishing
7)	Water Absorption	D570-98	0.008 (% after 24 hrs)
8)	Linear Thermal Expansion	D696-03	2.46 x 10 ⁻⁵
9)	Flame Spread Index	E84-06	7.4
10)	Smoke Developed Index	E84-06	221.2
 - c. Chemical Resistance Tests and Evaluation.
 - 1) Epoxy Resin Tops shall meet the performance test requirements and evaluations described under Paragraph 2.1.1 Chemical/Stain
 - 2) Resistance Test found in Section 3-2010 of the SEFA Recommended Practices for Laboratory Work Surfaces.

- 3) Epoxy Resin Top material shall be tested using (49) Reagents, and shall result in no more than (4) Level-3 conditions.
2. Provide raised drip edge at all Prep Lab countertops and all prep lab epoxy resin shelves in storage cabinets.
- C. Sinks and Troughs
 1. Epoxy Resin Sinks (Shelresin): Shall be one-piece, molded construction. Sinks to be "drop-in" style with inside corners and bottoms coved for easy cleaning. Standard color of sink is Black.
- D. Sink Outlets
 1. Epoxy Resin Sinks shall be provided with 1-1/2" dia. x 3" threaded polypropylene sink outlet with locknut, removable disc strainer, and sink stopper.

2.7 LABORATORY SERVICE FIXTURES AND FITTINGS

- A. Water Faucets and Valves.
 1. Provide units that comply with SEFA 7 - 2010, Laboratory Service Fittings Recommended Practices, and also complying with ANSI/ASME 112.18.1-2005 and certified by CSA International under CAN/CSA B.125.1-05.
 2. Provide units fabricated from cast or forged red brass unless otherwise indicated.
 3. Provide fittings complete with threaded mounting shanks, locknuts, and washers. Include necessary flanges, escutcheons, extension rods, etc.
 4. Provide units complying with ADA accessible requirements where indicated on Drawings or Equipment List. Provide (1) faucet with 4" wrist blade handles at ADA sinks.
 5. All Water Faucets shall be provided with Aerators unless specifically noted to have Serrated Hose Ends.
 6. If Serrated Hose Ends are designated on any Water Faucets, provide unit with Vacuum Breaker.
 7. Water Faucets shall have self-contained renewable compression valve units with stainless steel valve seats. Compression unit valve stem shall be sealed with molded TFE stem packing to prevent leakage. Provide color coded index discs.
- B. Multiple Service Combination Faucets shall be provided with the following Vandal-Resistant construction features.
 1. Goosenecks and faucet risers shall be constructed of minimum 1/2" IPS heavy wall pipe that is sufficient to resist bending and breakage.
 2. Aerators of Serrated Hose Ends shall be Vandal-Resistant design.
 3. Index discs shall be tamperproof and cemented in place.
 4. Fittings for laboratory gases shall be provided with ball valves and internal check valves (except vacuum) to prevent back flow into gas system.
 5. Where serrated hose ends are designated, integral vacuum breakers shall be provided, and shall have vandal-resistant brass bonnet and cover screws to prevent removal only by maintenance personnel.
 6. Combination water/gas faucets shall have inlet shanks machined from solid brass bar stock and heavy wall steel pipe.
- C. Quality Assurance
 1. All water faucets and gas fixtures shall be fully assembled and factory tested prior to shipment.
- D. All Diversified Casework Unicast water faucets and gas fixtures shall have Black Powder Coat Epoxy Finish.
 1. Reference Plumbing Schedule as indicated on Drawings.
- E. Electrical Fixtures
 1. Electrical Fixtures that are a part of, or installed in the Lab Equipment shall be approved by the National Board of Underwriters and must conform to City and State Building Codes.
 2. Knock-out Boxes when indicated, shall be installed in the Lab Equipment.
 3. Receptacles shall be grounded type, 20-amp heavy-duty industrial grade.

2.8 SCIENCE LAB EQUIPMENT

- A. Drying Rack
 1. As scheduled on Drawings.
- B. Jumbo Stacking Acid Storage Cabinet
 1. As scheduled on Drawings.

- C. Combination Emergency Shower and Eyewash Unit
 - 1. As scheduled on Plumbing Drawings.
- D. Eye Safety Cabinet
 - 1. As scheduled on Drawings.
- E. SE3006 FIRE BLANKET
 - 1. Red metal case with white lettering containing a fire retardant-treated wool blanket for smothering fires. Blanket dimensions are 66"W x 72"L. Drop hinge door allows for quick access.
 - 2. Provide one at each science lab.
- F. Diversified Casework: P7106K34N TWO STUDENT TABLE
 - 1. 60" L. X 42" W. X 34" H. frame. Hardwood fully framed with rails 3/4" X 4" with diagonal corner braces tenoned and screwed to inner face of rails. The corner braces shall be metal, grooved and screwed with four screws. Table legs shall be properly fitted into position and securely fastened to diagonal corner brace with nut, washer and 3-1/2" x 5/16 carriage bolt completely running through the leg providing a positive system whereby bolt can be tightened without depending upon screw holding power of the table legs. Legs shall be 2-1/4" square of solid laminated hardwood, thoroughly glued, and corners rounded. Legs shall be equipped with rubber leg shoes, and nylon adjustable glides. Top to be 1" Shelresin.
 - 2. Provide six tables at each science lab.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. The casework contractor shall verify that building conditions have been completed as described in Paragraph 1.06 Project Site Conditions, sub-paragraphs A. and B. which outline building readiness required before casework installation begins.

3.2 INSTALLATION

- A. Installer Qualifications: The Installer shall have a minimum of (5) years of experience installing laboratory casework using professional and accepted trade practices and be familiar with SEFA's Recommended Practices as described in SEFA 2-2010.
- B. Coordination: Coordinate the work of this Section with regard to installing casework. Cooperate with other trades regarding the mechanical and electrical connections to casework that are provided in their work, including final connections to sinks, plumbing fixtures, electrical fixtures, fume hoods, etc.
- C. Performance:
 - 1. Casework:
 - a. Set base cabinets in place, level, secure to walls or floors as necessary. Install fillers, trim and scribe to walls. Shim as required using concealed shims.
 - b. Screw continuous cabinets together with joints flush, tight and uniform.
 - c. Secure tall cabinets and wall cabinets to walls. Secure these cabinets to solid supporting material, utilizing grounds/blocking that is provided in walls in another section of work. Use steel mounting brackets for attachment to walls that are provided in wall and tall cabinets by manufacturer.
 - 2. Work Surfaces:
 - a. Work surfaces shall be installed with nominal one inch overhang on front and end, unless otherwise indicated on shop drawings.
 - b. Level and shim as necessary. Shims shall generally not exceed 1/8 inch.
 - c. Install work surfaces to achieve a uniform alignment of the front edge of top.
 - d. Only factory prepared field joints, located per shop drawings, shall be permitted.
 - e. Secure work surfaces to understructure with adhesive or mechanical fasteners per manufacturer's recommendations.
 - f. Provide flush joints not to exceed 1/8 inch between sections.
 - g. Grout Butt joints with material and method per manufacturer's recommendation.
 - h. Backsplashes and end returns shall be secured in place with joint sealed per manufacturer's recommendation.

3.3 ADJUST AND CLEANUP

- A. Adjust doors and drawers to operate smoothly.

- B. Clean casework and touch-up as required.
- C. Clean work surfaces.
- D. Remove all debris, dirt, rubbish, and excess material as a result of the installation of this equipment and leave clean and orderly.

3.4 PROTECTION

- A. Provide countertops with kraft paper or cardboard after installation to help prevent damage from other trades.
- B. Advise Contractor or Owner's Representative of procedures and precautions for protection of casework, work surfaces, and fixtures from damage by work of other trades.

END OF SECTION

SECTION 12 36 23.13

PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes plastic-laminate-clad countertops.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For plastic-laminate-clad countertops.
 - 1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
 - 2. Show locations and sizes of cutouts and holes for items installed in plastic-laminate-clad countertops.
 - 3. Apply AWI Quality Certification Program label to Shop Drawings.
- C. Samples for Verification: As follows:
 - 1. Plastic Laminates: For each type, color, pattern, and surface finish required, 8 by 10 inches (200 by 250 mm) in size.
 - 2. Fabrication Sample: For each type and profile of countertop required, provide one sample applied to core material with specified edge material applied to one edge.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For the following:
 - 1. Composite wood products.
 - 2. High-pressure decorative laminate.
 - 3. Adhesives.
- C. Quality Standard Compliance Certificates: AWI Quality Certification Program.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
 - 1. Shop Certification: AWI's Quality Certification Program accredited participant.
- B. Installer Qualifications: Fabricator of products.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.
- B. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
- C. Keep surfaces of countertops covered with protective covering during handling and installation.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during the remainder of the construction period.
- B. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

- C. Established Dimensions: Where countertops are indicated to fit to other construction, establish dimensions for areas where countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD COUNTERTOPS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of plastic-laminate-clad countertops indicated for construction, finishes, installation, and other requirements.
 - 1. Provide inspections of fabrication and installation together with labels and certificates from AWI certification program indicating that countertops comply with requirements of grades specified.
 - 2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.
- B. Grade: Custom.
- C. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Formica Corporation.
 - b. Nevamar; a Panolam Industries International, Inc. brand.
 - c. Wilsonart.
- D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. As scheduled.
- E. Edge Treatment: 3-mm (0.12 inch) PVC edging.
- F. Core Material: Particleboard or MDF.
- G. Core Material at Sinks: MDF made with exterior glue or exterior-grade plywood.
- H. Core Thickness: 3/4 inch (19 mm).
 - 1. Build up countertop thickness to 1-1/2 inches (38 mm) at front, back, and ends with additional layers of core material laminated to top.
- I. Backer Sheet: Provide plastic-laminate backer sheet, NEMA LD 3, Grade BKL, on underside of countertop substrate.
- J. Paper Backing: Provide paper backing on underside of countertop substrate.

2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.
 - 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of countertop and quality grade specified unless otherwise indicated.
 - 1. MDF: Medium-density fiberboard, ANSI A208.2, Grade 130.
 - 2. Particleboard: ANSI A208.1, Grade M-2.
 - 3. Softwood Plywood: DOC PS 1.

2.3 ACCESSORIES

- A. Wire-Management Grommets: Circular, molded-plastic grommets and matching plastic caps with slot for wire passage.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Doug Mockett & Company, Inc.: TG Flip-Top Series.
 - 2. Outside Diameter: 2 inches (51-mm).
 - 3. Color: As selected by Architect from Manufacturer's full range.
- B. Concealed Countertop Support Brackets: Concealed in-wall steel support brackets, rigidly fastened to metal studs with 2x4 wood blocking inside walls. Brackets equal to A&M Brackets "EC" series concealed brackets, except where a window or other opening above a countertop interferes with the upward leg of the bracket inside the wall then use A&M Brackets "C" series concealed brackets.

1. Sizes:
 - a. For countertops up to 25" deep, use 2" EC-21.
 - b. For countertops 25" to 30", use 2" EC-24.
 - c. For countertops 30" to 36", use 2" EC-30.
2. Space brackets as indicated in drawings, or as required to meet design loading requirements, whichever is closer.

2.4 MISCELLANEOUS MATERIALS

- A. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.5 FABRICATION

- A. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch (25 mm) over base cabinets. Ease edges to radius indicated for the following:
 1. Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.
- B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- C. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 1. Seal edges of cutouts by saturating with varnish.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.
- B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing.

3.2 INSTALLATION

- A. Grade: Install countertops to comply with same grade as item to be installed.
- B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.
 1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 2. Seal edges of cutouts by saturating with varnish.
- C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
 1. Secure field joints in countertops with concealed clamping devices located within 6 inches (150 mm) of front and back edges and at intervals not exceeding 24 inches (600 mm). Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.
- D. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Countertop Installation: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 1. Install countertops level and true in line. Use concealed shims as required to maintain not more than a 1/8-inch-in-96-inches (3-mm-in-2400-mm) variation from a straight, level plane.
 2. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c. and to walls with adhesive.
 3. Seal joints between countertop and backsplash, if any, and joints where countertop and backsplash abut walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.
- B. Clean countertops on exposed and semiexposed surfaces.
- C. Protection: Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches (1220 mm) o.c. Remove protection at Substantial Completion.

END OF SECTION

SECTION 12 36 61.16

SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid surface material countertops.
 - 2. Solid surface material backsplashes.
 - 3. Solid surface material end splashes.

1.2 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
 - 1. Show locations and details of joints.
 - 2. Show direction of directional pattern, if any.
- C. Samples for Verification: For the following products:
 - 1. Countertop material, 6 inches (150 mm) square.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of countertops.
- C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
 - 1. Build mockup of typical countertop as shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.6 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. E. I. du Pont de Nemours and Company.
 - b. Formica Corporation.
 - c. Wilsonart.
 - 2. Type: Provide Standard type unless Special Purpose type is indicated.
 - 3. Colors and Patterns: As scheduled.
- B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

- C. Wire-Management Grommets: Circular, molded-plastic grommets and matching plastic caps with slot for wire passage.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Doug Mockett & Company, Inc.: TG Flip-Top Series.
 - 2. Outside Diameter: 2 inches (51-mm).
 - 3. Color: As selected by Architect from Manufacturer's full range.
- D. Concealed Countertop Support Brackets: Concealed in-wall steel support brackets, rigidly fastened to metal studs with 2x4 wood blocking inside walls. Brackets equal to A&M Brackets "EC" series concealed brackets, except where a window or other opening above a countertop interferes with the upward leg of the bracket inside the wall then use A&M Brackets "C" series concealed brackets.
 - 1. Sizes:
 - a. For countertops up to 25" deep, use 2" EC-21.
 - b. For countertops 25" to 30", use 2" EC-24.
 - c. For countertops 30" to 36", use 2" EC-30.
 - 2. Space brackets as indicated in drawings, or as required to meet design loading requirements, whichever is closer.

2.2 COUNTERTOP FABRICATION

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
 - 1. Grade: Custom.
- B. Countertops: 1/2-inch- (12.7-mm-) thick, solid surface material.
- C. Backsplashes: 1/2-inch- (12.7-mm-) thick, solid surface material with wood-trimmed edges.
- D. Fabricate sills in one piece where possible. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing. Provide 3/4" projection of sills from face of wall.
- E. Edge Profile: Micro-chamfer exposed top and bottom edges.
- F. Joints: Fabricate countertops without joints.
- G. Cutouts and Holes:
 - 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
 - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch (5 mm) into fixture opening.
 - 2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
 - 3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m), 1/4 inch (6 mm) maximum. Do not exceed 1/64-inch (0.4-mm) difference between planes of adjacent units.

- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- F. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Pre-drill holes for screws as recommended by manufacturer.
- G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
 - 1. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- H. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

END OF SECTION

SECTION 12 61 00

FIXED AUDIENCE SEATING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes fixed, chair-type seating with the following:
 - 1. Standard mounting.
 - 2. Upholstered chairs.

1.2 DEFINITIONS

- A. Pan: An exposed, supporting seat bottom made of steel.
- B. Shell: An exposed, supporting seat bottom or back made of materials other than steel.

1.3 COORDINATION

- A. Coordinate layout and installation of electrical wiring and devices with seating layout to ensure that floor junction boxes for electrical devices are accurately located to allow connection without exposed conduit.
- B. Coordinate layout and installation of diffuser pedestals with HVAC work and with properties of diffuser pedestals to ensure alignment, proper air diffusion, and correct seat locations.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of components, and finishes for fixed audience seating.
 - 2. Include electrical characteristics of electrical components, devices, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Seating Layout: Show seating layout, aisle widths, aisle-end alignment or stepping, row-lettering and chair-numbering scheme, chair widths, and chair spacing in each row.
 - 3. Accessories: Show locations and features of accessories, including-- electrical devices, and accessibility provisions.
 - 4. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For each type of exposed color, finish, texture, and pattern indicated.
 - 1. Include Samples of accessories involving color and finish selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Chair Unit: Full-size unit of each type and combination of finishes.
 - 2. Baked-on Coating Finishes: Manufacturer's standard-size unit, not less than 3 inches (75 mm) square.
 - 3. Wood and Plywood Materials and Finishes: Manufacturer's standard-size unit, not less than 3 inches (75 mm) square.
 - 4. Upholstery Fabric: Full width by 36-inch- (914-mm-) long section of fabric from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of fabric.
 - 5. Row-Letter and Chair-Number Plates: Full-size units with letters and numbers marked.
 - 6. Aisle Lighting: Full-size unit.
 - 7. Exposed Fasteners: Full-size units of each type.
 - 8. Full-size samples of chair units, if approved, will be returned to Contractor for use in Project.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of fixed audience seating.
- B. Material Certificates: For each type of flame-retardant treatment of upholstery fabric.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fixed audience seating to include in operation and maintenance manuals.
 - 1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
 - a. Maintenance of self-rising seat mechanisms, folding armrests, and other operating components.
 - b. Adjustment of self-rising seat mechanisms to align seats.
 - c. Maintenance of electrical components, devices, and accessories.
 - d. Methods for maintaining upholstery fabric.
 - e. Precautions for cleaning materials and methods that could be detrimental to seating finishes and performance.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Chair Seats and Backs: 5 percent of quantity installed for each type and size of chair seat and back.
 - 2. Upholstered, Slip-on Cushions: 5 percent of quantity installed for each type and size of cushion.
 - 3. Fabric: 5 percent on the bolt of quantity installed for each type.

1.9 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Build mockups of two typical seats or a typical two-seat unit, including finishes and accessories:
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of fixed audience seating that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including standards, beams, and pedestals.
 - b. Faulty operation of self-rising seat mechanism.
 - c. Faulty operation of electrical components.
 - d. Wear and deterioration of fabric and stitching beyond normal use.
 - e. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Periods: As follows, from date of Substantial Completion.
 - a. Structural: Lifetime.
 - b. Operating Mechanisms: Five years.
 - c. Electrical Components: Five years.
 - d. Plastic, Wood, and Paint Components: Five years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of seating required, including accessories and mounting components, from single source from single manufacturer.
 - 1. Upholstery Fabric: Obtain fabric of a single dye lot for each color and pattern of fabric required.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics of Upholstered Chairs:
 - 1. Fabric and Padding:
 - a. Fabric: Class 1 according to DOC CS 191 or 16 CFR 1610, tested according to California Technical Bulletin 117-2000.
 - b. Padding: Comply with California Technical Bulletin 117-2000.
 - 2. Upholstery Assembly: Assembly shall comply with component-testing requirements of California Technical Bulletin 117-2013.
 - 3. Full-Scale Fire Test: Comply with California Technical Bulletin 133.
- B. Strength and Durability Performance: Chairs and components shall pass testing according to BIFMA X5.4.

2.3 FIXED AUDIENCE SEATING

- A. Description: Assembly-space seating in permanent arrangement as indicated on Drawings.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. American Seating Company.
 - b. Ducharme Seating International Inc.
 - c. Hussey Seating Company.
 - d. Interkal LLC.
 - e. Irwin Seating Company.
 - f. Krueger International, Inc.
 - g. Preferred Seating Co. Inc.
 - h. Seating Concepts LLC.
 - i. SERIES LLC.
 - j. Sitmatic.
 - k. Southern Bleacher Company Inc.
 - l. Theatre Solutions, Inc.
 - 2. Basis-of-Design Products for Auditorium Seating:
 - a. Hussey Seating Company; Quattro.
 - b. Irwin Seating Company; Model 90.12.00.4 Citation.
 - 3. Basis-of-Design Products for Gymnasium Seating:
 - a. Irwin Seating Company; 30C Chair Platform.
 - b. Irwin Seating Company; 4C Chair Platform.
 - c. Irwin Seating Company; 12 Universal New Pivot.
- B. Chair Mounting Standards: Floor attached of the following material:
 - 1. Steel: One-piece, heavy-tube or reinforced sheet with welded mounting plate and welded connections for seat pivots, backs, armrests, and end panels.
- C. Chair Mounting Beam: Steel horizontal beam mounted on floor -attached steel support pedestals spaced at intervals of 2 to 2-1/2 chair widths.
- D. End Panels: Plastic laminate.
- E. Fabric Upholstered Chairs:
 - 1. Back:
 - a. Padding Thickness: 1-1/4 inches (32 mm), unless otherwise indicated.
 - b. Outer Back Surface: As selected by Architect from manufacturer's full range.
 - 2. Seat: Two part, top and bottom construction and as follows:
 - a. Top Padding Thickness: Minimum 5/8 inch.
 - b. Seat Bottom: Molded-plastic shell.
- F. Plastic Chairs, Where Indicated:
 - 1. Back: Smooth surface.
 - 2. Seat: Smooth surface with upholstered inserts.
 - 3. Upholstered Inserts: Padding and fabric covering over 1/8-inch (3-mm) plywood or MDF backing board, recessed 3/16 inch (5 mm) into plastic surface, centered, and attached with hidden, vandal-resistant fasteners.
- G. Formed Hardwood-Veneer Chairs, Where Indicated: Hardwood-veneer-faced, formed plywood backs and seats, with concealed fasteners.
- H. Chair Width: Vary chair widths to optimize sightlines and row lengths.

- I. Back Height: Minimum 33 inches high from the floor.
 - J. Back Pitch: Fixed.
 - 1. Chair Back Hinges: Self-lubricating type with noiseless mechanism that raises back to vertical position when chair is unoccupied.
 - K. Chair Seat Hinges: Self-lubricating, with noiseless self-rising seat mechanism passing ASTM F 851, positive internal stops cushioned with rubber or neoprene, and requiring no maintenance.
 - 1. Self-Rising Seat Mechanism: Manufacturer's standard.
 - L. Armrests: Material as selected by Architect from manufacturer's full range, with rounded edges and concealed mounting.
 - M. Aisle-Lighting Fixtures: Manufacturer's standard fixtures.
 - 1. Power: 24 V.
 - 2. For low-voltage lighting, provide manufacturer's voltage-reduction device housed in safety enclosure equipped with fuses, terminal blocks, and safety disconnect.
 - N. Accessible Seating:
 - 1. Provide removable chair for each wheelchair space unless otherwise indicated.
 - 2. Provide chairs with folding armrest on aisle side in locations indicated, but not less than 5 percent of aisle seats, dispersed through the audience seating area. Identify these seats with a sign or marker.
 - O. Row-Letter and Chair-Number Plates: Manufacturer's standard.
 - 1. Material: Aluminum with black embossed characters.
 - 2. Location: As indicated on Drawings.
 - 3. Attachment: Manufacturer's standard method.
 - P. Accessibility-Logo Plates: Manufacturer's standard.
 - 1. Material: Aluminum with black embossed characters.
 - 2. Location: As indicated on Drawings.
 - 3. Attachment: Manufacturer's standard method.
- 2.4 MATERIALS AND FINISHES
- A. Composite Wood Products: Products shall be made using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.
 - B. Concealed Plywood: HPVA HP-1 hardwood plywood or DOC PS 1 softwood plywood as standard with manufacturer.
 - C. Exposed Plywood: HPVA HP-1, Face Grade A, hardwood-veneer core with color-matched hardwood-veneer faces.
 - D. Hardwood Lumber and Veneer Faces: Birch, unless otherwise indicated, selected to be free of visible defects.
 - 1. Stain and Finish: Manufacturer's standard, transparent, UV-resistant, protective finish.
 - E. Molded Plastic: High-density polyethylene or polypropylene, blow or injection molded, with surface that is mar and dent resistant.
 - 1. Provide with UV inhibitors to retard fading.
 - 2. Color and Texture: As selected by Architect from manufacturer's full range.
 - F. Fabric: Manufacturer's standard with flame-retardant treatment if required to meet performance requirements.
 - 1. Color and Pattern: As selected by Architect from manufacturer's full range.
 - G. Upholstery Padding: Flexible, cellular, molded or slab polyurethane foam.
 - 1. Pounding-Fatigue Performance: Grade AP (heavy-duty use) for seats and Grade BP (normal duty use) for backs; according to ASTM D 3453.
 - H. Metal Finish: Finish exposed metal parts with manufacturer's standard baked-on coating.
 - 1. Color: As selected by Architect from manufacturer's full range.
 - I. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 FABRICATION

- A. Floor Attachments: Fabricate to conform to floor slope so that standards and pedestals are plumb and chairs are maintained at same angular relationship to vertical throughout Project.
- B. Upholstery: Fabricate fabric-covered cushions with molded padding beneath fabric and with fabric covering free of welts, creases, stretch lines, and wrinkles. For each upholstered component, install pile and pattern run in a consistent direction.
- C. Upholstered Chairs: Fabricate as follows:
 - 1. Two-Part Upholstered Back: Padded cushion glued to a curved inner panel and covered with easily replaceable fabric; with curved outer back shell that fully encloses upholstery edges.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine floors, risers, and other adjacent work and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Verify that electrical connections are properly located.
- C. Verify that HVAC air-distribution locations are correct.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install seating in locations indicated and fasten to substrates according to manufacturer's written installation instructions.
 - 1. Install seating with each chair capable of complying with performance requirements without failure or other conditions that might impair the chair's usefulness.
 - 2. Install standards and pedestals plumb.
 - 3. Install seating so moving components operate smoothly and quietly.
- B. Install seating with end standards aligned or stepped as indicated from first to last row and with backs and seats varied in width and spacing to optimize sightlines.
- C. Where seating is indicated in curved rows, install seating at a constant radius unless otherwise indicated.
- D. Install wiring conductors and cables concealed in components of seating and accessible for servicing.
 - 1. Connect electrical service at junction-box locations according to Electrical Engineer's documents.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Inspect components, assemblies, and equipment, including connections, to verify proper, complete, and sturdy installation according to manufacturer's written instructions and product specifications.
 - 2. Verify that self-rising seats return to uniform at-rest, raised position.
 - 3. Test power receptacles as indicated in Electrical Engineer's documents.
 - 4. Test data ports when data connection is activated.
- B. Fixed audience seating will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust chair backs so that they are at required angles and aligned with each other in uniform rows.
- B. Adjust hardware and moving parts to function smoothly so they operate easily. Lubricate bearings and sliding parts as recommended in writing by manufacturer.
- C. Adjust self-rising seat mechanisms so seats in each row are aligned when in upright position.
- D. Repair minor abrasions and imperfections in finishes with coating that matches factory-applied finish.

- E. Replace damaged and malfunctioning components that cannot be acceptably repaired.
- F. Replace upholstery fabric damaged during installation or work of other trades.

END OF SECTION

SECTION 12 66 00

TELESCOPING STANDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Electrically operated telescoping stands.

1.2 DEFINITIONS

- A. Forward Folding: Wall- or floor-attached bleachers that open in the forward direction by moving the front row away from the stack to the fully extended position.
- B. Reverse Folding: Floor-attached bleachers that open in the backward direction by moving the last row away from the stack to the fully extended position.
- C. Freestanding: Being free or away from a permanent wall.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for telescoping stands.
 - 2. Include load capacities, assembly characteristics, and furnished accessories.
 - 3. Include electrical characteristics of electrical components, devices, and accessories.
- B. Shop Drawings: For telescoping stands in both stacked and extended positions.
 - 1. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.
 - 2. Include plans, elevations, sections, and attachment details.
 - 3. Include load capacities.
 - 4. Show seating layout, aisle widths, row-lettering and seat-numbering scheme, and wheelchair accessibility provisions.
 - 5. Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
 - 6. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For each type of exposed product and for each color and texture required.
 - 1. Include Samples of accessories involving color and finish selection.
- D. Samples for Verification: For the following products prepared on Samples of size indicated below:
 - 1. Decking: 6-inch- (150-mm-) square Samples of finished material.
 - 2. Metal Components: 6-inch- (150-mm-) square Sample of each color and finish indicated.
 - 3. Seating Material: 6-inch- (150-mm-) square Sample of each seating material, color, and finish indicated.
 - 4. Seat Unit: Full-size unit of each type.
 - 5. Signage: Full-size units for row letters seat numbers each type of accessibility sign and custom graphics.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Welding certificates.
- C. Product Certificates: For each type of telescoping stand assembly.
- D. Material Certificates: For each type of flame-retardant treatment of upholstery fabric.
- E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For telescoping stands to include in operation and maintenance manuals.
 - 1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
 - a. Procedures for conducting periodic inspections.
 - b. Precautions for cleaning materials and methods that could be detrimental to telescoping-stand finishes and performance.
 - c. Methods for maintaining upholstery fabric.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.8 FIELD CONDITIONS

- A. Finished Spaces: Do not deliver or install telescoping stands until finishes in spaces to receive them are complete, including suspended ceilings, floors, and painting.
- B. Field Measurements: Indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Telescoping stands shall withstand the effects of gravity loads, operational loads, and other loads and stresses according to ICC 300.
- B. Fire-Test-Response Characteristics of Upholstered Chairs: Comply with California Technical Bulletin 117.
- C. Accessibility Standard: Comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design and Texas Accessibility Standards (TAS).

2.2 TELESCOPING STANDS

- A. System Description: Operable system of multiple-tiered seating on interconnected folding platforms that close for storage, without being dismantled, into a nested stack. Telescoping-stand units permit opening and closing of adjacent, individual and multiple rows, and close with vertical faces of platforms in the same vertical plane.
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Telescoping-Stands Standard: ICC 300.
- B. Wall-Attached Telescoping Stands: Forward-folding system, in which the bleachers open in the forward direction by moving the front row away from the stack to the fully extended position and the rear of bleacher understructure permanently attaches to wall construction.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Hussey Seating Company.
 - b. Interkal LLC.
 - c. Irwin Telescopic Seating Company; Irwin Seating Company.
 - d. Sheridan Seating Inc.
 - 2. Basis-of-Design Product: Hussey Seating Company; MAXAM.
 - 3. Row Spacing: 24 inches (610 mm).
 - 4. Row Rise: 10 inches.
 - 5. Seat Type: Benches.
 - 6. Elevated Front Row: Height indicated on Drawings.
 - 7. Operation: Electrically operated, with friction-type, integral power unit.
 - 8. Electrical Characteristics for Each Seating Section:
 - a. Voltage: 208 V ac, three phase, 60 hertz.

9. Electrical Controls:
 - a. Control Devices: Walk-along pendant control system.
 - b. Limit Switches: Automatically stop power system when telescoping stands reach fully opened or closed positions.
 - c. Motion Monitor: Flashing light with self-contained warning horn, rated at 85 dB at 10 feet (3 m), mounted under telescoping seating for audio and visual warning during operation.
 - d. Transformer: As required to coordinate current characteristics of motor and control station with building electrical system.

2.3 COMPONENTS

- A. Benches: Seats and skirts.
 1. Basis-of-Design Product: Hussey Seating Company; CourtSide XC10.
 - a. Material: Molded plastic with contour surfaces.
 - 1) Color: As selected by Architect from manufacturer's standard range of colors.
 - b. Bench Depth: 10 inches (254 mm).
- B. Wheelchair-Accessible Seating: Locate retractable truncated benches to provide wheelchair-accessible seating at locations indicated on Drawings.
 1. Equip tiers adjacent to wheelchair-accessible seating with front rails as required by ICC 300.
 2. Basis-of-Design Product: Hussey Seating Company; Flex-Row.
- C. Deck: Plywood, 5/8 inch (16 mm) thick.
 1. Finish: Manufacturer's standard.
 - a. Color: As selected by Architect from manufacturer's standard colors.
- D. Risers: Steel sheet with manufacturer's standard, rust-inhibiting coating or hot-dip galvanized finish.
- E. Safety Rails: Steel, finished with manufacturer's standard powder coat system.
 1. Self-storing mid-aisle handrails located at centerline of each aisle with seating on both sides.
 - a. Color: Black.
 2. End rails (guards) that are telescoping and self-storing.
 - a. Color: Painted to match PT-1.
 3. Removable front rails (guards) along front of units where required by ICC 300.
 4. Removable rails around accessible seating cutouts and truncations.
- F. Understructure: Structural steel.
 1. Finish: Manufacturer's standard rust-inhibiting finish.
 2. Color: Manufacturer's standard.
- G. Support Column Wheels: Nonmarring, soft, rubber-face wheel assembly under each support column.
 1. Include wheels of size, number, and design required to support stands and operate smoothly without damaging the flooring surface, but no fewer than four per column or less than 4 inches (100 mm) in diameter and 1-1/2 inch (32 mm) wide.
- H. Control Devices:
 1. Walk-Along Pendant: Manufacturer's standard unit, which plugs into first row of each operating section. Provide one unit for each operating section.
- I. Fasteners: Vibration proof, in manufacturer's standard size and material.

2.4 ACCESSORIES

- A. Steps:
 1. Slip-resistant, abrasive tread nosings at aisles.
 2. Intermediate aisle steps, fully enclosed, at each aisle.
 3. Transitional top step, fully enclosed, at each aisle where last row of telescoping stands is adjacent to a cross aisle.
 4. Foldable front steps, fully enclosed, at each aisle, that hinge with front row to prevent accidental separation or movement and are equipped with free rolling wheels.
- B. Closure Panels and Void Fillers:
 1. End panels covering exposed ends of stands in the stored position.
 2. Panels at cutouts and truncations for accessible seating.
 3. Rear fillers including supports for closing openings between top row and rear wall of adjoining construction.

4. Gap fillers for closing openings between stand units or between stand units and adjoining construction.

C. Signage:

1. Accessibility signs at each accessible space and accessible aisle seat.

2.5 MATERIALS

- A. Lumber: Kiln dried, surfaced four sides; southern pine complying with SPIB's "Standard Grading Rules for Southern Pine Lumber" for B & B finish (B and better) grade-of-finish requirements.
- B. Plywood: PS 1 as standard with manufacturer.
- C. Molded Plastic: High-density polyethylene; blow or injection molded, color-pigmented, textured, impact-resistant, with integral reinforcing ribs for attachment and anchoring points.

2.6 FABRICATION

- A. Fabricate telescoping stands to operate easily without special tools or separate fasteners unless otherwise indicated.
- B. Round corners and edges of components and exposed fasteners to reduce snagging and pinching hazards.
- C. Form exposed work with flat, flush surfaces, level and true in line.
- D. Supports: Fabricate supports to withstand, without damage to components, the forces imposed by use of stands without failure or other conditions that might impair their usefulness.
 1. Cantilever bench seat supports to produce toe space uninterrupted by vertical bracing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install telescoping stands according to ICC 300 and manufacturer's written instructions.

3.3 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly, and lubricate, test, and adjust each telescoping stand unit to operate according to manufacturer's written instructions.
- B. Clean installed telescoping stands on exposed and semiexposed surfaces. Touch up factory-applied finishes or replace components as required to restore damaged or soiled areas.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to inspect, adjust, operate, and maintain telescoping stands.

END OF SECTION

SECTION 14 24 00
HYDRAULIC ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes hydraulic passenger elevators.

1.2 DEFINITIONS

- A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

1.3 ACTION SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures; hoistway entrances; and operation, control, and signal systems.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and large-scale details indicating service at each landing; machine room layout; coordination with building structure; relationships with other construction; and locations of equipment.
 - 2. Include large-scale layout of car-control station and standby-power operation control panel.
 - 3. Indicate maximum dynamic and static loads imposed on building structure at points of support as well as maximum and average power demands.
- C. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes, 3 inch (75 mm-) square Samples of sheet materials and 4-inch (100-mm) lengths of running trim members.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Manufacturer Certificates: Signed by elevator manufacturer, certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service including standby-power generator, as shown and specified, are adequate for elevator system being provided.
- C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
 - 1. Submit manufacturer's/installer's standard operation and maintenance manual, in accordance with ASME A17.1/CSA B44 including diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.
- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.8 COORDINATION

- A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- B. Furnish well casing and coordinate delivery with related excavation work.
- C. Coordinate locations and dimensions of other work specified in other Sections that relates to hydraulic elevators, including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

1.9 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
 - 2. Warranty Period:
 - a. 12 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 HYDRAULIC ELEVATOR MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Otis.
 - 2. Schindler Elevator Corp.
 - 3. ThyssenKrupp Elevator.
- B. Source Limitations: Obtain elevators from single manufacturer.
 - 1. Major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Accessibility Requirements: Comply with Section 407 in the United States Access Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.

2.3 ELEVATORS

- A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturers' standard components shall be used, as included in standard elevator systems and as required for complete system.
- B. Elevator Description:
 - 1. Basis-of-Design Products:
 - a. ThyssenKrupp Elevator; Endura HMRL 3500, Two Stage.
 - 1) Rated Speed: 110 fpm.
 - b. ThyssenKrupp Elevator; Endura HMRL 3500, Three Stage.
 - 1) Rated Speed: 125 fpm.
 - 2. Rated Load: 3500 lb (1589 kg).
 - 3. Operation System: Single automatic operation.
 - 4. Auxiliary Operations:
 - a. Battery-powered lowering.
 - b. Automatic operation of lights and ventilation fans.
 - 5. Security Features: Card-reader operation.
 - 6. Dual Car-Control Stations: Provide two car-control stations; equip only one with required keyswitches if any.

7. Car Enclosures:
 - a. Front Walls (Return Panels): Satin stainless steel, No. 4 finish with integral car door frames.
 - b. Vandal-Resistant Car Fixtures: Satin stainless steel, No. 4 finish.
 - c. Side and Rear Wall Panels: Plastic laminate.
 - 1) Color: Stop Red, 839.
 - d. Reveals: Satin stainless steel, No. 4 finish.
 - e. Door Faces (Interior): Satin stainless steel, No. 4 finish.
 - f. Door Sills: Aluminum.
 - g. Ceiling: Satin stainless steel, No. 4 finish.
 - h. Handrails: 1-1/2 inches (38 mm) round satin stainless steel, No. 4 finish, at sides and rear of car.
 - i. Floor prepared to receive resilient flooring specified in Section 09 65 19 "Resilient Tile Flooring").
8. Hoistway Entrances:
 - a. Width: 42 inches (1067 mm).
 - b. Height: 84 inches, unless otherwise indicated.
 - c. Type:
 - 1) Two Stage Elevator: One speed, center opening; front and rear opening.
 - 2) Three Stage Elevator: One speed, center opening; front opening.
 - d. Frames Satin stainless steel, No. 4 finish.
 - e. Doors Satin stainless steel, No. 4 finish.
 - f. Sills: Aluminum.
9. Hall Fixtures Satin stainless steel, No. 4 finish.
10. Additional Requirements:
 - a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
 - b. Provide hooks for protective pads in all cars and one complete set(s) of full-height protective pads.

2.4 SYSTEMS AND COMPONENTS

- A. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations.
 1. Pump shall be submersible type with submersible squirrel-cage induction motor, and shall be suspended inside oil tank from vibration isolation mounts.
 2. Motor shall have variable-voltage, variable-frequency control.
- B. Hydraulic Silencers: System shall have hydraulic silencer containing pulsation-absorbing material in blowout-proof housing at pump unit.
- C. Hydraulic Fluid: Nontoxic, biodegradable, fire-resistant fluid, made from vegetable oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives, that is approved by elevator manufacturer for use with elevator equipment.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hydro Safe Oil Division, Inc.
- D. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.
- E. Car Frame and Platform: Welded steel units.
- F. Guides: Roller guides. Provide guides at top and bottom of car frame.

2.5 OPERATION SYSTEMS

- A. General: Provide manufacturer's standard microprocessor operation system as required to provide type of operation indicated.
- B. Auxiliary Operations:
 1. Single-Car Battery-Powered Lowering: When power fails, car is lowered to the lowest floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
 2. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors start closing.

3. Automatic Operation of Lights and Fan: When elevator is stopped and unoccupied with doors closed, lighting, ventilation fan, and cab displays are de-energized after 5 minutes and are re-energized before car doors open.

C. Security Features: Security features shall not affect emergency firefighters' service.

1. Card-Reader Operation: System uses card readers at car-control stations and hall push-button stations to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space for card reader in car.

2.6 DOOR-REOPENING DEVICES

- A. Infrared Array: Provide door-reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.
- B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door-reopening device, a loud buzzer shall sound, and doors shall begin to close at reduced kinetic energy.

2.7 CAR ENCLOSURES

- A. General: Provide steel-framed car enclosures with nonremovable wall panels, with removable car roof, access doors, power door operators, and ventilation.
 1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.
- B. Materials and Finishes: Manufacturer's standards, but not less than the following:
 1. Subfloor: Exterior, underlayment-grade plywood, not less than 5/8-inch (15.9-mm) nominal thickness.
 2. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to 1/2-inch (13-mm) fire-retardant-treated particleboard with manufacturer's standard protective edge trim. Panels have a flame-spread index of 25 or less, when tested according to ASTM E 84. Plastic-laminate color, texture, and pattern as selected by Architect from plastic-laminate manufacturer's full range.
 3. Fabricate car with recesses and cutouts for signal equipment.
 4. Fabricate car door frame integrally with front wall of car.
 5. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
 6. Sight Guards: Provide sight guards on car doors.
 7. Sills: Extruded or machined metal, with grooved surface, 1/4 inch (6.4 mm) thick.
 8. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
 9. Light Fixture Efficiency: Not less than 35 lumens/W.
 10. Ventilation Fan Efficiency: Not less than 3.0 cfm/W (1.4 L/s per W).

2.8 HOISTWAY ENTRANCES

- A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.
 1. Where gypsum board wall construction is indicated, frames shall be self-supporting with reinforced head sections.
- B. Fire-Rated Hoistway Entrance Assemblies: Door-and-frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to NFPA 252 or UL 10B.
 1. Fire-Protection Rating: 1-1/2 hours.
- C. Materials and Fabrication: Manufacturer's standards, but not less than the following:
 1. Steel Subframes: Formed from cold- or hot-rolled steel sheet, with factory-applied enamel or powder-coat finish or rust-resistant primer. Fabricate to receive applied finish as indicated.
 2. Stainless-Steel Frames: Formed from stainless-steel sheet.
 3. Star of Life Symbol: Identify emergency elevators with star of life symbol, not less than 3 inches (76 mm) high, on both jambs of hoistway door frames.
 4. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.

5. Sight Guards: Provide sight guards on doors matching door edges.
6. Sills: Extruded or machined metal, with grooved surface, 1/4 inch (6.4 mm) thick.
7. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

2.9 SIGNAL EQUIPMENT

- A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Provide vandal-resistant buttons and lighted elements illuminated with LEDs.
- B. Car-Control Stations: Provide manufacturer's standard recessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.
 1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
 2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- C. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
- D. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Electrical Engineer's documents.
- E. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.
- F. Hall Push-Button Stations: Provide one hall push-button station at each landing.
 1. Provide manufacturer's standard wall-mounted units.
 2. Equip units with buttons for calling elevator and for indicating applicable direction of travel.
 3. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in Electrical Engineer's documents.
- G. Hall Lanterns: Units with illuminated arrows; however, provide single arrow at terminal landings. Provide the following:
 1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
- H. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
 1. At manufacturer's option, audible signals may be placed on cars.
- I. Hall Position Indicators: Provide illuminated, digital-display-type position indicators, located above each hoistway entrance at ground floor.
 1. Provide units with flat faceplate for mounting and with body of unit recessed in wall.
 2. Integrate ground-floor hall lanterns with hall position indicators.
- J. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

2.10 FINISH MATERIALS

- A. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
- B. Stainless-Steel Bars: ASTM A 276, Type 304.
- C. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
- D. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.
- E. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGS for flat applications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS workmanship and welding operator qualification standards.
- B. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- C. Install piping above the floor, where possible. Install underground piping in casing.
 - 1. Excavate for piping and backfill encased piping according to applicable requirements in Civil Engineer's documents.
- D. Lubricate operating parts of systems as recommended by manufacturers.
- E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- F. Leveling Tolerance: 1/4 inch (6 mm), up or down, regardless of load and travel direction.
- G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- H. Locate hall signal equipment for elevators as follows unless otherwise indicated:
 - 1. Place hall lanterns either above or beside each hoistway entrance.
 - 2. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 PROTECTION

- A. Temporary Use: Limit temporary use for construction purposes to one elevator. Comply with the following requirements for each elevator used for construction purposes:
 - 1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
 - 2. Provide strippable protective film on entrance and car doors and frames.
 - 3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
 - 4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
 - 5. Do not load elevators beyond their rated weight capacity.
 - 6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
 - 7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s).
- B. Check operation of each elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

3.6 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 1. Perform maintenance during normal working hours.
 - 2. Perform emergency callback service during normal working hours with response time of two hours or less.
 - 3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of two hours or less.

END OF SECTION

SECTION 21 00 10

BASIC FIRE PROTECTION SYSTEM REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Basic fire protection requirements necessary to provide complete installation of all Division 21 work.

1.2 WORK INCLUDED

- A. This section of work comprises furnishing of all materials, equipment, tools, scaffolding, rigging, hoisting, labor, and transportation necessary for the complete installation of the fire protection system as shown on the plans and as specified herein.
- B. Bidders shall determine the contents of a complete set of drawings and specifications and be aware that they may be bidding from a partial set of drawings, applicable only to the various separate contracts, subcontracts, or trades as may be issued for bidding purposes only. The contract documents and the complete scope of work for the project are illustrated on the combined Architectural, Structural, Plumbing, Heating, Ventilating, Air Conditioning and Electrical, and each Bidder shall thoroughly acquaint himself with all the details of the complete set of drawings and specifications before submitting his bid. All drawings and specifications form a part of the contract documents for each separate contract and shall be considered as bound therewith in the event partial sets of plans and specifications are issued for bidding only. The submission of bids shall be deemed evidence of the review and examination of all drawings, specifications, and addenda issued for this project as no allowances will be made because of unfamiliarity with any portion of the complete set of documents.

1.3 RELATED SECTIONS

- A. The conditions of the Division 1 requirements and the contract requirements which include the General Conditions and the Supplementary Conditions apply to the work of this division.

1.4 CODES & REFERENCE STANDARDS

- A. General:
 - 1. Perform all Division 21 work in strict accordance with the requirements and recommendations stated in the codes and standards except when requirements are modified by the contract documents.
 - 2. Nothing in the Contract Documents shall be construed to permit work not conforming to these codes.
 - 3. When two or more codes or standards are applicable to the same work, then the stricter code or standard shall govern.
 - 4. The date of the code or standard that is in effect on the date of issue of the contract documents except when a particular publication date is specified.
 - 5. The Contractor shall be held responsible for verifying all local codes and ordinances that may alter any part of the plans or specifications. The Contractor shall bear all costs for correcting the deficiencies.
 - 6. Where local codes and ordinances are not in writing or on record, but a local precedence has been set, the Owner shall pay for any additional cost incurred.
- B. Applicable Codes and Standards for All Division 21 Work:
 - 1. International Building Code
 - 2. International Gas Code
 - 3. International Plumbing Code
 - 4. International Mechanical Code
 - 5. International Energy Conservation Code
- C. National Electrical Code

- D. Occupational Safety and Health Administration Standards:
 - 1. OSHA Standard 2207 - Construction Industry Standards
 - 2. OSHA 29 CFR Part 1926 - Regulation of Excavation
 - 3. Texas Underground Facility Damage Prevention Act (H.B. 2295)
 - 4. All other applicable standards
- E. National Fire Protection Association
- F. Fire Sprinkler System:
 - 1. NFPA 13
 - 2. NFPA 14
 - 3. NFPA 101 Section 8-3
 - 4. All other applicable codes
- G. National Appliance Energy Conservation Act of 1987
- H. Texas State Board of Insurance Standards
- I. Clean Air Act and Clean Air Act Amendments of 1990
- J. Safety Code for Elevators and Escalators
- K. State Codes:
 - 1. Texas Department of Labor Boiler Rules and Regulations
 - 2. All other applicable codes
- L. Local Municipal Codes and Ordinances

1.5 SCHEDULE OF ABBREVIATIONS

- A. Reference Standards are listed in Section 21 using abbreviations listed below:
 - 1. AABC (NSTSB) - Associated Air Balance Council
 - 2. AASHTO - American Association of State Highway and Transportation Officials
 - 3. ADA - Americans with Disabilities Act
 - 4. ADC - Air Diffusion Council
 - 5. AGA - American Gas Association
 - 6. AMCA - Air Moving and Conditioning Association
 - 7. ANSI - American National Standards Institute
 - 8. ARI - Air-Conditioning and Refrigeration Institute
 - 9. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
 - 10. ASME - American Society of Mechanical Engineers
 - 11. ASPE - American Society of Plumbing Engineers
 - 12. ASTM - American Society for Testing and Materials
 - 13. AWE - American Welding Society
 - 14. AWWA - American Water Works Association
 - 15. CGA - Compressed Gas Association
 - 16. CISPI - Cast Iron Soil Pipe Institute
 - 17. CS - Commercial Standard
 - 18. CSA - Canadian Standards Association
 - 19. DIPRA - Ductile Iron Pipe Research Association
 - 20. DOT - Department of Transportation
 - 21. DOC - Department of Commerce
 - 22. FCC - Federal Communications Commission
 - 23. FM - Factory Mutual
 - 24. FS - Federal Specification
 - 25. IBC - International Building Code
 - 26. ITL - Independent Testing Laboratories
 - 27. NEC - National Electric Code
 - 28. NFPA - National Fire Protection Association
 - 29. NSF - National Sanitation Foundation
 - 30. OSHA - Occupational Safety and Health Administration

31. PDI - Plumbing and Drainage Institute
32. SMACNA - Sheet Metal and Air Conditioning National Association
33. TCEQ - Texas Commission on Environmental Quality
34. TDH - Texas Department of Health
35. TWC - Texas Water Commission
36. UL - Underwriters Laboratories

1.6 QUALITY ASSURANCE

- A. Provide complete installations of all systems.
- B. Furnish all items of equipment, material, and labor to complete the Contract even though each and every item necessary is not specifically mentioned or shown.
- C. In case of any conflict between the specifications, plans, and ordinances, the ordinances shall govern.
- D. All materials furnished under this Contract shall be new, free from defects of any kind, of the quality and design hereinafter specified, and shall conform to the standards of Underwriter's Laboratories Inc., except for equipment which UL does not list or provide label service.
- E. All fire sprinkler equipment and sprinkler heads shall be the same brand.
- F. Contractor's Responsibility
 1. Erect barricades, protective fencing, and signs to prevent injury to personnel on-site.
 2. Make permanent connection to utilities or existing lines. Determine depth and location, and bid accordingly.
 3. Relocate and repair any existing lines cut by general construction work.
 4. Pay all costs in connection with double check detector assembly.
 5. Plans do not show exact location and elevations of lines, nor do they show all offsets required.
 6. Deviate from plans as required to conform to the general construction and provide proper grading.
 7. Maintain all utility services during construction to existing portions of the job that remain.
 8. Procure and pay for all necessary permits or licenses to carry out the work.
 9. Obtain and pay for all the necessary certificates of approval which must be delivered to the Architect before final acceptance of the work.
 10. Periodically remove rubbish, clean or repair all surfaces marred by the work required under this contract.
 11. Protect work from damage by other trades.
 12. Make all tests required by law; pay all costs in connection with the testing.
 13. Where job conditions require changes in indicated locations and arrangement, make such changes without extra cost to Owner.
 14. Provide controls, relays, all low-voltage wiring, conduit, and wiring related to fire sprinkler system, and other equipment and devices to form a complete working system.

1.7 DEFINITIONS

- A. Approval:
 1. It is understood that approval must be obtained from the Architect in writing before proceeding with the proposed work.
 2. Approval by the Architect of any changes, submitted by the Contractor will be considered as general only to aid the Contractor in expediting his work.
 3. Contractor:
 - a. The Contractor engaged to execute the work included in a particular section only, even though he may be technically described as a Subcontractor to the General Contractor.
 - b. If the Contractor engaged to execute said work employs Sub-Contractors to perform various portions of the work included under this Section, he shall be held responsible for the execution of same, in full conformity with Contract Document requirements.
 - c. The Contractor shall cooperate at all times and shall be responsible for the satisfactory cooperation of his Subcontractors with the other Contractors on the job so that all of the various phases of the work may be properly coordinated without unnecessary delays or damage to any parts of the work of any Contractor.
 4. Provide:

- a. Defined as requiring the furnishing and installing of the item or facility indicated, complete in all respects, and ready for operation unless otherwise specifically noted.

1.8 WARRANTY

- A. The Contractor shall warranty his work against defective materials and workmanship for a period of one year from date of acceptance of the job.
- B. Neither the final payment nor any provisions in Contract Documents shall relieve the Contractor of the responsibility for faulty materials or workmanship.
- C. He shall remedy any defects due thereto, and pay for any damage to other work resulting therefrom, which shall appear within a period of one year from date of substantial completion.
- D. The Owner shall give notice of observed defects with reasonable promptness.
- E. This Guarantee shall not be construed to include the normal maintenance of the various components of the system covered by these specifications.

1.9 SITE VISIT

- A. Before submitting his proposal, each bidder shall examine all plans and specifications relating to the work, shall visit the site of the project and become fully informed of the extent and character of the work required.
- B. No consideration will be granted for any alleged misunderstanding of the materials to be furnished or the amount of work to be done, it being fully understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying plans or required by nature of the site of which may be fairly implied as essential to the execution and completion of any and all parts of the work.

1.10 SUBMITTALS

- A. Submittal Procedures:
 - 1. Bidding requirements, contract forms, conditions of the contract, Division 1 - General Requirements, and Division 21 apply to work of this division, in addition to the following:
 - a. The materials, workmanship, design, and arrangement of all work installed under this contract shall be subject to the review of the Architect, Engineer, and Owner.
 - b. Where specified materials, process, or methods of construction or manufactured article is specified by name or by reference to the catalog number of a manufacturer, the specifications are to be used as a guide and are not intended to take precedence over the basic duty and performance specified or noted on the Drawings.
 - c. In all cases, the Contractor shall verify the duty and available electric characteristics with the specific characteristics of the equipment offered for review. All component parts of each item of equipment or device shall bear the manufacturer's nameplate giving the name of manufacturer, description, size, type, serial or model number, electrical characteristics, etc., in order to facilitate maintenance or replacement.
 - d. Unapproved Products: If materials or equipment are installed before being reviewed and approved by the engineer, the contractor shall be liable for the removal and replacement of such unapproved materials and equipment, at no additional expense to the owner. Additionally, if the removal and replacement of unapproved materials or equipment necessitates the removal and replacement of other related materials or equipment, then the contractor shall be liable for the removal and replacement of the related materials and equipment at no additional expense to the owner.
 - e. This Contractor shall call to the attention of the Architect/Engineer by letter or on shop drawing submittals, any instance in which the shop drawings differ from the requirements of the Drawings and Specifications.
 - f. Data and shop drawings shall be coordinated and included in a single submission. Multiple submissions are not acceptable except where prior approval has been obtained from the Architect/Engineer. In such cases, a list of data to be submitted later shall be included with the first submission. Failure to submit shop drawings that meet the requirements of the

Drawings and Specifications in ample time for review shall not entitle the Contractor to an extension of contract time, and no claim for extension by reason of such default shall be allowed.

- g. Catalogs, pamphlets, or other documents submitted to describe items on which review is being requested shall be specific and identifications in catalogs, pamphlets, etc., of items submitted, shall be clearly made in a contrasting ink. Data of a general nature shall not be acceptable. Data and shop drawings shall be identified in accordance with Division 01. In addition, shop drawings shall be identified by the name of the item and system and the applicable Specification paragraph number.
 - h. Electronic Submittals: Electronic submittal requirements will be determined by the Architect. If this method is required then the procedures described in this section shall be modified as follows:
 - 1) The contractor shall supply only one copy of the submittal, rather than the six copies described in this section. The submittal shall be accompanied by a letter stating that the contractor desires the response in electronic form and that prior approval for this method has been granted.
 - 2) After reviewing the submittal, the engineer will create electronic files from the reviewed submittal material.
 - 3) The electronic files will either be mailed to the architect or posted to a website, depending on the architect's requirements. The architect and contractor can distribute copies of the files as desired.
 - 4) The engineer will retain the paper copy of the submittal as a file copy.
- B. Product Data:
- 1. Where the content of manufacturer submittal literature includes data not pertinent to the submittal, clearly indicate which portions of the contents are being submitted for review. Catalogs, pamphlets, or other documents submitted to describe items on which review is being requested shall be specific and identifications in catalogs, pamphlets, etc., of items submitted, shall be clearly made in a contrasting ink or highlighting. Data of a general nature shall not be acceptable.
- C. Coordination Correspondence: The contractor may desire to verify the acceptability of a particular item prior to assembling the initial submittal package. The contractor may send material directly to the engineer for comments and feedback. This communication, whether by mail, fax, or e-mail, will be treated as normal coordination correspondence and will not be tracked or documented as a formal submittal. The engineer may or may not respond to such correspondence. If the engineer agrees, in writing, to the use of a particular item, then that same material shall be included in the initial submittal package along with a copy of the correspondence.

1.11 PROJECT RECORD DOCUMENTS

- A. The Contractor shall keep a set of plans on the job, noting daily all changes made in connection with the final installation including exact dimensioned locations of all new and uncovered existing utility piping outside the building.
- B. Upon submitting his request for final payment, he shall turn over to the Architect/Engineer, for subsequent transmittal to the Owner, a clean, neatly marked set of reproducible plans showing "as installed" work and an electronic file with changes of materials.
- C. In addition to the above, the Contractor shall accumulate during the job's progress the following data, in duplication (2 each), prepared in 3 ring binders of sufficient size, black in color, neat in appearance, and turned over to the Architect/Engineer for checking and subsequent delivery to the Owner:
 - 1. All warranties, guarantees, and manufacturer's directions on equipment and material covered by the Contract.
 - 2. Approved fixture brochures.
 - 3. Copies of approved shop drawings.
 - 4. Set of operating instructions. Operating instructions shall also include recommended maintenance and seasonal changeover procedures.
 - 5. Any and all other data and/or plans required during construction.
 - 6. Repair parts lists of all major items and equipment including name, address, and telephone number of local supplier or agent.

- D. The first page, or pages, shall have the names, addresses, and telephone numbers of the following:
 - 1. General Contractor and all sub-contractors.
 - 2. Major Equipment Suppliers.

1.12 TRAINING

- A. Upon completion of the work and at a time designated by the Owner's representative, provide a formal training session for the Owner's operating personnel to include location, operation, and maintenance of all fire protection equipment and systems, some sections have further instructions.
- B. Before proceeding with instruction, prepare a typed outline in triplicate listing the subjects that will be covered. Submit the outline for review by the Owner's representative.
- C. At the conclusion of the instruction, obtain the signatures of the attendees on each copy of the outline to signify that they have a proper understanding of the operation and maintenance of the system. Submit the signed outlines to the Owner's representative and Engineer as a condition of final acceptance.

1.13 PLANS AND SPECIFICATIONS

- A. The plans show diagrammatically the locations of the various lines, ducts, conduits, fixtures, and equipment and the method of connecting and controlling them.
- B. It is not intended to show every connection in detail and all fittings required for a complete system.
- C. The systems shall include but are not limited to the items shown on the plans.
- D. Exact locations of these items shall be determined by reference to the general plans and measurements of the building and in cooperation with other contractors, and in all cases, shall be subject to the approval of the Architect/Engineer.
- E. The Architect/Engineer reserves the right to make any reasonable change in the location of any part of this work without additional cost to the Owner.
- F. Contractor, subcontractor, vendors, and suppliers are required to waive subrogation against Owner and Engineer.

1.14 UTILITIES, LOCATIONS, AND ELEVATIONS

- A. Locations and elevations of the various utilities within the scope of this work have been obtained from the City and/or other substantially reliable sources and are offered separately from the Contract documents, as a general guide only, without guarantees as to accuracy.
- B. The Contractor shall examine the site, shall verify to his own satisfaction the locations, elevations, and availability of all utilities and services required, and shall adequately inform himself as to their relation to the work; the submission of bids shall be deemed evidence thereof.
- C. The Contractor shall coordinate all services with the Utility Companies during construction, coordinate changes made by Utility Companies to the design of project, and coordinate with the Owner, Architect/Engineer, and Utility the scheduling of any shutdowns or delays that may occur in providing service.
- D. The Contractor shall verify location, conduct all necessary tests, inspections, coordinate with Owner's representatives and utilities, and check for existing underground utilities and lines before ditching.
- E. The Contractor shall be responsible for repair of any cut or damaged lines or utilities he uncovers. There are lines and utilities not shown on any plans.

1.15 SUBSTITUTION OF PRODUCTS

- A. Substitution of products specified herein will be considered only when a complete list of proposed alternative equipment is submitted to the Engineer in writing, supported by adequate technical and cost

data. This includes a complete description of the proposed substitution, drawings, catalog cuts, performance data, test data, or any other data or information necessary for evaluation.

- B. All proposed substitutions and data must be received by the Engineer no less than ten working days prior to the scheduled date for opening of bids.
- C. The Engineer will consider all such submittals and the Architect will issue an addendum listing items that the Engineer considers acceptable. Only such items as specified or approved as acceptable will be installed on this project.
- D. Manufacturers` names are listed herein and on the plans to establish a standard of quality and design. Where a manufacturer`s name is mentioned, products of other manufacturers will be acceptable, if, in the opinion of the Engineer, the substitute material is of equivalent quality or better than that of the material specified.
- E. The Contractor`s Bid represents that the bid price is based solely upon the materials and equipment described in the Bid Documents (including addenda, if any) and that he contemplates no substitutions or extras.
- F. Requests for substitution are understood to mean that the Contractor:
 - 1. Has personally investigated the proposed substitution and determined that it is equal or superior in all respects to that specified.
 - 2. Will provide the same guarantee for the substitution that he would for that specified.
 - 3. Will, at no cost to the Owner, replace the substitute item with the specified product if the substitute item fails to perform satisfactorily.
- G. After Award of the Contract, substitutions will be considered only under one or more of the following circumstances:
 - 1. The substitution is required for compliance with subsequent interpretations of code or insurance requirements.
 - 2. The specified product is unavailable through no fault of the Contractor.
 - 3. The manufacturer refuses to warranty the specified products as required.
 - 4. Subsequent information that the specified product is unable to perform properly or to fit in the designated space.
 - 5. In the Engineer`s sole judgment, the substitution would be in the Owner`s best interest.
- H. Revisions to the fire protection system shall be under the supervision of the Engineer at a standard hourly rate charged by the Engineer and shall be paid by the Contractor originating the changes.

1.16 PROTECTION OF EQUIPMENT AND MATERIALS

- A. The Contractor shall take such precautions as may be necessary to properly protect his apparatus from damage.
- B. This shall include the creation of all required temporary shelters to adequately protect any apparatus above the floor of the construction and the covering of apparatus in the completed building with tarpaulins or other protective covering.
- C. Failure to comply with the above to the satisfaction of the Owner`s inspector will be sufficient cause for the rejection of the equipment in question and its complete replacement by this Contractor.
- D. All apparatus shall be cribbed up from the floor or ground by the Contractor and covered with tarpaulins or other protective covering where necessary or directed.

1.17 FINAL INSPECTION

- A. It shall be the duty of this Contractor to make a careful inspection trip of the entire project, assuring himself that the work on the project is ready for final acceptance before calling upon the Architect/Engineer to make a final inspection.
- B. To avoid delay of final acceptance of the work, the Contractor shall have all necessary bonds, warranties, receipts, affidavits, etc., called for in the various articles of these specifications, prepared and

signed in advance, together with a letter of transmittal, listing each paper included, and shall deliver the same to the Architect/Engineer at or before the time of said final inspection. The Contractor is cautioned to check over each bond, receipt, etc., before preparing for submission to verify that the terms check with the requirements of the specifications.

1.18 ASBESTOS

- A. No asbestos or asbestos containing materials shall be permitted in this project.

1.19 CUTTING AND PATCHING

- A. All Subcontractors shall notify the General Contractor sufficiently ahead of construction of any floors, walls, ceiling, roof, etc., of any openings that will be required for his work.
- B. He shall see that all sleeves required for his work are set at proper times so as to avoid delay of the job.
- C. All necessary cutting of walls, floors, partitions, ceilings, etc., as required for the proper installation of the work under this Contract shall be done at the Subcontractor's expense in a neat and workmanlike manner, and as approved by the Architect/Engineer.
- D. No joists, beams, girders, or columns shall be cut by any Contractor without first obtaining written permission of the Architect/Engineer.
- E. Patching of openings and/or alterations shall be provided by the General Contractor.
- F. All openings in firewalls and floors, such as thimbles, shall be completely sealed after installation for a completely airtight installation. Sealing material shall be non-combustible and UL approved. The installed sealing assembly shall not cause the fire rating of the penetrated structure to be decreased.
- G. All openings in exterior walls shall be sealed watertight.

1.20 IDENTIFICATION

- A. Refer to Section 22 05 54.

1.21 MANUFACTURER'S INSTRUCTIONS

- A. All equipment and devices shall be installed in accordance with these plans and specifications, manufacturer's instructions, and applicable codes.
- B. Where specifications call for installation of a product to be in accordance with manufacturer's instructions and/or where manufacturer's instructions are required for installation of a product, it shall be the contractor's responsibility to obtain the necessary applicable manufacturer's instructions and install the product in accordance with the manufacturer's instructions.
- C. It shall be the Contractor's responsibility to install all equipment, materials, and devices shown on the plans and as called out in these specifications even if manufacturer's instructions are absolutely unattainable.

1.22 RELATED WORK

- A. The various specification sections for this division may or may not include related work listings.
- B. All related work shall be coordinated and provided by the Fire Protection Contractor regardless whether specifically identified or not.

1.23 ELECTRICAL WIRING AND EQUIPMENT FOR FIRE PROTECTION SYSTEMS (FIRE PUMPS)

- A. All wiring, conduit, boxes, equipment (controls, relays, contactors, motor starters, heaters, switches), and any other control devices or equipment required to form a complete and properly operating system, shall be the responsibility of this Contractor.

- B. The Electrical Contractor shall only provide line voltage (including hook-up) to all fire protection equipment.
- C. All fire protection controls and devices shall be low voltage unless otherwise noted or shown on the plans. Where line voltage controls or devices are noted, the Contractor shall provide complete wiring diagrams (approved by the Engineer) to the Electrical Contractor prior to final hook-up.
- D. The Fire Protection and Electrical plans are based on a performance specification and preliminary flow test. Should any fire protection equipment or device be changed or approved from those which are shown or noted, all electrical and/or fire protection changes shall be made at the expense of the trade or contractor initiating the change with no expense to the Owner, Architect, Engineer, or their representatives.
- E. All wiring provided by this Contractor shall be installed in a workmanlike manner using tie wraps, labels, anchors and etc. Loose wiring is not acceptable. All wiring in exposed areas shall be installed in conduits.
- F. All conduit and boxes required in all walls for control purposes shall be provided by electrical contractor. All conduit required in attic, clear spaces, or on roof shall be by mechanical contractor.

1.24 DEMOLITION AND REMODEL

- A. It shall be the responsibility of this Contractor to see that all demolition and remodeling work involving his trade (including but not limited to fire sprinkler piping, control air piping, fire protection equipment, etc.) is accomplished in a manner and completeness to provide the appearance of new construction work.
- B. Any usable equipment and/or structure damaged during demolition and remodel work shall be replaced.
- C. All abandoned and/or otherwise unused piping shall be securely capped using materials of the same composition as the original piping.
- D. No exposed piping and/or other materials will be permitted in the finished job.
- E. Any abandoned piping which penetrates the slab in an exposed area shall be securely capped below the slab.

1.25 OPERATION PRIOR TO COMPLETION

- A. When any piece of fire protection equipment is operable and the Contractor needs to operate the equipment, he may do so providing that he properly supervises the operation.
- B. The warranty period shall, however, not commence until such time as the equipment is operated for the beneficial use of the Owner.
- C. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, install clean filter media, and properly adjust and complete all punch list items before final acceptance by the Owner.
- D. The date of acceptance and the start of the warranty may not be the same date.

1.26 SAFETY GUARDS

- A. Contractor shall furnish and install all safety guards required. All belt driven equipment, projecting shafts, and other rotating parts shall be enclosed or adequately guarded.

1.27 FLAME SPREAD PROPERTIES OF MATERIALS

- A. All materials and adhesives used in fire sprinkler system shall conform to NFPA and UL life and flame spread properties of materials.
- B. The composite classifications shall not exceed 25 for a flame spread rating and 50 for a smoke developed rating as listed for the basic material, the finishes, adhesives, etc., specified for each system

and shall be such when completely assembled.

1.28 LEAD MATERIALS

- A. No lead or lead containing materials shall be allowed in any domestic or potable water supply piping, valves, fixtures, components, equipment, or any other item.

1.29 ACCESS CLEARANCE

- A. Proper access to all installed equipment shall be provided. The Fire Sprinkler Contractor shall label all points of access immediately upon installation with a marker pen.
- B. This contractor is responsible for providing coordinated clearances with all other trades.
- C. If another trade violates this space, the General Contractor shall be notified immediately.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 TESTING

- A. After the fire protection system has been completed and put into operation, subject system to an operating test under design conditions to check for system leaks.
- B. Make adjustments as required to ensure proper functioning of all systems.
- C. Special tests on individual systems are specified under individual sections.
- D. Obtain all state and city permits and approvals.

END OF SECTION

SECTION 21 00 90

FIRE PROTECTION SYSTEM SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section supplements Division 01 Submittal Procedures and contains additional requirements applicable to Division 21 submittals.

1.2 SECTION INCLUDES

- A. This section includes, but is not limited to:
 - 1. Fire protection submittal procedures
 - 2. List of required Division 21 submittals to the engineer
 - 3. This section applies only to the Division 21 specifications. Submittals required by other specification divisions are not included here, even though the same subcontractor may be providing work under other divisions.

1.3 RELATED SECTION

- A. Division 01 - Submittal Procedures

1.4 DEFINITIONS

- A. Product Data: Illustrations, standard schedules, performance charts, instructions, and brochures furnished by the contractor, subcontractor, manufacturer, or supplier to illustrate materials or equipment or to illustrate some portion of the work. Provide a summary of scheduled items with all data in schedules.
- B. Shop Drawings: Drawings, diagrams, schedules, and other data specifically prepared for the work by the contractor, subcontractor, manufacturer, or supplier to illustrate some portion of the work.
- C. Equipment/Material Submittal Package: A compilation of the product data, shop drawings, and other items as required by the specifications, submitted near the start of the work. Typically, the specifications require the initial submittal package to be submitted within a certain number of days after the work starts.
- D. Quality Assurance Submittal: Items submitted before and during the execution of a particular portion of the work for the purpose of guarding against defects and deficiencies.
- E. Quality Control Submittal: Items submitted at the completion of a particular portion of the work for the purpose of evaluating completed activities and elements of the work for conformance with contract requirements (e.g. start-up reports).
- F. Closeout Submittals: Items submitted at or near the completion of the contract.

1.5 SUBMITTALS

- A. The materials, workmanship, design, and arrangement of all work installed under this contract shall be subject to the review of the architect, engineer, and owner.
- B. Manufacturers: Manufacturers submitted shall be as per the acceptable manufacturers listed in each specification section or referenced schedule. For additional manufacturers requiring approval, reference the Substitution of Products article in Section 21 00 10.
- C. Required Submittals: Refer to the Submittals article of each individual Division 21 specification section for the required items to be submitted.

- D. Contractor's Coordination Submittals: The contractor may require his subcontractors to provide drawings, setting diagrams, and similar information to help coordinate the project, but such data shall remain between the contractor and his subcontractors and will not be reviewed by the engineer.
- E. Electronic Submittals: Fax, e-mail, or other electronic forms of submittals from the contractor are not acceptable. With the prior approval of the architect and the engineer, the contractor may request that the review comments of the engineer be returned in electronic form. If this method is agreed upon, then the procedures described in this section shall be modified as follows:
 - 1. The contractor shall supply only one copy of the submittal, rather than the six copies described in this section. The submittal shall be accompanied by a letter stating that the contractor desires the response in electronic form and that prior approval for this method has been granted.
 - 2. After reviewing the submittal, the engineer will create electronic files from the reviewed submittal material.
 - 3. The electronic files will either be mailed to the architect or posted to a website, depending on the architect's requirements. The architect and contractor can distribute copies of the files as desired.
 - 4. The engineer will retain the paper copy of the submittal as a file copy.
- F. Coordination Correspondence: The contractor may desire to verify the acceptability of a particular item prior to assembling the initial submittal package. The contractor may send material directly to the engineer for comments and feedback. This communication, whether by mail, fax, or e-mail, will be treated as normal coordination correspondence and will not be tracked or documented as a formal submittal. The engineer may or may not respond to such correspondence. If the engineer agrees, in writing, to the use of a particular item, then that same material shall be included in the initial submittal package along with a copy of the correspondence.
- G. Unapproved Products: If materials or equipment are installed before being reviewed and approved by the engineer, the contractor shall be liable for the removal and replacement of such unapproved materials and equipment, at no additional expense to the owner. Additionally, if the removal and replacement of unapproved materials or equipment necessitates the removal and replacement of other related materials or equipment, then the contractor shall be liable for the removal and replacement of the related materials and equipment at no additional expense to the owner.
- H. Product Data:
 - 1. Where the content of manufacturer submittal literature includes data not pertinent to the submittal, clearly indicate which portions of the contents are being submitted for review. Catalogs, pamphlets, or other documents submitted to describe items on which review is being requested shall be specific and identifications in catalogs, pamphlets, etc., of items submitted, shall be clearly made in a contrasting ink or highlighting. Data of a general nature shall not be acceptable.
- I. Shop Drawings:
 - 1. Scale and measurements: Make shop drawings accurately to a scale sufficiently large to show all pertinent aspects of the item.
 - 2. Types of prints required: Submit shop drawings in blue-line or black-line prints, minimum of six (6) sets blue-line or black-line prints of each sheet.

1.6 QUALITY ASSURANCE/CONTROL SUBMITTALS

- A. Quality assurance and quality control submittals may be in the form of documentation or may be in the form of completed physical work that is offered for review by the engineer, architect, or owner.
- B. If documentation is the subject, then submit in a manner similar to the initial submittal package.
- C. If completed physical work is the subject, then the work shall not be concealed, nor shall subsequent work be performed, until the engineer's representative has reviewed the work. If the work is concealed, or if subsequent work is performed, before the engineer's representative has reviewed the work, then the contractor shall be liable for removal and replacement at no additional expense to the owner.
- D. Sequencing:
 - 1. Within 30 calendar days after the contractor has received the owner's notice to proceed, provide the complete submittal package.
 - 2. Submit to local authority having jurisdiction and then submit to Engineer.

3. After the engineer has reviewed the submittal package, make necessary revisions to the submittals as directed by the engineer and resubmit.
 4. After the submittal has been reviewed by the engineer, proceed to purchase materials and perform the work.
- E. Scheduling:
1. Failure to submit items that meet the requirements of the contract documents in ample time for review shall not entitle the contractor to an extension of contract time, and no claim for extension by reason of such default shall be allowed. The contractor may be held liable for delays so occasioned.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 SUBMITTALS

- A. Submit all drawings and design criteria to local authority having jurisdiction prior to submitting to Engineer.
- B. Make submittals of product data, shop drawings, samples, quality assurance submittals, quality control submittals, and other items in accordance with the requirements of this section, applicable sections in Division 22, and additional requirements of each individual Division 21 specification section.
- C. Grouping of Submittals:
1. The submittal package shall be coordinated and included in a single submission. Multiple submissions are not acceptable except where prior written approval has been obtained from the engineer. Partial submittals may be rejected, without being reviewed, as not complying with the provisions of the contract.
- D. Submittal Organization:
1. Provide a submittal cover sheet that lists at least the following:
 - a. Project name
 - b. Date
 - c. Name and address of architect
 - d. Name and address of engineer
 - e. Name, address, and telephone number of prime contractor
 - f. Name, address, and telephone number of fire protection contractor
 - g. Name, address, and telephone number of fire protection supplier
 2. The second and third sheet shall be blank for stamping of submittals
 3. Provide an index sheet listing all items submitted.
 4. The contractor shall call to the attention of the engineer by letter, included in the submittal after the index sheet, any instance in which the submittals are known to differ from the requirements of the contract documents.
 5. Organize all required items by specification section. The material for each specification section shall be organized as follows:
 - a. Provide a tabbed index divider with the specification number and title.
 - b. Provide a section cover sheet that lists the same information as the submittal cover sheet, plus the specification number and title and the name, address, and telephone number of the vendor or vendor's representative, if applicable.
 - c. Refer to the individual Division 21 specification sections for any required organization of the submittal material within each tabbed submittal section.
 - d. Tabbed sections shall be arranged by specification section number in numerical order.
 - e. Organize all required data in a 3-ring hard cover binder suitable for filing. Soft binders are not acceptable.
 - f. Provide a minimum of six copies, each in a separate binder.
 - g. Submit in accordance with the procedures described in Division 01 Submittal Procedures.

- h. Submittals not organized as described here may be rejected, without being reviewed, as not complying with the provisions of the contract.
- E. Response to engineer's review:
 - 1. Review comments: Review comments of the engineer will either be shown on the returned sets to the contractor or shown on a document attached to the sets. If the comments are on an attached document, then the engineer will place a note on the submittal referring to the attached comments. In such cases, the engineer's signature will appear only on the attached document. If the attached, signed document becomes physically separated from the submittal, then the submittal will no longer be considered as being a reviewed submittal.
 - 2. Complete rejection: If the submittal is not complete or does not meet the requirements of this specification section, then the engineer may reject the entire submittal and return the submittal without further review or comment. In such cases, the entire submittal shall be completely revised and resubmitted. The resubmittal shall be given a new submittal number and shall be documented and processed as a separate submittal from the original.
 - 3. Held for completion: If the submittal is not complete, but is only missing some minor item, the engineer may, at the engineer's sole discretion, hold the submittal rather than rejecting and returning the submittal. In such cases, the engineer will notify the architect and contractor that the submittal is being held for completion. The contractor will be given a predetermined amount of time to provide the missing item. Upon receipt of the missing item, the engineer will insert the missing item into the submittal package and proceed with the review process.
 - 4. Partial rejection: The engineer may reject only certain portions of the submittal. In such cases, only those rejected portions or items need to be revised and resubmitted.
 - 5. Provide as corrected: The engineer may note a required change to a submitted item, but may not consider the change serious enough to require a resubmittal. In such cases, the engineer will note that the item is to be provided as noted or corrected. In such cases, the contractor may proceed to provide the item. However, if subsequent observations reveal that the noted change was not made, then the contractor shall be liable for removal and replacement of the item at no additional cost to the owner.
 - 6. Reviewed without comment: The contractor may proceed to provide all materials and equipment.
- F. Quality Assurance/Quality Control Submittals:
 - 1. Provide quality assurance and quality control submittals at those points in the progress of the work in accordance with the requirements of individual Division 22 specification sections.
 - 2. If the subject of the submittal is completed physical work, then submit the work for review by notifying the engineer's representative in sufficient time to schedule the site visit. The engineer's representative will document the review in an observation report. Make noted corrections to the work and resubmit the work for review before covering the work or proceeding with subsequent work.
- G. Close-out Submittals:
 - 1. Provide close-out submittals in accordance with the requirements of Division 1.

END OF SECTION

SECTION 21 13 14
FIRE PROTECTION SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install complete fire protection system, as described, including all piping, heads, hangers, fittings, valves, devices, and components whether specifically specified or not. Keep existing system operational during construction.

1.2 RELATED SECTIONS

- A. Section 21 00 10 - Basic Fire Protection System Requirements
- B. Section 22 05 24 - Valves - General
- C. Section 22 05 30 - Pipe and Pipe Fittings - General
- D. Section 22 33 34 - Access Doors
- E. Section 28 46 21 - Fire Detection and Alarm System

1.3 REFERENCES

- A. NFPA 10 - Fire Extinguisher Cabinet
- B. NFPA 13 - Sprinkler System
- C. NFPA 20 - Fire Pumps
- D. NFPA 24 - Underground Mains
- E. NFPA 1961 - Fire Hose
- F. NFPA 1963 - Fire Hose Connections
- G. NFPA 1964 - Spray Nozzles
- H. UL 2443 - Standard for Flexible Sprinkler Hose
- I. UL - Underwriter Laboratory
- J. FM - Factory Mutual
- K. State Fire Marshall's Office
- L. Insurance Services Office
- M. ASTM C150/C150M - Pipe and Fittings
- N. ASTM A53/A53M - Steel Pipe Black and Hot-Dipped, Zinc-Coated, Welded, and Seamless
- O. ASTM A795/A795M - Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe For Fire Protection Use
- P. AWWA C502 - Dry-Barrel Fire Hydrants

1.4 WORK REQUIRED

- A. Multi-Story Building:
 - 1. This new building will have both light and ordinary hazards. There will be 5 sprinkler zones and allow for 1 future zone(s). The building is multi-story so intermediate stair landing Class One fire valve cabinets will be required. Class One fire valve cabinets will be required at all entry points from the means of ingress and those locations interior to the entry points as required by NFPA 14. All work to include connection to City main, risers, double check detector assembly, alarm checks, alarm valves, fire department connection, all exterior water piping, all interior water piping, sprinkler heads, hangers, unions, fittings, approved OS&Y valves, flow switches, escutcheons for a complete turnkey job.
- B. Existing Sprinkled Building
 - 1. Modify existing sprinkler system to accommodate new layout. Provide new piping and sprinkler heads as need for proper coverage. The contractor is responsible for removal of ceilings and reinstallation of ceilings for new piping.
- C. Furnish and install a complete automatic wet pipe fire protection sprinkler system including all materials, labor, equipment, appurtenances, and accessories necessary for, or incidental to, the execution of a complete sprinkler and fire line/fire hydrant system. This system shall include all necessary freeze protection as required to meet NFPA requirements.
- D. The work shall include the connection of the City main, risers, double check detector assembly, alarm checks, fire department connections, all exterior water piping, ditching, pavement patching, all interior piping, heads, hanger, unions, fittings, alarm valves, approved OS&Y valves, valves, escutcheons, flow switch for fire alarm connections, etc. for a complete turnkey job.
- E. The Contractor shall coordinate with the City regarding the requirements and layout of the vault for the detector check, double check, and any by-pass valves.
- F. The work shall include all freeze protection as required in accordance with NFPA.
- G. This is a Performance Specification to meet the requirements of authorities listed in Section 21 00 10. The drawings are prepared as diagrammatic and are drawn for coordination with the mechanical, electrical, and other trades. They are suggested arrangements only. The Fire Protection Contractor shall coordinate the installation of all items of the fire protection system with all other trades so that all components will be installed to avoid conflict. Components improperly installed shall be removed and/or relocated as directed by Architect or Engineer at no additional cost.
- H. Become thoroughly familiar with the construction details illustrated on the drawings before submitting your bid as no allowance will be made because of the Contractor's unfamiliarity with these details.
- I. Construction and installation drawings shall be prepared according to standard practice. Changes from these drawings necessary to accomplish the work of the various trades or to conform to the rules of authorities having jurisdiction shall be made without additional cost to the Owner.
- J. Exact final location of all exposed mechanical piping, equipment, etc. shall be verified with the Architect.

1.5 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 21 00 10, General Conditions, and Division 1.
- B. Sprinkler Contractor to provide building shop drawings to Mechanical, Electrical, and Plumbing Contractors for coordination.
- C. Submit fully-dimensioned shop drawings in accordance with general conditions. Densities and spacing as required by NFPA 13 and City Fire Department.
- D. All piping on shop drawing to be labeled with pipe elevation above finished floor.
- E. The system shall be a hydraulically calculated system for the hazard categories, and hydraulic calculations shall be submitted.

- F. Shop Drawings to show piping, materials, heads, pipe elevations, pipe hangers, fittings, appurtenances, hydraulic calculation, etc. Show all details as required by NFPA 13.
 - 1. Sprinklers shall be referred to on drawings, submittals, and other documentation, by the sprinkler identification or Model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.
- G. Submit and obtain approval from the local approving authority before submission to the Architect.
- H. Submit data books showing sprinkler heads, alarm valves, pipes, fittings, hangers, switches, and other specialty items for review and approval.
- I. Provide "as-built" drawings at the end of project with disk using PDF files.

1.6 QUALITY ASSURANCE

- A. Sprinkler Contractor to be licensed and have a minimum of 3 years' experience installing fire protection systems.
- B. All piping shall be new materials.
- C. All products meet UL or F.M. and display labels.
- D. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- E. All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.
- F. Conform to NFPA 10, NFPA 13, NFPA 20, and NFPA 24.
- G. Meet or exceed State Fire Marshall's Office and Insurance Services Office.
- H. Meet or exceed all local codes.

PART 2 - PRODUCTS

2.1 CONNECTION TO CITY MAIN

- A. Provide connection to City water main as shown on drawings from the connection to and including the point inside the building above ground. Sprinkler Contractor to obtain up to date water flow test to verify sprinkler system will work in accordance with NFPA 24.
- B. This work shall include the connection to the existing main, all exterior water piping, ditching, pavement patching, fittings, valves, etc.
- C. Piping:
 - 1. Ductile Iron Pipe and Fittings:
 - a. Class 150 per AWWA C-150-76 specification.
 - 2. PVC Pipe and Fittings:
 - a. C900 PVC Class 150
 - b. Use PVC for underground piping 5'-0" from building if approved by code.
 - 3. Thrust Blocks:
 - a. Constructed of 2,500 psi concrete.
 - b. Provide at all changes in direction in the fire line piping.

2.2 SPRINKLER PIPING ABOVE GROUND

- A. Type:
 - 1. Black steel per ASTM A53/A53M or ASTM A795/A795M.

- B. Wall Thickness and Joining System:
 - 1. Per NFPA 13 requirements.
- C. Sleeves:
 - 1. Above Grade:
 - a. Galvanized steel.
 - 2. Below Grade:
 - a. Cast iron.
- D. Hangers:
 - 1. Per NFPA 13 requirements
- E. Fittings:
 - 1. Screwed fittings to be 125 lb. cast iron.
 - 2. Grooved fittings and couplings to be Victaulic FireLock or engineer approved equal.
 - 3. Welded outlets may be used.
 - 4. Any other joining system requires prior approval.
 - 5. Compression fittings/saddles taps are not allowed.

2.3 VALVES

- A. Acceptable Manufacturers:
 - 1. Nibco
 - 2. Victaulic
 - 3. Viking
 - 4. Ames
 - 5. Milwaukee
- B. Backflow Preventers:
 - 1. Ames 2000SS, or as approved by local municipalities.
 - 2. B.F.P. must be certified by approved testing personnel and testing report submitted for Owner's records.
- C. Control Valves:
 - 1. Grooved butterfly valves only:
 - a. Working pressure to 300 psig (2065-kPa).
 - b. Ductile iron grooved end body.
 - c. Pressure responsive elastomer seat.
 - d. Stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating.
 - e. Weatherproof actuator housing with handwheel and supervisory switches.
 - f. Basis of Design: Victaulic Series 705.
 - 2. Manufacturers:
 - a. Victaulic
 - b. Milwaukee
 - c. NIBCO
 - d. Viking
 - 3. The use of O.S.& Y. valves to be avoided if possible.
- D. Check Valves:
 - 1. To be grooved type for appropriate pressures to 250 psig (1725 kPa).
 - 2. Stainless steel spring, suitable for vertical or horizontal installation.
 - 3. Basis of Design: Victaulic Series 717.
- E. Inspector's Test Connections:
 - 1. AGF or Victaulic TestMaster II one handle type complete unit that allows testing and draining.
- F. Alarm Valves:
 - 1. Acceptable Manufacturers:
 - a. Victaulic, Reliable, or TYCO

- b. Valves to be pre-trimmed grooved type if possible complete with variable pressure trim and retard chamber are required.
 - c. Valve internal components shall be replaceable without removal of valve from installed position.
 - d. Basis of Design: Victaulic Series 751 with Series 752 Retarding Chamber.
- G. Dry Valves:
- 1. Acceptable Manufacturers:
 - a. Victaulic, Reliable, or TYCO
 - b. Valves to be pre-trimmed grooved type if possible and include all necessary pressure switches as required.
 - c. Required air pressure shall be 13-psi (90-kPa).
 - d. Valve internal components shall be replaceable without removal of valve from installed position.
 - e. Valve shall be externally re-settable.
 - f. Basis of Design: Victaulic Series 768N.

2.4 PIPING

- A. Exterior Piping:
- 1. Exterior underground piping shall be domestic made C900 or Blue Brute with ductile iron mechanical joint fittings. All joints to be rodded and thrust blocked per NFPA 24 requirements. All exposed support materials to be made of stainless steel to prevent corrosion.
 - 2. The 5'-0" stub out piece of underground fireline to be a stainless steel in building riser made as one piece. This is to be installed per NFPA 24.
- B. Interior Piping:
- 1. Piping to meet the ASTM requirements for welded steel piping. The sprinkler mains to be Schedule 10 black piping joined with grooved fittings. The branchline piping to be SCD 40 black piping joined with threaded cast iron fittings. Piping and fittings are to be UL listed. No mixing of black and galvanized piping.
 - 2. No piping will be allowed over electrical or IDF/MDF/IT spaces. Only branch lines serving the sprinkler head(s) for the spaces will be permitted.
 - 3. For spaces without ceilings; all vertical rises/falls in piping must be concealed in walls.

2.5 FLEXIBLE SPRINKLER HOSE FITTINGS

- A. Manufacturer:
- 1. Victaulic Vic-Flex
 - 2. Viking Flex Head
 - 3. Approved equal
- B. Product: Hose fittings are to be:
- 1. FM approved to 200 psi (1380 kPa) and UL listed for sprinkler services to 175 psi (1206 kPa).
 - 2. Compliance with UL 2443.
 - 3. 100% type 304 stainless steel, pressure tested in accordance to meet all NFPA standards.
 - 4. Fully welded non-mechanical fittings, braided or corrugated and leak tested.
 - 5. The drop system shall consist of a braided type 304 stainless steel flexible tube, zinc plated steel Male threaded nipple, or Victaulic FireLock IGS Groove Style 108 coupling for connection to branch-line piping and a zinc plated steel reducer with a female thread for connection to the sprinkler head.
 - 6. The drop shall include a UL approved Series AH1 with 3" bend radius; AH2 or AH2-CC braided hose with a bend radius to 2" to allow for proper installation in confined spaces.
 - 7. Union joints shall be provided for ease of installation.
 - 8. The flexible drop shall attach to the ceiling grid using a one-piece open gate Series AB1 or AB2 bracket. The bracket shall allow installation before the ceiling tile is in place. The braided drop system is and FM Approved.
 - 9. Basis of Design: Victaulic VicFlex™ Multiple-Use Flexible Stainless Steel Sprinkler Drop System with captured coupling Style 108.

2.6 FITTINGS AND COUPLINGS

- A. Acceptable Manufacturers:
1. Victaulic
 2. Anvil
 3. Star
 4. Tx Line
 5. All fittings must be UL listed and FM approved for use in fire sprinkler systems and be from the same manufacturer. In applicable sizes, fittings shall be short-pattern, with flow equal to standard pattern fittings. Basis of Design: Victaulic Firelock.
 - a. Installation-Ready™ fittings for Schedule TBD grooved end steel piping in fire protection applications sizes NPS 1-¼ thru 2½ (DN 32 thru DN 65). Fittings shall consist of a ductile iron housing with Installation-Ready™ ends, prelubricated Grade “E” EPDM Type ‘A’ gasket, and ASTM A449 electroplated steel bolts and nuts. UL listed for a working pressure of 300 psi (2065 kPa) and FM approved for working pressure 365 psi (2517kPa).
- B. Grooved Joint Couplings:
1. Couplings shall consist of two ductile iron housing segments, pressure responsive center-leg gasket with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth, and ASTM A449 compliant bolts and nuts. Installation-Ready, for direct stab installation without field disassembly.
 - a. Rigid Type: Housings cast with offsetting, angle-pattern, bolt pads to provide system rigidity and support and hanging in accordance with NFPA 13, fully installed at visual pad-to-pad offset contact. (Couplings that require exact gapping at specific torque ratings are not permitted.) Basis of Design: Victaulic Style 009N and 107N.
 - b. Flexible Type: For use in locations where vibration attenuation and stress relief are required. Basis of Design: Victaulic Installation-Ready Style 177.
- C. No mixing of black and galvanized fittings allowed.

2.7 HANGERS AND SUPPORTS

- A. All hangers and supporting materials to be per NFPA and code requirements.
- B. All hanger attachments on steel beams and bar joists are to be attached at the top of the beam or joist. No attachments to bottom of steel structure or wind bracing.
- C. All thread rod to be plated type to prevent corrosion.
- D. Trapeze material to be per NFPA 13 requirements.

2.8 CLASS ONE FIRE VALVES AND CABINETS

- A. Type:
1. Standard 2½-inch fire department valves with caps and chains mounted in valve cabinets where required by NFPA and/or Local authority having jurisdiction (LAJ). Cabinet doors to be lockable with break glass capabilities.
- B. Inlet Threads:
1. Standard National Pipe Threads.
- C. Outlet Threads:
1. Standard National Fire Hose Threads.
- D. Manufacturer:
1. Larsen’s Manufacturing Company.
- E. Location and placement of all fire valves to be coordinated with the Construction Manager/General Contractor before installation.

2.9 SPRINKLER HEADS

- A. Type:

1. Sprinklers shall be glass bulb type, with hex shaped wrench boss integrally cast into the sprinkler body to reduce the risk of damage during installation.
 2. Approved Manufacturers:
 - a. Victaulic
 - b. Viking
 - c. Wrenches shall be provided by the sprinkler manufacturer that directly engage the hex-shaped wrench boss integrally cast in the sprinkler body.
 3. Recessed pendant sprinkler heads conforming to NFPA 13. Escutcheons to be positive locking. Friction type not acceptable.
 4. Concealed sprinkler, sprinkler heads.
 5. In sloped ceilings under stairs and ceilings less than 9'-0" are penal/institutional heads.
- B. Cover plate finish to be special color to match architectural paint scheme. Sprinkler head rating to be 155°F and cover plate rating to be 135°F.
- C. Upright heads for areas with no ceilings to conform to NFPA 13.
- D. UL listed and FM approved rigid coupling to join sprinklers with IGS profile grooved ends to matching 1" IGS outlets; Coupling consists of two cast copper-alloy housing segments for connection of 1/2", 3/4", and 1" sprinklers. Coupling includes an EPDM Type A gasket, with zinc-plated cap screws conforming to ASTM F835, and nylon insert locknut. Installation-ready, for direct push installation without field disassembly. Rated for a working pressure to 175 psi (1205 kPa). Victaulic Style V9.
- E. Guards:
 1. Chrome metal guards on all heads with exposed pipes. (e.g., gymnasiums, pavilions, mechanical rooms, electrical rooms).
 2. Escutcheons and guards shall be listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.
- F. Temperature Ratings:
 1. Minimum of 155°F - Ordinary
 2. Intermediate - Mechanical, electrical, and all similar rooms.
- G. Match existing sprinkler head type in renovation projects.

2.10 FIRE DEPARTMENT CONNECTIONS

- A. Provide Knox Lock caps on all fire department connections.
- B. At the low point near each fire department connection, install a 90-degree elbow with drain connection to allow for localized system drainage. Basis of Design: Victaulic #10-DR.

2.11 EXTRA MATERIALS

- A. Provide Owner with 6 heads and 12 escutcheons in a head box located in sprinkler riser room. Provide one head wrench for each type of head.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Sprinkler Systems Contractor shall be responsible for coordinating with all trades. All elevations shown on sprinkler shop drawings are void unless elevations are coordinated with all trades.

3.2 ACCESS DOORS

- A. Provide access doors for concealed valves, controls, and other parts requiring accessibility for operation and maintenance.

3.3 PIPING INSTALLATION

- A. Install piping in a neat and workmanlike manner. All piping routing and elevations to be coordinated with Electrical, Mechanical, and Ceiling Contractors before installation of any piping.
- B. Run the interior fire lines concealed and support from the beams and joists. Exposed piping except in mechanical rooms shall require specific approval of the Architect.
- C. No piping will be allowed over electrical or IDF/MDF/IT spaces. Only branch lines serving the sprinkler head(s) for the spaces will be permitted.
- D. Cut all pipe accurately to measurements established at the building. Install pipe without forcing or springing.
- E. Place all inserts to accommodate the ultimate installation of pipe hangers in the forms before concrete is provided. Set sleeves in place before concrete is poured and masonry walls while they are under construction. Provide sleeves for all pipe passing through foundations, walls, partitions, and ceilings.
- F. Caulk pipes through outside walls and floors between pipe and sleeve.
- G. All drains and test connections shall be piped to outside of building.
- H. Paint exposed drain fittings on outside walls to match wall color. Architect to select color.
- I. Provide unions and flanged connections as required. Unions or flanges for servicing and disconnect are not required in installations using grooved joint couplings.
- J. Grooved joints shall be installed in accordance with the manufacturer's latest published instructions. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Grooved coupling manufacturer's factory trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically visit the job site to ensure best practices in grooved product installation are being followed. Contractor shall remove and replace any improperly installed products.
- K. Space all hangers according to NFPA requirements.
- L. Flexible hose connections shall be one (1) piece from factory. No field modifications.
- M. Install all heads in the center of ceiling tiles. Install all heads in straight line with building lines.
- N. Coordinate with Electrical and Mechanical Contractor to produce the building sprinkler shop drawings
- O. Change of Direction:
 - 1. Install supports within two feet of change of direction.
 - 2. Brackets of approved type may be used along the walls.
 - 3. Install hangers within 2 feet of each change in vertical or horizontal direction, pipe tees, and on each side of valves, strainers, etc.
 - 4. Multiple horizontal pipes, smaller than 12" diameter pipe, may be supported on trapeze hangers. Space trapeze hangers in accordance with the schedule for pipe spacing based upon the smallest size pipe.
 - 5. Properly size the trapeze members for the piping load they are to support. The number of pipes on the trapeze must be approved by the Engineer to prevent overloading of the building structure.
 - 6. Where pipes are insulated, oversize the hanger accordingly to accommodate the outside diameter of the insulation. Provide half-round 16 gauge galvanized steel shields, not less than 12" long and rolled to fit the insulation diameter, between the insulation and the hanger.
 - 7. When pipe is guided at top and bottom, cover the entire pipe circumference with metal shields.
 - 8. Adhere metal shield to the insulation so that the metal will not slide with respect to the insulation.
 - 9. Wood struts shall not be used to support piping in walls.

3.4 FIRE VALVE CABINETS

- A. Provide Class One fire valve cabinets in all intermediate landings in stairs per NFPA 14 (reference 7.3.2.1.1).
- B. Provide Class One fire valve cabinets at all locations in building where 200' point of ingress is exceeded inside the building per NFPA 14 (reference 7.3.2.11).

3.5 TESTING

- A. Perform such tests as required by the Architect/Engineer, State Fire Marshall's Office, Insurance Services Office, NFPA 13, and local municipal requirements.
- B. Provide all apparatus, temporary pipeline, and all other requirements necessary for such tests. Take all due precautions to prevent damage to the building or its contents incurred by such tests. The Contractor will be required to repay and make good any damage so caused at his own expense.
- C. Repair and make good any leaks, defects, or deficiencies discovered as a result of the tests. Repeat the tests until all requirements have been fully satisfied.
- D. The following tests will be required by the Engineer unless otherwise indicated:
 - 1. Subject all water piping to a 2-hour hydrostatic pressure test at 200 psig. Check all horizontal piping to determine if proper drainage is provided. Test piping for tightness before being concealed.
 - 2. Flow tests, water supply capability tests, and any other test required by NFPA 13, Texas State Board of Insurance, or local authorities.

3.6 INSPECTION

- A. The Architect/Engineer shall have the right to inspect the work whenever advisable.
- B. The Contractor shall have a representative present on each inspection and shall give assistance as may be required.
- C. Any piping installed that is in direct conflict with building configuration, design, and intent, and conflicts with installation of mechanical plumbing and electrical components are to be removed and not reinstalled until all parties (sprinkler, mechanical, plumbing, electrical, etc.) are in agreement with utilization of ceiling/attic space. Sprinkler piping to be installed as high as possible and out of the direct path of any HVAC ductwork, plumbing, and electrical pull boxes/j-boxes.

END OF SECTION

SECTION 22 00 10

BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Basic plumbing requirements necessary to provide complete installation of all Division 22 work.

1.2 WORK INCLUDED

- A. This section of work comprises furnishing of all materials, equipment, tools, scaffolding, rigging, hoisting, labor, and transportation necessary for the complete installation of the plumbing systems as shown on the plans and as specified herein.
- B. Bidders shall determine the contents of a complete set of drawings and specifications and be aware that they may be bidding from a partial set of drawings, applicable only to the various separate contracts, subcontracts, or trades as may be issued for bidding purposes only. The contract documents and the complete scope of work for the project are illustrated on the combined Architectural, Structural, Mechanical, Heating, Ventilating, Air Conditioning, Plumbing, and Electrical, and each Bidder shall thoroughly acquaint himself with all the details of the complete set of drawings and specifications before submitting his bid.
- C. All drawings and specifications form a part of the contract documents for each separate contract and shall be considered as bound therewith in the event partial sets of plans and specifications are issued for bidding only. The submission of bids shall be deemed evidence of the review and examination of all drawings, specifications, and addenda issued for this project as no allowances will be made because of unfamiliarity with any portion of the complete set of documents.
- D. Plumbing Contractor is responsible for all final connections to specified plumbing fixtures and all owner furnished equipment requiring plumbing (drain, water, gas, condensate, air).

1.3 RELATED SECTIONS

- A. The conditions of the Division 01 requirements and the contract requirements which include the General Conditions and the Supplementary Conditions apply to the work of this division.

1.4 CODES & REFERENCE STANDARDS

- A. General
 1. Perform all Division 22 work in strict accordance with the requirements and recommendations stated in the codes and standards except when requirements are modified by the contract documents.
 2. Nothing in the Contract Documents shall be construed to permit work not conforming to these codes.
 3. When two or more codes or standards are applicable to the same work, then the stricter code or standard shall govern.
 4. The date of the code or standard that is in effect on the date of issue of the contract documents except when a particular publication date is specified.
 5. The Contractor shall be held responsible for verifying all local codes and ordinances that may alter any part of the plans or specifications. The Contractor shall bear all costs for correcting the deficiencies.
 6. Where local codes and ordinances are not in writing or on record but a local precedence has been set, the Owner shall pay for any additional cost incurred.

1.5 APPLICABLE CODES AND STANDARDS FOR ALL DIVISIONS 22 WORK

- A. International Building Code

- B. International Gas Code
- C. International Plumbing Code
- D. International Mechanical Code
- E. International Energy Conservation Code
- F. National Electrical Code
- G. American Society of Heating, Refrigerating and Air Conditioning Engineers Standards.
- H. Occupational Safety and Health Administration Standards:
 - 1. OSHA Standard 2207 - Construction Industry Standards
 - 2. OSHA 29 CFR Part 1926 - Regulation of Excavation
 - 3. Texas Underground Facility Damage Prevention Act (H.B. 2295)
 - 4. All other applicable standards
- I. National Fire Protection Association:
 - 1. NFPA 90A Installation of Air Conditioning and Ventilating Systems
- J. Fire Sprinkler System:
 - 1. NFPA 13
 - 2. NFPA 14
 - 3. NFPA 101 Section 8-3
 - 4. All other applicable codes
- K. National Appliance Energy Conservation Act of 1987
- L. Texas State Board of Insurance Standards
- M. Clean Air Act and Clean Air Act Amendments of 1990
- N. State Codes:
 - 1. Texas Department of Labor Boiler Rules and Regulations
 - 2. All other applicable codes
- O. Local Municipal Codes and Ordinances
- P. Schedule of Abbreviations:
 - 1. Reference Standards are listed in Division 22 using the abbreviations listed below:
 - a. AABC (NSTSB) - Associated Air Balance Council
 - b. AASHTO - American Association of State Highway and Transportation Officials
 - c. ADA - Americans with Disabilities Act
 - d. AGA - American Gas Association
 - e. ANSI - American National Standards Institute
 - f. ASME - American Society of Mechanical Engineers
 - g. ASPE - American Society of Plumbing Engineers
 - h. ASTM - American Society for Testing and Materials
 - i. AWE - American Welding Society
 - j. AWWA - American Water Works Association
 - k. CISPI - Cast Iron Soil Pipe Institute
 - l. CS - Commercial Standard
 - m. CSA - Canadian Standards Association
 - n. DIPRA - Ductile Iron Pipe Research Association
 - o. DOT - Department of Transportation
 - p. DOC - Department of Commerce
 - q. FCC - Federal Communications Commission
 - r. FM - Factory Mutual
 - s. FS - Federal Specification

- t. IBC - International Building Code
- u. ITL - Independent Testing Laboratories
- v. NEC - National Electric Code
- w. NFPA - National Fire Protection Association
- x. NSF - National Sanitation Foundation
- y. OSHA - Occupational Safety and Health Administration
- z. PDI - Plumbing and Drainage Institute
- aa. SMACNA - Sheet Metal and Air Conditioning National Association
- bb. Texas Department of Health
- cc. Texas Water Resource Commission
- dd. UL - Underwriters Laboratories

1.6 QUALITY ASSURANCE

- A. Provide complete installations of all systems.
- B. Furnish all items of equipment, material, and labor to complete the Contract even though each and every item necessary is not specifically mentioned or shown.
- C. In case of any conflict between the specifications, plans, and ordinances, the ordinances shall govern.
- D. All materials furnished under this Contract shall be new, free from defects of any kind, of the quality and design hereinafter specified, and shall conform to the standards of Underwriter's Laboratories Inc., except for equipment which UL does not list or provide label service.
- E. All plumbing equipment and fixtures shall be the same brand unless scheduled differently on plans.

1.7 CONTRACTOR'S RESPONSIBILITY

- A. Erect barricades, protective fencing, and signs to prevent injury to personnel on-site.
- B. Make permanent connection to utilities or existing lines. Determine depth and location, and bid accordingly.
- C. Relocate and repair any existing lines cut by general construction work.
- D. Pay all costs in connection with metering devices.
- E. Plans do not show exact location and elevations of lines, nor do they show all offsets required.
- F. Deviate from plans as required to conform to the general construction and provide proper grading.
- G. Maintain all utility services during construction to existing portions of job that remain.
- H. Procure and pay for all necessary permits or licenses to carry out the work.
- I. Obtain and pay for all the necessary certificates of approval which must be delivered to the Architect before final acceptance of the work.
- J. Periodically remove rubbish, clean or repair all surfaces marred by the work required under this contract.
- K. Protect work from damage by other trades.
- L. Make all tests required by law; pay all costs in connection with the testing.
- M. Where job conditions require changes in indicated locations and arrangements, make such changes without extra cost to Owner.
- N. Provide motor starters, controls, relays, all low-voltage wiring, conduit, and wiring related to plumbing and other equipment and devices to form a complete working system. See Division 26 00 00.

1.8 DEFINITIONS

- A. Approval:
 - 1. It is understood that approval must be obtained from the Architect in writing before proceeding with the proposed work.
 - 2. Approval by the Architect of any changes, submitted by the Contractor will be considered as general only to aid the Contractor in expediting his work.
- B. Contractor:
 - 1. The Contractor engaged to execute the work included in a particular section only, even though he may be technically described as a Subcontractor to the General Contractor.
 - 2. If the Contractor engaged to execute said work employs Sub-Contractors to perform various portions of the work included under this Section, he shall be held responsible for the execution of same, in full conformity with Contract Document requirements.
 - 3. The Contractor shall cooperate at all times and shall be responsible for the satisfactory cooperation of his Subcontractors with the other Contractors on the job so that all of the various phases of the work may be properly coordinated without unnecessary delays or damage to any parts of the work of any Contractor.
- C. Provide:
 - 1. Defined as requiring the furnishing and installing of the item or facility indicated, complete in all respects, and ready for operation unless otherwise specifically noted.

1.9 WARRANTY

- A. The Contractor shall warranty his work against defective materials and workmanship for a period of one year from date of acceptance of the job.
- B. Neither the final payment nor any provisions in Contract Documents shall relieve the Contractor of the responsibility for faulty materials or workmanship.
- C. He shall remedy any defects due thereto, and pay for any damage to other work resulting therefrom, which shall appear within a period of one year from date of substantial completion.
- D. The Owner shall give notice of observed defects with reasonable promptness.
- E. This Guarantee shall not be construed to include the normal maintenance of the various components of the system covered by these specifications.

1.10 SITE VISIT

- A. Before submitting his proposal, each bidder shall examine all plans and specifications relating to the work, shall visit the site of the project, and become fully informed of the extent and character of the work required.
- B. No consideration will be granted for any alleged misunderstanding of the materials to be furnished or the amount of work to be done, it being fully understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying plans or required by nature of the site of which may be fairly implied as essential to the execution and completion of any and all parts of the work.

1.11 PROJECT RECORD DOCUMENTS

- A. The Contractor shall keep a set of plans on the job, noting daily all changes made in connection with the final installation including exact dimensioned locations of all new and uncovered existing utility piping outside the building.
- B. Upon submitting his request for final payment, he shall turn over to the Architect/Engineer, for subsequent transmittal to the Owner, a clean, neatly marked set of reproducible plans showing "as installed" work and an electronic file with changes of materials.
- C. In addition to the above, the Contractor shall accumulate during the job's progress the following data, in duplication (2 each), prepared in 3 ring binders of sufficient size, black in color, neat in appearance, and

turned over to the Architect/Engineer for checking and subsequent delivery to the Owner:

1. All warranties, guarantees, and manufacturer's directions on equipment and material covered by the Contract.
2. Approved fixture brochures.
3. Copies of reviewed shop drawings.
4. Set of operating instructions. Operating instructions shall also include recommended maintenance.
5. Any and all other data and/or plans required during construction.
6. Repair parts lists of all major items and equipment including name, address, and telephone number of local supplier or agent.
7. The first page, or pages, shall have the names, addresses, and telephone numbers of the following:
 - a. General Contractor and all sub-contractors.
 - b. Major Equipment Suppliers.

1.12 TRAINING

- A. Upon completion of the work and at a time designated by the Owner's representative, provide a formal training session for the Owner's operating personnel to include location, operation, and maintenance of all plumbing equipment and systems, some sections have further instructions.
- B. Before proceeding with instruction, prepare a typed outline in triplicate listing the subjects that will be covered. Submit the outline for review by the Owner's representative.
- C. At the conclusion of the instruction, obtain the signatures of the attendees on each copy of the outline to signify that they have a proper understanding of the operation and maintenance of the system. Submit the signed outlines to the Owner's representative and Engineer as a condition of final acceptance.

1.13 PLANS AND SPECIFICATIONS

- A. The plans show diagrammatically the locations of the various lines, ducts, conduits, fixtures, and equipment and the method of connecting and controlling them.
- B. It is not intended to show every connection in detail and all fittings required for a complete system.
- C. The systems shall include but are not limited to the items shown on the plans.
- D. Exact locations of these items shall be determined by reference to the general plans and measurements of the building and in cooperation with other Contractors, and in all cases, shall be subject to the approval of the Architect/Engineer.
- E. The Architect/Engineer reserves the right to make any reasonable change in the location of any part of this work without additional cost to the Owner.
- F. Contractor, subcontractor, vendors, and suppliers are required to waive subrogation against Owner and Engineer.

1.14 UTILITIES, LOCATIONS, AND ELEVATIONS

- A. Locations and elevations of the various utilities within the scope of this work have been obtained from the City and/or other substantially reliable sources and are offered separately from the Contract documents, as a general guide only, without guarantees as to accuracy.
- B. The Contractor shall examine the site, shall verify to his own satisfaction the locations, elevations, and availability of all utilities and services required, and shall adequately inform himself as to their relation to the work; the submission of bids shall be deemed evidence thereof.
- C. The Contractor shall coordinate all services with the Utility Companies during construction, coordinate changes made by Utility Companies to the design of project, and coordinate with the Owner, Architect/Engineer, and Utility the scheduling of any shutdowns or delays that may occur in providing service.

- D. The Contractor shall verify location, conduct all necessary tests, inspections, coordinate with Owner's representatives and utilities, and check for existing underground utilities and lines before ditching.
- E. The Contractor shall be responsible for repair of any cut or damaged lines or utilities he uncovers. There are lines and utilities not shown on any plans.
- F. Contractor is responsible for coordination of all existing and new utilities at site. Contractor is responsible for protecting and repairing any utilities damaged by installation of pipe. All existing and new landscaping/trees to remain and to be protected unless directed otherwise by Architect/Owner.

1.15 SUBSTITUTION OF PRODUCTS

- A. Substitution of products specified herein will be considered only when a complete list of proposed alternative equipment is submitted to the Engineer in writing, supported by adequate technical and cost data. This includes a complete description of the proposed substitution, drawings, catalog cuts, performance data, test data, or any other data or information necessary for evaluation.
- B. All proposed substitutions and data must be received by the Engineer no less than ten working days prior to the scheduled date for opening of bids.
- C. The Engineer will consider all such submittals and the Architect will issue an addendum listing items that the Engineer considers acceptable. Only such items as specified or approved as acceptable will be installed on this project.
- D. Manufacturers' names are listed herein and on the plans to establish a standard of quality and design. Where a manufacturer's name is mentioned, products of other manufacturers will be acceptable, if, in the opinion of the Engineer, the substitute material is of equivalent quality or better than that of the material specified.
- E. The Contractor's Bid represents that the bid price is based solely upon the materials and equipment described in the Bid Documents (including addenda, if any) and that he contemplates no substitutions or extras.
- F. Requests for substitution are understood to mean that the Contractor:
 - 1. Has personally investigated the proposed substitution and determined that it is equal or superior in all respects to that specified.
 - 2. Will provide the same guarantee for the substitution that he would for that specified.
 - 3. Will, at no cost to the Owner, replace the substitute item with the specified product if the substitute item fails to perform satisfactorily.
- G. After Award of the Contract, substitutions will be considered only under one or more of the following circumstances:
 - 1. The substitution is required for compliance with subsequent interpretations of code or insurance requirements.
 - 2. The specified product is unavailable through no fault of the Contractor.
 - 3. The manufacturer refuses to warranty the specified products as required.
 - 4. Subsequent information that the specified product is unable to perform properly or to fit in the designated space.
 - 5. In the Engineer's sole judgment, the substitution would be in the Owner's best interest.
- H. Revisions to the plumbing system shall be under the supervision of the Engineer at a standard hourly rate charged by the Engineer and shall be paid by the Contractor originating the changes.

1.16 PROTECTION OF EQUIPMENT AND MATERIALS

- A. The Contractor shall take such precautions as may be necessary to properly protect his apparatus from damage.
- B. This shall include the creation of all required temporary shelters to adequately protect any apparatus above the floor of the construction and the covering of apparatus in the completed building with tarpaulins or other protective covering.

- C. Failure to comply with the above to the satisfaction of the Owner's inspector will be sufficient cause for the rejection of the equipment in question and its complete replacement by this Contractor.
- D. All apparatus shall be cribbed up from the floor or ground by the Contractor and covered with tarpaulins or other protective covering where necessary or directed.

1.17 FINAL INSPECTION

- A. It shall be the duty of this Contractor to make a careful inspection trip of the entire project, assuring himself that the work on the project is ready for final acceptance before calling upon the Architect/Engineer to make a final inspection.
- B. To avoid delay of final acceptance of the work, the Contractor shall have all necessary bonds, warranties, receipts, affidavits, etc., called for in the various articles of these specifications, prepared and signed in advance, together with a letter of transmittal, listing each paper included, and shall deliver the same to the Architect/Engineer at or before the time of said final inspection. The Contractor is cautioned to check over each bond, receipt, etc., before preparing for submission to verify that the terms check with the requirements of the specifications.

1.18 CUTTING AND PATCHING

- A. All Subcontractors shall notify the General Contractor sufficiently ahead of construction of any floors, walls, ceiling, roof, etc., of any openings that will be required for his work.
- B. He shall see that all sleeves required for his work are set at proper times so as to avoid delay of the job.
- C. All necessary cutting of walls, floors, partitions, ceilings, etc., as required for the proper installation of the work under this Contract shall be done at the Subcontractor's expense in a neat and workmanlike manner, and as approved by the Architect/Engineer.
- D. No joists, beams, girders, or columns shall be cut by any Contractor without first obtaining written permission of the Architect/Engineer.
- E. Patching of openings and/or alterations shall be provided by the General Contractor.
- F. All openings in firewalls and floors, such as thimbles, shall be completely sealed after installation for a completely airtight and watertight installation. Sealing material shall be non-combustible and UL approved. The installed sealing assembly shall not cause the fire rating of the penetrated structure to be decreased.
- G. All openings in exterior walls shall be sealed watertight.

1.19 IDENTIFICATION

- A. Refer to Section 22 05 54.

1.20 MANUFACTURER'S INSTRUCTIONS

- A. All equipment and devices shall be installed in accordance with these plans and specifications, manufacturer's instructions, and applicable codes.
- B. Where specifications call for installation of a product to be in accordance with manufacturer's instructions and/or where manufacturer's instructions are required for installation of a product, it shall be the Contractor's responsibility to obtain the necessary applicable manufacturer's instructions and install the product in accordance with the manufacturer's instructions.
- C. It shall be the Contractor's responsibility to install all equipment, materials, and devices shown on the plans and as called out in these specifications even if manufacturer's instructions are absolutely unattainable.

1.21 RELATED WORK

- A. The various specification sections for this division may or may not include related work listings.
- B. All related work shall be coordinated and provided by the Contractor regardless of whether specifically identified or not.

1.22 ELECTRICAL WIRING AND EQUIPMENT FOR PLUMBING SYSTEMS

- A. All wiring, conduit, boxes, equipment (controls, thermostats, relays, contactors, motor starters, heaters, switches), and any other control devices or equipment required to form a complete and properly operating system, shall be the responsibility of this Contractor.
- B. The Electrical Contractor shall only provide line voltage (including hook-up) to all plumbing equipment.
- C. All controls and devices shall be low voltage unless otherwise noted or shown on the plans. Where line voltage controls or devices are noted, the Contractor shall provide complete wiring diagrams (approved by the Engineer) to the Electrical Contractor prior to final hook-up.
- D. The Plumbing and Electrical plans are based on the equipment and devices scheduled as shown on the plans or as called for in the specifications. Should any plumbing equipment or device be changed or approved from those which are shown or noted, all electrical and/or plumbing changes shall be made at the expense of the trade or Contractor initiating the change with no expense to the Owner, Architect, Engineer, or their representatives.
- E. All wiring provided by this Contractor shall be installed in a workmanlike manner using tie wraps, labels, anchors and etc. Loose wiring is not acceptable.
- F. All conduit and boxes required in all walls for control purposes (thermostats, switches, etc.) shall be provided by electrical contractor.
- G. All conduit required in attic, clear spaces, or on roof shall be by electrical Contractor.

1.23 DEMOLITION AND REMODEL

- A. It shall be the responsibility of this Contractor to see that all demolition and remodeling work involving his trade (including but not limited to plumbing piping, condensate lines, plumbing equipment, etc.) is accomplished in a manner and completeness to provide the appearance of new construction work.
- B. Abandoned plumbing fixtures shall be removed and disposed of off-site in a legal manner.
- C. Any usable equipment and/or structure damaged during demolition and remodel work shall be replaced.
- D. All abandoned and/or otherwise unused piping shall be securely capped using materials of the same composition as the original piping.
- E. No exposed piping and/or other materials will be permitted in the finished job.
- F. Any abandoned piping which penetrates the slab in an exposed area shall be sealed and securely capped below the slab.

1.24 OPERATION PRIOR TO COMPLETION

- A. When any piece of plumbing equipment is operable and the Contractor needs to operate the equipment, he may do so providing that he properly supervises the operation.
- B. The warranty period shall, however, not commence until such time as the equipment is operated for the beneficial use of the Owner.
- C. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, install clean filter media, properly adjust and complete all punch list items before final acceptance by the Owner.
- D. The date of acceptance and the start of the warranty may not be the same date.

1.25 SAFETY GUARDS

- A. Contractor shall furnish and install all safety guards required. All belt driven equipment, projecting shafts, and other rotating parts shall be enclosed or adequately guarded.

1.26 FLAME SPREAD PROPERTIES OF MATERIALS

- A. All materials and adhesives used for plumbing and insulation shall conform to NFPA and UL life and flame spread properties of materials.
- B. The composite classifications shall not exceed 25 for a flame spread rating and 50 for a smoke developed rating as listed for the basic material, the finishes, adhesives, etc., specified for each system and shall be such when completely assembled.

1.27 ASBESTOS

- A. No asbestos or asbestos containing materials shall be permitted in this project.

1.28 LEAD MATERIALS

- A. No lead or lead containing materials shall be allowed in any domestic or potable water supply piping, valves, fixtures, components, equipment, or any other item.

1.29 REFRIGERANTS

- A. Chlorofluorocarbons (CFCs) shall not be allowed in any equipment on this project.
- B. Comply with ASHRAE Std 15 and ASHRAE Std 34.

1.30 REFRIGERANT RECOVERY AND RECYCLE

- A. Refrigerants shall not be released to the environment.
- B. Contractor shall provide recovery and recycle equipment that has been certified by the Electrical Testing Laboratories or Underwriters Laboratories.
- C. Contractor shall also provide properly trained and certified (in accordance with EPA) personnel for refrigerant work during installation, demolition, start-up, servicing, etc.

1.31 ACCESS CLEARANCE

- A. Proper access to all installed equipment shall be provided. This Contractor shall label all points of access immediately upon installation with a marker pen.
- B. A minimum of 3 feet shall be maintained in front of all access points.
- C. If another trade violates this space, this Contractor shall immediately notify the General Contractor to correct this condition.
- D. When equipment is installed above lay-in ceiling this Contractor shall coordinate with the Ceiling Contractor to provide access without removing part of T-bar ceiling.
- E. No speakers, lights, fire alarm equipment, etc. shall be installed in lay-in ceiling tiles where access is to be gained.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 TESTING

- A. After all plumbing systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequence and operation throughout the range of operation regardless of the season the Contractor shall test all plumbing equipment.
- B. Perform a smoke test on all sanitary sewers and camera all lines and provide owner with a videotape.
- C. Perform gas piping pressure test to comply with HB 1611 and all required City or governing body tests.
- D. Make adjustments as required to ensure proper functioning of all systems.
- E. Special tests on individual systems are specified under individual sections.

3.2 AS BUILT DRAWINGS

- A. Upon substantial completion, Contractor shall submit as-built drawings showing all deviations between contract drawings and actual installed conditions.
- B. Show location of all valves in gas and water piping. Submit to Owner.

END OF SECTION

SECTION 22 00 90

PLUMBING SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section supplements Division 01 Submittal Procedures and contains additional requirements applicable to Division 22 submittals.

1.2 SECTION INCLUDES

- A. This section includes, but is not limited to:
 - 1. Plumbing submittal procedures
 - 2. List of required Division 22 submittals to the engineer
 - 3. This section applies only to the Division 22 specifications. Submittals required by other specification divisions are not included here, even though the same subcontractor may be providing work under other divisions.

1.3 RELATED SECTION

- A. Division 01 - Submittal Procedures

1.4 DEFINITIONS

- A. Product Data: Illustrations, standard schedules, performance charts, instructions, and brochures furnished by the contractor, subcontractor, manufacturer, or supplier to illustrate materials or equipment or to illustrate some portion of the work. Provide a summary of scheduled items with all data in schedules.
- B. Shop Drawings: Drawings, diagrams, schedules, and other data specifically prepared for the work by the contractor, subcontractor, manufacturer, or supplier to illustrate some portion of the work.
- C. Equipment/Material Submittal Package: A compilation of the product data, shop drawings, and other items as required by the specifications, submitted near the start of the work. Typically, the specifications require the initial submittal package to be submitted within a certain number of days after the work starts.
- D. Quality Assurance Submittal: Items submitted before and during the execution of a particular portion of the work for the purpose of guarding against defects and deficiencies.
- E. Quality Control Submittal: Items submitted at the completion of a particular portion of the work for the purpose of evaluating completed activities and elements of the work for conformance with contract requirements (e.g. start-up reports).
- F. Closeout Submittals: Items submitted at or near the completion of the contract.

1.5 SUBMITTALS

- A. The materials, workmanship, design, and arrangement of all work installed under this contract shall be subject to the review of the architect, engineer, and owner.
- B. Manufacturers: Manufacturers submitted shall be as per the acceptable manufacturers listed in each specification section or referenced schedule. For additional manufacturers requiring approval, reference the Substitution of Products article in Section 22 00 10.
- C. Required Submittals: Refer to the Submittals article of each individual Division 22 specification section for the required items to be submitted.

- D. Contractor's Coordination Submittals: The contractor may require his subcontractors to provide drawings, setting diagrams, and similar information to help coordinate the project, but such data shall remain between the contractor and his subcontractors and will not be reviewed by the engineer.
- E. Electronic Submittals: E-mail or other electronic forms of submittals from the contractor are required. The procedures described in this section shall be as follows:
 - 1. The contractor shall supply one electronic copy of the submittal.
 - 2. The electronic files will either be e-mailed to the architect or posted to a project management and information exchange website, depending on the architect's requirements. The architect and contractor can distribute copies of the files as desired.
 - 3. The engineer will retain an electronic copy of the submittal and all responses.
- F. Coordination Correspondence: The contractor may desire to verify the acceptability of a particular item prior to assembling the initial submittal package. The contractor may send material directly to the engineer for comments and feedback. This communication will be treated as normal coordination correspondence and will not be tracked or documented as a formal submittal. The engineer may or may not respond to such correspondence. If the engineer agrees, in writing, to the use of a particular item, then that same material shall be included in the initial submittal package along with a copy of the correspondence.
- G. Unapproved Products: If materials or equipment are installed before being reviewed and approved by the engineer, the contractor shall be liable for the removal and replacement of such unapproved materials and equipment, at no additional expense to the owner. Additionally, if the removal and replacement of unapproved materials or equipment necessitates the removal and replacement of other related materials or equipment, then the contractor shall be liable for the removal and replacement of the related materials and equipment at no additional expense to the owner.
- H. Product Data:
 - 1. Where the content of manufacturer submittal literature includes data not pertinent to the submittal, clearly indicate which portions of the contents are being submitted for review. Catalogs, pamphlets, or other documents submitted to describe items on which review is being requested shall be specific and identifications in catalogs, pamphlets, etc., of items submitted shall be clearly made in a contrasting ink or highlighting. Data of a general nature shall not be acceptable.
- I. Shop Drawings:
 - 1. Scale and measurements: Make shop drawings accurately to a scale sufficiently large to show all pertinent aspects of the item.
 - 2. Electronic shop drawing submittals are required.
 - 3. Shop drawings must include domestic water entry rooms with backflow prevention and all water heater rooms.

1.6 QUALITY ASSURANCE/CONTROL SUBMITTALS

- A. Quality assurance and quality control submittals may be in the form of documentation or may be in the form of completed physical work that is offered for review by the engineer, architect, or owner.
- B. If documentation is the subject, then submit in a manner similar to the initial submittal package.
- C. If completed physical work is the subject, then the work shall not be concealed, nor shall subsequent work be performed, until the engineer's representative has reviewed the work. If the work is concealed, or if subsequent work is performed, before the engineer's representative has reviewed the work, then the contractor shall be liable for removal and replacement at no additional expense to the owner.
- D. Sequencing:
 - 1. Within 30 calendar days after the contractor has received the owner's notice to proceed, provide the complete submittal package.
 - 2. After the engineer has reviewed the submittal package, make necessary revisions to the submittals as directed by the engineer and resubmit.
 - 3. After the submittal has been reviewed by the engineer, proceed to purchase materials and perform the work.

E. Scheduling:

1. Failure to submit items that meet the requirements of the contract documents in ample time for review shall not entitle the contractor to an extension of contract time, and no claim for extension by reason of such default shall be allowed. The contractor may be held liable for delays so occasioned.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 SUBMITTALS

- A. Make submittals of product data, shop drawings, samples, quality assurance submittals, quality control submittals, and other items in accordance with the requirements of this section, applicable sections in Division 22, and additional requirements of each individual Division 22 specification section.
- B. Grouping of Submittals:
1. The submittal package shall be coordinated and included in a single submission. Multiple submissions are not acceptable except where prior written approval has been obtained from the engineer. Partial submittals may be rejected, without being reviewed, as not complying with the provisions of the contract.
 2. In the case that multiple submissions are approved, it is the responsibility of the contractor to maintain and update a submittal checklist. The contractor shall ensure that all applicable submittal sections are submitted to the Engineer. If a submittal section is not submitted, it will be considered rejected until reviewed by the Engineer.
 3. If submittal sections are submitted as individual submittal files, the submittal sections will be grouped and returned as one file with one set of submittal responses.
- C. Electronic Submittal Organization:
1. Electronic submittals are to be submitted as a single PDF file. Within the PDF file, each section shall be bookmarked.
 2. Provide an electronic submittal cover sheet that lists at least the following:
 - a. Project name
 - b. Date
 - c. Name and address of architect
 - d. Name and address of engineer
 - e. Name, address, and telephone number of prime contractor
 - f. Name, address, and telephone number of HVAC contractor
 - g. Name, address, and telephone number of HVAC supplier
 3. Provide an electronic index sheet listing all items submitted.
 4. The contractor shall call to the attention of the engineer, clouded in the submittal and noted after the index sheet, any instance in which the submittals are known to differ from the requirements of the contract documents.
 5. Organize all required items by specification section. The material for each specification section shall be organized as follows:
 - a. Provide an electronic section cover sheet that lists the same information as the submittal cover sheet, plus the specification number and title and the name, address, and telephone number of the vendor or vendor's representative, if applicable.
 - b. Refer to the individual Division 22 specification sections for any required organization of the submittal material within each submittal section.
 - c. Bookmarked sections shall be arranged by specification section number in numerical order.
 - d. Submit in accordance with these procedures and procedures described in Division 01 Submittal Procedures.
 - e. Submittals not organized as described here may be rejected, without being reviewed, as not complying with the provisions of the contract.

- D. Response to engineer's review:
1. Review comments:
 - a. Review comments of the engineer will either be shown on the returned sets to the contractor or shown on a document attached to the sets. If the comments are on an attached document, then the engineer will place a note on the submittal referring to the attached comments. In such cases, the engineer's signature will appear only on the attached document. If the attached, signed document becomes physically separated from the submittal, then the submittal will no longer be considered as being a reviewed submittal.
 2. Complete rejection:
 - a. If the submittal is not complete or does not meet the requirements of this specification section, then the engineer may reject the entire submittal and return the submittal without further review or comment. In such cases, the entire submittal shall be completely revised and resubmitted. The resubmittal shall be given a new submittal number and shall be documented and processed as a separate submittal from the original.
 3. Held for completion:
 - a. If the submittal is not complete but is only missing some minor item, the engineer may, at the engineer's sole discretion, hold the submittal rather than rejecting and returning the submittal. In such cases, the engineer will notify the architect and contractor that the submittal is being held for completion. The contractor will be given a predetermined amount of time to provide the missing item. Upon receipt of the missing item, the engineer will insert the missing item into the submittal package and proceed with the review process.
 4. Partial rejection:
 - a. The engineer may reject only certain portions of the submittal. In such cases, only those rejected portions or items need to be revised and resubmitted.
 5. Provide as corrected:
 - a. The engineer may note a required change to a submitted item, but may not consider the change serious enough to require a resubmittal. In such cases, the engineer will note that the item is to be provided as noted or corrected. In such cases, the contractor may proceed to provide the item. However, if subsequent observations reveal that the noted change was not made, then the contractor shall be liable for removal and replacement of the item at no additional cost to the owner.
 6. Reviewed without comment:
 - a. The contractor may proceed to provide all materials and equipment.
- E. Close-out Submittals:
1. Provide close-out submittals in accordance with the requirements of Division 1.

Section	Submit on the following	1	2	3	4	Arch Sub #
22 05 24	Valves - General					
	Full port					
	Bronzed body					
	Ball valves					
22 05 30	Pipe and Pipe Fittings - General					
	Hangers					
	Dissimilar Metals Union					
	Unions					
	Escutcheons					
	Sleeves					
	Hanger rods					
	Concrete anchors					
	Beam Clamps					
	Fire Penetration Products					
22 05 54	Plumbing Identification					
	Valve tags and chains					

Section	Submit on the following	1	2	3	4	Arch Sub #
	Valve chart					
	Piping markers					
	18 gauge copper wire for underground gas piping					
	Equipment labels					
	Nametag fasteners					
	Underground warning tape					
22 07 20	Piping Insulation					
	Closed cell only in concrete masonry walls					
	2" wrap for concealed roof drain piping					
	2" wrap at roof drain deck pan					
	2" rigid on exposed roof drains or					
	2" wrap with PVC jacketing on exposed roof drains					
	Domestic hot and cold water pipe insulation					
	(1" for hot water and 1" for lines in exterior walls)					
	Flange, fitting, valve Insulation					
	Insulation metal shield					
	Sealant, adhesive, finish					
22 11 17	Domestic Water Piping and Appurtenances					
	Type K - underslab					
	Type L - underground/above slab					
	CPVC piping					
	PEX-A piping					
	Pipe Fittings					
	a. Up to 1-1/2" - 95-1/2% tin, 4% copper, 1/2% silver					
	b. 2" and up - SILFOS 15% silver, 80% copper, 5% phosphorus					
	c. Pressfit fittings					
	CPVC fittings					
	PEX-A with cold expansion fittings					
	PEX manifolds					
	Valves - same as valve general					
	Water hammer arrestors					
	Freeze protection heat trace					
22 13 17	Soil, Waste and Sanitary Drain Piping and Appurtenances					
	Schedule 40 PVC pipe and fittings					
	Schedule 40 cast iron pipe and fittings					
	No hub and bell spigot					
	CPVC/cast iron on first 20' of dishwasher discharge					

Section	Submit on the following	1	2	3	4	Arch Sub #
	Cleanouts					
	Closet Flanges					
	Trap Guards					
	Trap primers					
	Pressure differential (automatic)					
	Electronic					
	Automatic flush valve					
	Plumbing Void Systems					
	Sand backfill embedment for C.I. Pipe					
	Pea gravel embedment for PVC pipe					
	Copper DWV on exposed kitchen indirect waste					
22 13 18	Condensate Piping					
	Copper type M or DWV					
	Schedule 40 PVC painted exterior w/ 4'-0" oc hangers					
	Schedule 40 CPVC painted exterior w/ 4'-0" oc hangers					
	Insulation thickness and thermal conductivity (K)					
	Hangers - see 22 05 30					
	Insulation - See piping insulation					
	Fittings, unions					
22 14 01	Roof Drainage and Appurtenances					
	Primary roof drains					
	Emergency roof drains					
	Schedule 40 PVC pipe and fittings					
	Schedule 40 cast iron pipe and fittings					
	Hangers - see 22 05 30					
	Schedule 40 perforated PVC pipe					
	Black Swan adhesive					
	Downspout Nozzles					
	Insulation - See piping insulation					
	Plumbing Void Systems					
	Sand embedment for cast iron pipe					
	Pea gravel embedment for PVC pipe					
22 15 14	Compressed Air Piping (Shops)					
	Reciprocating air compressor					
	Screw Air compressor					
	Compressed air piping and fittings					
	Filters					
	Regulators					
	Quick connections					
	Air reels					
	Refrigerated air dryers					
	Aftercoolers					

Section	Submit on the following	1	2	3	4	Arch Sub #
	Valves - see Valves General					
	Hangers - see 22 05 30					
22 16 01	Natural Gas Piping and Appurtenances					
	Schedule 40 black steel pipe and fittings					
	Gas regulators					
	Paint for roof and up wall installations					
	Cut off valves, unions, inspection ports					
	Polyethylene gas piping below grade					
	Roof supports					
22 16 03	Propane Gas Piping and Fittings					
	Black steel schedule 40 pipe and fittings					
	Gas regulators					
	Paint for roof and up wall installations					
	Polyethylene gas piping below grade					
	Cut off valves, unions, inspection ports					
	Roof supports					
22 33 34	Access Doors					
	Stainless steel for kitchens and locker/shower areas					
	Primer steel access doors for general use					
	Verify sizes per specification					
22 40 01	Plumbing Fixtures and Carriers					
	Water heaters					
	Gas-BTUH, tank size, electrical					
	Electric - KW size, electrical, tank size					
	Expansion tanks					
	Circulating pumps					
	Water closets - wall or floor mount					
	Urinals - wall mount					
	Lavatories - wall mount or counter mount					
	Floor drains and sinks					
	Mop sinks with stainless steel backsplash					
	Sinks-standard, ADA, TAS					
	Faucets-standard, ADA, TAS, sensor type					
	Electric water coolers-standard, ADA, TAS					
	Plaster traps					
	Oil and sand separators with alarm panel					
	Oil separators with alarm panel					
	Grease interceptors					
	Hose bibbs - exterior, interior, roof					
	Acid dilution basin					
	Carriers					
	Sump pumps - GPM, total head, electrical					

Section	Submit on the following	1	2	3	4	Arch Sub #
	Lift stations - GPM, total head, electrical					
	Commercial washer, dryer					
	Whirlpools					
	Showers - ADA, one, two, three, column					
	Thermostatic mixing valves					
	Wash fountains - 120 volt					
	Shop drawings for all water heater rooms and domestic water entry with RPZ backflow preventer, and booster pumps					
22 66 54	Chemical Waste and Vent Piping					
	CPVC acid waste piping and fittings					
	Schedule 40 acid waste pipe-Orion, Ipex, Fuseal, George Fischer, Zurn					
	Dilution Basins					
	Limestone					
	Acid floor drain					
	Inspectors Port					
	Hangers - See 22 05 30					
1 - Reviewed						
2 - Furnish as corrected in comments, resubmit not required						
3 - Revise and Resubmit based on comments						
4 - Rejected based on comments						

END OF SECTION

SECTION 22 05 20

GAUGES, METERS, AND THERMOMETERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Thermometers
- B. Pressure gauges
- C. Pete`s plugs

1.2 RELATED SECTIONS

- A. Section 22 00 10 - Basic Plumbing Requirements
- B. Section 22 05 30 - Pipe and Pipe Fittings - General
- C. Section 22 33 34 - Access Doors
- D. Section 22 40 01 - Plumbing Fixtures and Fixture Carriers

1.3 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 22 00 10, General Conditions, and Division 01.

PART 2 - PRODUCTS

2.1 THERMOMETERS

- A. Type:
 - 1. 9" adjustable angle thermometer
- B. Construction:
 - 1. Temperature range:
 - a. Fahrenheit degrees as approved by the Engineer.
 - 2. Window:
 - a. Unbreakable Plexiglas.
 - b. Furnish with separable socket.
 - 3. Manufacturer/Model:
 - a. Terice BX91403 ½
 - b. MILJOCO SX935

2.2 PRESSURE GAUGES

- A. Type:
 - 1. 4" dial type pressure gauge
- B. Manufacturer/Model:
 - 1. Terice 500X
 - 2. MILJOCO P4509LX
- C. Construction:
 - 1. Pressure range:
 - a. As approved by the Engineer.

2. Cast aluminum case
3. Double strength clear glass window
4. Stainless steel movement
5. Phosphor bronze tube
6. Brass socket
7. Furnish with a Trerice No. 880 lever handle gauge cock.

D. Accuracy: 1/2 of 1% of scale range.

2.3 PETE'S PLUGS

- A. Provide two sets of suitable pressure and temperature gauges for use with the plugs.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Furnish and install thermometers, pressure gauges, and Pete's plugs where indicated on plans in accordance with manufacturer's instructions.
- B. Install thermometers at each pump for domestic hot water systems.
- C. Install pressure gages across each pump over one horsepower.

END OF SECTION

SECTION 22 05 24
VALVES - GENERAL

PART - 1 GENERAL

1.1 SECTION INCLUDES

- A. General requirements for valves

1.2 RELATED SECTIONS

- A. Section 22 00 10 - Basic Plumbing Requirements
- B. Section 22 05 20 - Gauges, Meters, and Thermometers
- C. Section 22 05 30 - Pipe and Pipe Fittings - General
- D. Section 22 11 17 - Domestic Water Piping and Appurtenances
- E. Section 22 16 01 - Natural Gas Piping and Appurtenances

1.3 REFERENCES

- A. ASTM 763 - Standard Specification for Copper Alloy Sand Castings for Valve Applications
- B. ASTM 61 - Standard Specification For Steam or Valve Bronze Castings
- C. ASTM C27450 - Standard Specification for Brass Rod, Bar & Shapes
- D. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges Pipe Fittings
- E. ASTM A105/A105M - Standard Specification for Carbon Steel Forgings for Piping Applications
- F. ASTM - American Society of Testing Materials
- G. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service
- H. ASTM B813 - Standard Specification for Liquid & Paste Fluxes for Soldering of Copper and Copper Alloy Tube
- I. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
- J. ASTM B88 - Standard Specification for Seamless Copper Water Tube
- K. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings
- L. CSA - Canadian Standards Association
- M. PDI - Plumbing & Drainage Institute

1.4 QUALITY ASSURANCE

- A. Manufacturer to stamp valve to show that shell and seat tests have been successfully completed.

1.5 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 22 00 10, General Conditions, and Division 01.

PART 2 - PRODUCTS

2.1 MATERIAL SPECIFICATIONS

- A. Bronze - 150 psi maximum: ASTM B62
- B. Bronze - 300 psi maximum: ASTM B61
- C. Cast Iron: ASTM A126, Class B
- D. Cast Carbon Steel: ASTM A216/A216M, Grade WCB
- E. Forged Carbon Steel: ASTM A105/A105M, Grade II
- F. Brass - Lead free, dezincification resistant arsenical brass, 125 psi maximum, ASTM 763 or ASTM B283/B283M.

2.2 CONSTRUCTION

- A. Provide valves designed for repacking under pressure when fully opened.
- B. Equip with packing suitable for intended service.
- C. Furnish with gland followers.
- D. Provide valves rated greater than the design temperature and pressure for the intended system.
- E. All domestic cold water and hot water valves 2" and less shall be full port ball valves with stainless steel ball.
- F. All domestic cold water and hot water grooved valves 2" Grade CF8M stainless steel body, 316 stainless steel ball, and stem, TFE seats, fluoroelastomer seals, standard port, two-piece valve. Basis of design Victaulic Series 726S or engineer approved equal.
- G. All domestic cold water and hot water valves 2-1/2" and larger to gate valves.
- H. All domestic cold water and hot water grooved stainless valves 2-1/2" and larger to be Victaulic butterfly valves. Butterfly Valves: Grade CF8M stainless steel body and disc, 316 stainless steel stem, PTFE impregnated glass fabric bearings with 316 stainless steel backing, with Grade-P synthetic rubber seal. (Grade to suit the intended service.) Valve stem shall be offset from the disc centerline to provide full 360-degree circumferential seating. Bubble-tight, dead-end, or bi-directional service to 300 psi (2065 kPa) CWP. Basis of design Victaulic Series 763 or engineer approved equal.
- I. All domestic cold water and hot water grooved stainless valves 2-1/2" and larger to be Victaulic check valve. Fluoroelastomer Grade-P gasket Temperature range +20°F to +180°F/-7°C to +82°C. Specifically formulated for compatibility with potable water systems. Basis of design Victaulic Series 816 or engineer approved equal.
- J. All domestic cold water and hot water grooved copper valves 2-1/2" - 6", 300 psi (2065 kPa) maximum pressure rating, with copper tubing sized grooved ends. Cast bronze body to UNS C87850. (Alloy code shall be cast or stamped into the valve body.) Elastomer encapsulated ductile iron disc, ASTM A536, Grade 65-45-12, with integrally cast stem. Bubble tight, dead-end, or bi-directional service, with memory stop for throttling, metering, or balancing service. Valve may be automated with electric, pneumatic, or hydraulic operators. Basis of design Victaulic Series 608 or engineer approved equal.
- K. All domestic cold water and hot water systems requiring pressure reduction will utilize factory assembled pressure reducing valve stations. Station will be consisting of a Victaulic Style 972S-H Watchdog valve combo, main branch PRV with a low-flow bypass branch. Assembly shall be Schedule 10S, type 304L,

stainless steel pipe conforming to ASTM A312/A312M, with Victaulic stainless steel fittings, Victaulic Series 461 butterfly valves for isolation, Victaulic 968 wye pattern strainers, Victaulic installation-ready rigid couplings, Style 807N (Grade-P Gasket). All components shall be UL classified in accordance with ANSI / NSF-61 for potable water hot and cold service and shall be certified to the low lead requirements of NSF-372. Basis of design Victaulic 386A or engineer approved equal.

- L. All domestic cold water and hot water balancing valves 2" down will be s NSF Certified in accordance with ANSI/NSF 61 for cold +73°F/+23°C and hot +180°F/+82°C potable water service and ANSI/NSF 372. Valves 1/2" to 3/47" will have removable flow cartridge that limits flow within +/-5% of flow range. Basis of design Victaulic 76X or 78BL or engineer approved equal.

2.3 MANUFACTURERS

- A. Apollo
- B. Crane
- C. Grinnell
- D. Jenkins
- E. Jomar, T-100NGDZ
- F. Kennedy
- G. Milwaukee Valve Company
- H. Nibco
- I. Stockham
- J. Walworth
- K. Watts
- L. Hammond
- M. Kitz

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install valves and stops inaccessible locations.
- B. Provide where shown or as required to make system complete and readily maintained.
- C. Provide access doors for all inaccessible valves.
- D. Provide as-built drawings locating all valves in gas and water lines.
- E. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
- F. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified.
- G. See the latest copy of the manufacturer's Field Assembly and Installation Instruction Pocket Handbook (I-100).

3.2 APPLICATION:

- A. Use grooved couplings and fittings on applicable systems in accordance with manufacturer's recommendations.
- B. Unions are not required in installations using grooved mechanical couplings. (The couplings shall serve as unions.)
- C. Grooved joint products may be installed in all locations as permitted by the engineer and local code.
- D. Use grooved end valves where possible. Install grooved joint flange adapters where flanged or lug type valves are necessary.
- E. The coupling manufacturer's representative shall periodically visit the job site and review installation. Contractor shall remove and replace any joints deemed improperly installed.

3.3 TRAINING:

- A. A factory trained field representative (direct employee) shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products.

END OF SECTION

SECTION 22 05 30

PIPE AND PIPE FITTINGS - GENERAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe
- B. Pipe fittings

1.2 RELATED SECTIONS

- A. Section 22 00 10 - Basic Plumbing Requirements
- B. Section 22 05 24 - Valves - General
- C. Section 22 07 20 - Piping Insulation
- D. Section 22 11 17 - Domestic Water Piping and Appurtenances
- E. Section 22 13 17 - Soil, Waste, and Sanitary Drain Piping, Vent Piping, and Appurtenances
- F. Section 22 13 18 - Condensate Piping
- G. Section 22 14 01 - Roof Drainage Piping and Appurtenances
- H. Section 22 16 01 - Natural Gas Piping and Appurtenances
- I. Section 22 40 01 - Plumbing Fixtures and Fixture Carriers
- J. Section 22 66 54 - Chemical Waste and Vent Piping

1.3 REFERENCES

- A. ASME - American Society of Mechanical Engineers
- B. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
- C. ASTM D2665 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
- E. UL - Underwriters Laboratory
- F. NFPA 90A & NFPA 90B - Installation of Air Conditioning & Ventilation Systems and Installation of Warm Air Heating and Air Conditioning Systems
- G. CISPI-310 - Cast Iron Soil Pipe Institute
- H. CSA - Canadian Standards Association

1.4 QUALITY ASSURANCE

- A. Valves:
 - 1. All valves to be from a single manufacturer.

- B. The welder, employed on this project, shall have passed qualification tests as prescribed by the National Pipe Welding Bureau, or other reputable testing laboratory using qualification procedures as recommended by the ASME Boiler Construction Code or the American Welding Society Standards.

1.5 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 22 00 10, General Conditions, and Division 01.
- B. Submit product data indicating dimensions, general assembly, and use.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. The type of pipe and fittings necessary for each system are specified in the section on that system.

2.2 DISSIMILAR MATERIALS

- A. Use approved adapters such as Di-Electric Unions manufactured for making piping connections between dissimilar materials such as copper and brass or copper and steel.

2.3 ESCUTCHEONS

- A. Usage:
 - 1. All exposed lines passing through floors, walls, and ceilings.
- B. Material:
 - 1. Chrome plated steel
- C. Flange size:
 - 1. As necessary to cover penetrated openings.
- D. Plate size:
 - 1. As necessary to fit pipe or insulation and securely lock in place.
- E. Manufacturer/Model:
 - 1. Engineered Brass Company, Type CF

2.4 SLEEVES

- A. Application:
 - 1. Provide sleeves for all pipes and conduits which pass through a concrete slab, masonry wall/concrete wall, sheetrock wall (fire rated or not fire rated), roof, or other portion of the building structure.
- B. Above Grade and/or dry locations:
 - 1. Material:
 - a. 20 or 22-gauge galvanized steel.
 - 2. Size:
 - a. As necessary to allow free passage of the insulated pipe.
- C. Below Grade and/or moist locations:
 - 1. Material:
 - a. ASTM D2665 Schedule 40 PVC. When PVC not allowed by code, use schedule 40 galvanized steel.
 - b. Return Air Plenum:
 - 1) Schedule 40 galvanized steel.
- D. Passing through fire-rated enclosures:

1. Material:
 - a. Galvanized or black steel pipe.
 - b. Non-combustible.
 - c. PVC will not be allowed.
- E. Penetration Seal: (All Sleeved Penetration Locations- fire rated or non-fire rated)
 1. Seal penetration with 3M Fire Barrier Sealant CP 25WB+ or one-component ceramic fiber-based putty fill, void, or cavity material, UL rated material classified for use in through-penetration firestop systems nos. 124, 125, 150, and 151.
 2. Flame Spread/Smoke Contribution:
 - a. 0/0 in accordance with ASTM E84.

2.5 VALVES, UNIONS, STOP COCKS, ETC.

- A. Applications:
 1. Ball Valves:
 - a. Provide accessible valves at each group of plumbing fixtures and at each piece of equipment on all piping systems for isolation of fixtures and equipment. All valves shall be full port valves.
- B. All Other Valves, Unions, Stop Cocks, Etc.:
 1. Provide at each group of plumbing fixtures and at each individual fixture, at each piece of equipment, at all inlet and outlet connections for hot and cold water and gas.
 2. Provide Di-Electric Unions at connection of dissimilar pipe materials to prevent electrolysis.
- C. Type:
 1. Suitable for 125 lbs. working pressure.

2.6 PIPE SUPPORTS

- A. Hangers:
 1. 2" and Smaller Piping:
 - a. May be split cast ring type with fastening device in walls and chases.
 2. Copper Piping:
 - a. Copper plated ferrous hangers.
 3. All Other Above Ceiling Locations:
 - a. Adjustable clevis type. Hangers to accommodate circumference of pipe and saddles.
- B. Hanger Rods:
 1. Type:
 - a. Minimum 3/8 inch diameter with machine threads.
- C. Minimum Steel Hanger Rod Diameter for Individually Suspended Horizontal Pipes:
 1. 2" and smaller diameter pipe:
 - a. 3/8"
 2. 2-1/2" to 3 - 1/2" diameter pipe:
 - a. 1/2"
 3. 4" to 5" diameter pipe:
 - a. 5/8"
 4. 6" diameter pipe or larger:
 - a. 3/4"
- D. Hanger Manufacturers:
 1. Anvil
 2. Elcen
 3. ERICO
 4. F&S Manufacturing
 5. Fee & Mason
 6. PHD
- E. In wall pipe supports:

1. Metal strut, manufactured pipe clamps
- F. In wall pipe support manufacturer:
 1. Holdrite or Equivalent
- G. Refer to Specification Sections 22 13 17 and 22 14 01 for void system requirements.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

- A. Install piping in a neat and workmanlike manner.
- B. Install each of the piping systems to provide for expansion and contraction.
- C. Solder all joints when the system is not under strain.
- D. Expansion Offsets:
 1. Copper Piping:
 - a. Use developed length Copper Tube Handbook 411-R as published by Copper Development Association, Inc.
 2. Steel Piping:
 - a. Use developed per Carrier System Design Manual, Part 3 Piping Design.
- E. Furnish necessary spring pieces and offsets as required.
- F. Conceal all of the piping systems in chases, above ceilings, in walls, and in finished areas.
- G. Run Exposed piping only in machinery spaces and unfinished areas as specified or as shown on the plans.
- H. Install all necessary fittings and offsets to hold the piping close to walls and ceilings.
- I. Where these lines run exposed, obtain a clearance from the Engineer in writing before making the installation.
- J. Install piping in the most advantageous manner possible with respect to headroom, valve access, openings, equipment clearances, and clearances for other work.
- K. Give particular attention to piping in the vicinity of equipment.
- L. Preserve the maximum access to various equipment parts for maintenance.
- M. Do not cut or weaken any structural member.
- N. Cut all pipes accurately to measurement determined at the site.
- O. After cutting pipe, ream it to remove burrs.
- P. Install piping neatly, free from unnecessary traps and pockets. Work into place without springing or forcing.
- Q. Use fittings to make all changes in direction.
- R. Field bending and mitering are prohibited.
- S. Make all connections to equipment using flanged joints or unions.
- T. Make reducing connections with reducing fittings only.
- U. Do not allow piping to pass through or over designated electrical rooms or technology spaces.

- V. Compression fittings are not allowed.

3.2 VALVES, UNIONS, STOP COCKS, ETC.

- A. Locate all valves so that their bonnets may be easily removed.
- B. Move all flange valves shown in horizontal positions so that valve stem is inclined one bolt hole above the horizontal position.
- C. Make up all screwed pattern valves placed in horizontal lines so that their valve stem is inclined at an angle of 30 degrees above the horizontal position.
- D. All valve stems must be true and straight at the time the system is tested for final acceptance.
- E. Pack all valves and leave perfectly tight at the completion of the work.
- F. Provide access doors as required for these valves.
- G. Furnish locations of all access doors to the Architect/Engineer.

3.3 PIPING JOINTS

- A. Screwed Pipe Joints:
 - 1. Provide full cut pipe threads.
 - 2. Assemble joints with an approved compound applied to only the male threads.
 - 3. Leave a maximum of three pipe threads exposed where the joint is assembled.
- B. Welded Pipe Joints:
 - 1. Fuse weld by using a metallic arc welding process.
 - 2. Conform to the current recommendations of the American Welding Society for all welding operations.
- C. Mechanical Coupling Joints for Copper Systems:
 - 1. Grooved-End-Tube Couplings: Ductile iron conforming to ASTM A536, Grade 65-45-12, coated with copper colored alkyd enamel. Housings cast with offsetting, angle-pattern bolt pads to provide rigidity. Coupling Gaskets: Grade "P" Fluoroelastomer compound with red and blue color code designed for operating temperatures from 0 deg F to +180 deg F.
 - a. Center-leg gasket with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth.
 - b. Installation Ready direct-push-installation.
 - c. Reference shall always be made to the latest published Victaulic Selection Guide for Gaskets for proper gasket selection for the intended service.
 - d. Basis of design Victaulic Style 607 or engineer approved equal.
 - 2. Fittings: Fittings shall be manufactured to copper tubing sizes, with grooves designed to accept grooved end couplings of the same manufacturer. Fittings shall be wrought copper, conforming to ASTM B75/B75M alloy C12200 or ASTM B-152 alloy C11000 and ANSI B16.22, or bronze sand-casting ANSI B16.18 and UNS-C89836. Victaulic Copper Connection Fittings.
- D. Solder Joints:
 - 1. Assemble with square cut pipe using a pipe cutter.
 - 2. Hacksaw-cut pipe ends will not be acceptable.
 - 3. Ream open pipe end to full size.
 - 4. Burnish both the pipe and fitting absolutely clean.
 - 5. Apply brazing flux to both the pipe and the fittings.
 - 6. The use of corrosive acid flux will not be permitted.
 - 7. Charge the pipe and fittings with nitrogen gas during the brazing.
- E. Hubless Cast Iron Soil Pipe Joints:
 - 1. Make with an approved neoprene gasket and stainless steel retaining sleeve.
 - 2. Mark no-hub gaskets with the manufacturer's name, ASTM C564, the word "No-Hub", nominal diameter, and the CI symbol of the Cast Iron Soil Institute indicating it meets the standard.

3. Mark stainless steel couplings for no-hub "All Stainless", name of manufacturer, words "No-Hub", nominal diameter, and the CI symbol indicating it conforms to CISPI 310.
 4. Install the hubless cast iron soil pipe systems in accordance with CISPI Pamphlet 100 - Installation Suggestions for CI No-Hub Pipe and Fittings.
 5. Provide identifying markers for stainless steel couplings and neoprene gaskets to indicate compliance with CISPI 310.
- F. Positive-Seal One Piece Elastomeric Compression-Type Gasket:
1. May be used for joining hub and spigot cast iron soil pipe as an alternate for lead or oakum joints or for drainage and waste system above and below ground.
 2. Form the joint by inserting an approved gasket in the hub.
 3. Lubricate the inside of the gasket and push the spigot end of the pipe into the gasket until seated, thus effecting a positive seal.
 4. Use neoprene compression gaskets for cast iron soil pipe, marked as such, with ASTM C564 and the CI symbol of Cast Iron Soil Pipe Institute to indicate the gasket meets the standard.
- G. PVC Pipe Joints:
1. May be solvent cemented using the proper cement recommended for the particular materials.
 2. Cut all pipe square and clean both pipe and fittings of all soil, dirt, oil, and grease.
 3. Make solvent joints in accordance with the applicable ASTM Standards.
 4. Allow joints to dry before testing.
 5. If any leak occurs during the water test, then replace the defective joint.
 6. Comply with requirements of the NSF Standard 14 for all solvent cements and primers and label to identify the laboratory certifying compliance for the particular cement and primer being used.
 7. Plastic pipe and fittings for sewer and water pressure lines may also be joined by use of elastomeric (O-ring gasket) joints when the respective standards for the materials so specify. No-Hub fittings are not allowed on PVC sanitary sewer and storm drain piping under slab or underground.
 8. Do not use pipes with cracked bells.
 9. PVC pipe and pipe fittings are not allowed in any return air plenum serving mechanical systems. Use cast iron piping above slab for these installations.

3.4 SLEEVES

- A. Above Grade and/or Dry Locations:
1. Walls:
 - a. Mount flush on both sides.
 2. Floors:
 - a. Mount 2 inches above finished floor in pipe chases.
- B. Below Grade and/or Moist Locations:
1. Install suitable flange in the center of wall or floor to form a waterproof passage.
 2. Fill the void space around the pipe with jute twine or Oakum caulk or an asphalt based compound to insure a waterproof penetration.
- C. Passing Through Fire-Rated Enclosure:
1. Fill the void space around the pipe in accordance with NFPA requirements.
 2. Do not allow the sleeve installation to lower the fire rating of the assembly.

3.5 SECURING AND SUPPORTING OF PIPE

- A. Support all pipe from the building structure by means of approved hangers and supports while maintaining required grade and pitch, preventing vibration, and providing for expansion and contraction.
- B. Secure all hangers to approved inserts wherever possible.
- C. Set hanger inserts in place when the concrete is poured.
- D. If Joists Are Used for Attachment:
1. Must be attached to the top cord of the joists.
 2. Do not support any piping and trapeze hangers from joist bridging on roof and floor deck.

- E. If Structural Steel Framing Is Used for Attachment:
 - 1. Use approved beam clamps.
 - 2. Where required, install channels to span between framing members.
 - 3. Do not attach hangers to the roof deck or cross bracing.

- F. Hanger Spacing:
 - 1. Schedule 40 PVC Piping:
 - a. All Sizes:
 - 1) 4'-0"
 - 2. Ferrous (Schedule 40) Piping:
 - a. 1/2" diameter pipe:
 - 1) 6'-0" or less
 - b. 3/4" diameter pipe:
 - 1) 8'-0" or less
 - c. 1-1/4" diameter pipe:
 - 1) 10'-0" or less
 - d. Vertical:
 - 1) Every Floor Level Minimum
 - 3. Copper (Water Tube) Piping:
 - a. Smaller Than 1 1/4":
 - 1) 6'-0"
 - b. 1 1/2" and Larger:
 - 1) 10'-0"
 - c. Vertical:
 - 1) 10'-0"
 - 4. Cast Iron Piping:
 - a. All pipe sizes:
 - 1) One hanger per length of pipe and not exceeding 5'-0" O.C.
 - b. Vertical:
 - 1) Every Floor Level Minimum

- G. Vertical Lines:
 - 1. Adequately support at their bases, either by a suitable hanger placed in the horizontal line near the riser or by a base fitting set on a pedestal or foundation.
 - 2. Support from each floor slab by means of an approved clamp-type support which bears on the slab or beam.

- H. Change of Direction:
 - 1. Install supports within two feet of change of direction.
 - 2. Brackets of approved type may be used along the walls.
 - 3. Install hangers within 2 feet of each change in vertical or horizontal direction, pipe tees, and on each side of valves, strainers, etc.
 - 4. Multiple horizontal pipes, smaller than 12" diameter pipe, may be supported on trapeze hangers. Space trapeze hangers in accordance with the schedule for pipe spacing based upon the smallest size pipe.
 - 5. Properly size the trapeze members for the piping load they are to support. The number of pipes on the trapeze must be approved by the Engineer to prevent overloading of the building structure.
 - 6. Where pipes are insulated, oversize the hanger accordingly to accommodate the outside diameter of the insulation. Provide half-round 16 gauge galvanized steel shields, not less than 12" long and rolled to fit the insulation diameter, between the insulation and the hanger.
 - 7. When pipe is guided at top and bottom, cover the entire pipe circumference with metal shields.
 - 8. Adhere metal shield to the insulation so that the metal will not slide with respect to the insulation.
 - 9. Wood struts shall not be used to support piping in walls.

- I. Refer to Specification Sections 22 13 17 and 22 14 01 for Plumbing Void Systems requirements.

3.6 EXCAVATION AND BACKFILLING

- A. Excavation:

1. Call utility companies before digging.
2. Call Notifications Center before digging.
3. Excavate trenches for underground piping to the required depths with bell holes being provided as necessary to ensure uniform bearing. Dig all bell holes after the trench has been graded.
4. Refill excavation below the required grade of piping with fine granular material to the pipe grade.
5. Where rock is encountered, excavate to a grade 3 inches below the lowermost part of the pipe and refill with fine granular materials to the pipe grade.
6. Sheath, brace, pump or bail the trenches as required to protect workmen and structures and to permit execution of the work. A trench greater than 5 feet deep will not be permitted unless the sides are cut back at 45 degrees to 5 feet or less. If this cannot be accomplished, hire a Registered Engineer to design shoring.
7. Install all underground piping below the frost line and in no case less than 18 inches below the surface.

B. Void System Under Piping:

1. Refer to Specification Sections 22 13 17 and 22 14 01 for Plumbing Void Systems requirements.

C. Sand Embedment:

1. Refer to Specification Sections 22 13 17 and 22 14 01 for Sand Embedment requirements for cast iron piping below slab.

D. Pea Gravel Embedment

1. Refer to Specification Sections 22 13 17 and 22 14 01 for Pea Gravel Embedment for schedule 40 PVC piping below slab.

3.7 EQUIPMENT PLUMBING CONNECTIONS

- A. Make all final connections to all pieces of equipment which require natural gas, water, drain, waste, or vent connections.
- B. Provide all required shut-off cocks, valves, drain valves, and traps.

3.8 TESTING AND INSPECTION

- A. Perform all tests as specified in Division 22 or as required by the Engineer or by the Local, Federal, and State Bureaus having jurisdiction and under their supervision during the progress and upon completion of work.
- B. Include costs of all required tests in your bid.
- C. Provide all apparatus, temporary pipeline, and all other requirements necessary for such tests.
- D. Take all due precautions to prevent damage to the building or its contents incurred by such tests as the Contractor will be required to repay and make good any damage so caused at his own expense.
- E. Immediately repair any leaks, defects, or deficiencies discovered as a result of the tests. Repeat until test requirements are in full compliance.

3.9 IDENTIFICATION OF PIPING AND EQUIPMENT

- A. Mark all piping to show the service and direction of flow.
- B. Place markers at each branch of tees, at equipment connections, and change of direction and at 20-foot intervals. Minimum of one (1) marker in each room.
- C. Install valve tags on all valves.
- D. Frame under glass cover and hang a typewritten list including the valve number, type of service, and location of each valve in the boiler mechanical room.
- E. Mark all valve numbers corresponding to this system of identification on the as-built drawings which will be delivered to the Owner upon completion of the work.

END OF SECTION

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SECTION 22 05 54
PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Identification required for plumbing systems.
- B. Code required identification not shown on plans nor specified herein shall be provided.

1.2 RELATED SECTIONS

- A. Section 22 00 10 - Basic Plumbing Requirements
- B. Section 22 05 30 - Pipe and Pipe Fittings - General

1.3 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 22 00 10, General Conditions, and Division 01.
- B. Submit wording of nameplates with submittals.
- C. Submit list of all products incorporated in this section.

1.4 REFERENCES

- A. Comply with ANSI A13.1
- B. USAS Code B31.8
- C. NTSB-PSS-73-1
- D. AGA
- E. API

1.5 DESCRIPTION OF WORK

- A. Provide signs for the following equipment identification:
 - 1. Water Heaters
 - 2. Piping
 - 3. Pumps
 - 4. Starters
 - 5. Valves

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Seton
- B. Brady
- C. Marking Services, Inc.

2.2 EQUIPMENT LABELS

- A. Type:
 - 1. Engraving-Stock, melamine plastic laminate, 3 layer.
 - a. Thickness:
 - 1) Less than 25 square inches: 1/16 inch
 - 2) 25 square inches or more: 1/8 inch

- B. Color:
 - 1. Black

- C. Conform to FS L-P-287

2.3 LETTERING

- A. Style:
 - 1. Engraved standard print, unless otherwise indicated.

- B. Size:
 - 1. 3/16 inch to 1/4 inch

- C. Color:
 - 1. White letters, black background

2.4 SIGN INFORMATION

- A. Plumbing Equipment:
 - 1. Unit mark from Drawings/Owner
 - 2. Voltage - Phase
 - 3. Manufacturer and Model Number

2.5 NAMEPLATE FASTENERS

- A. Securely attach nameplates to equipment with non-corroding stainless steel screws.
- B. Non-corroding pop rivets are acceptable.
- C. Stick-ons or adhesives will not be allowed.

2.6 PIPING AND CONTROL DIAGRAM SIGNS

- A. Material:
 - 1. 1/4 inch acrylic cover and backing screwed together with brass screw/bolts.
 - 2. Size:
 - a. Minimum:
 - 1) 12" x 17"
 - b. Maximum:
 - 1) 24" x 36"
- B. Provide a diagram in each mechanical room similar to the diagrams shown on the plans, and/or as required for the area served.
- C. Provide pipe markers with the following features.
 - 1. Letters from 1/2" to 3-1/2":
 - a. Size letters to afford readability from the appropriate viewing position.
 - 2. Repeated and reversed words for viewing from 360° around pipe.
 - 3. Self-clinging, coiled markers that snap into place around pipe and do not require any other securement.
 - 4. Integral directional arrows.
- D. Letters on Field:
 - 1. Identify the specific material conveyed, e.g., "Domestic Cold Water", "Domestic Hot Water", etc.

- E. Model:
1. Less than 3/4":
 - a. Tags, same as Paragraph. Piping System Devices, color codes for hazard.
 2. 3/4" up to 6":
 - a. Seton Setmark SNA snap-on.
 3. Over 6":
 - a. Seton Setmark STR strap-on, with stainless steel spring straps.
 4. Use Seton Ultra-Mark for outdoor use.
- F. Piping System Devices (Valves, Thermometers, Pressure Gages, etc., and Pipe Less Than 3/4"):
1. Identify with the following:
 - a. Tags:
 - 1) Not less than 1-1/2 inch brass or aluminum tags, round, square, or octagonal.
 - b. Stamp tags with minimum 1/2" high descriptive characters, 1/2" high numbers with black enamel-filled indentations.
- G. Attachment:
1. Stainless steel or solid brass jack chain; Seton JA16, or stainless steel or brass "S" hooks
- H. Underground Warning Tapes:
1. Provide materials that meet the codes or have the approvals listed below:
 - a. Office of Pipeline Safety Regulation, USAS Code B31.8.
 - b. GSA Public Building Service Guide Specification.
 - c. National Transportation Safety Board Report NTSB-PSS-73-1.
 - d. AGA Report 72-D-56.
 - e. API Report API RP 1109.
 2. Material:
 - a. Plastic, continuous tape, color-coded, marked for hazard.
 - b. For Non-metallic Piping System:
 - 1) Aluminum foil core encased in plastic.
 - c. Metallic Piping:
 - 1) Plastic tape.
 3. Color:
 - a. Colored (not printed color) plastic, coded for material conveyed by piping.
 4. Width:
 - a. As scheduled for piping system burial depth.
 5. Legend:
 - a. "Caution "System Name" Line Buried Below".
 6. Tape Colors:

Utility	Color
Natural Gas, Oil, Dangerous Materials	Hi-Visibility Safety Yellow
Communications	Safety Alert Orange
Water Systems	Safety Precaution Blue
Sewer Systems	Safety Green
 7. Model:
 - a. Metallic Piping System: Seton Polyethylene Tape.
 - b. Non-Metallic Piping System: Seton Metallic Detection Tape.
- I. Underground Gas Piping:
1. Attach No. 18 gauge copper tracer wire to the piping and terminate above grade at each end.
- J. Pipeline Markers for Pipe Beneath Pavement and Slabs:
1. Minimum 2" round, square, or octagonal, same as specified in Subparagraph: Piping System Devices.
 2. Attachment:
 - a. 1-1/2" screw, bolted to tag as anchor.
 - b. Anchor Setting Compound: Epoxy or epoxy grout, compatible with the pavement.

PART 3 - EXECUTION

3.1 GENERAL

- A. Contractor shall verify room numbers with Owner/Engineer before nameplates are fabricated.
- B. The following shall be permanently and clearly identified:
 - 1. Each valve and pump.

3.2 INSTALLATION

- A. Install signs on non-removable panels. Attach to equipment with pop rivets or stainless steel screws.
- B. Mount in an easily visible location.
- C. All labeling identification shall conform to final room numbers. Coordinate with General Contractor, Architect, and Owner to secure construction room numbers.
- D. Provide all additional signage required by local authority at no cost to the Owner.
- E. Complete installation in accordance with ANSI A13.1 and manufacturer's installation instructions and with the Drawings. Fasten each unit securely in place with stainless steel screws.
- F. Equipment Labeling:
 - 1. Install on scheduled items of equipment, including the following:
 - a. Water heaters
 - b. Pumps
 - c. Control panels and major control components
 - d. Other items of equipment
 - e. Include Mark Number and descriptive name from Drawing and Specification schedules
 - f. Attach with corrosion resistant, stainless steel screws or pop rivets
 - g. Install 1/2" diameter adhesive marker (color to be approved by Architect), and apply to T-bar below any mechanical equipment, valves, and fire dampers above lay-in ceilings.
 - 2. Spacing:
 - a. Where pipe passes through walls, floors, and other barriers.
 - b. In Tunnel Vaults and Equipment Rooms:
 - 1) Maximum spacing, 10 feet; closer where piping is congested, and where piping continuity is obscured from view.
 - c. Piping in Tunnels:
 - 1) Maximum spacing 100 feet
 - d. Other Places:
 - 1) Maximum spacing 50 feet
- G. Piping System Color Coding:
 - 1. Designate for painter the following:
 - a. Types of piping services
 - b. Direction of flow
 - c. Other information required for proper identification.
- H. Surfaces to be Painted:
 - 1. Bare piping
 - 2. Insulation covering of insulated piping
- I. Paint according to the following schedule:

System	Pastel Color
Exposed Domestic Cold Water	Blue
Waste and Vent	None
Exposed Gas Piping	Black

- J. Piping System Devices (Valves, Thermometers, Pressure Gages, etc.):
1. Identify with the following information:
 - a. System
 - b. Device number
 - c. Device Function
 2. Device Chart:
 - a. Key devices to device chart
 - b. Give complete description of device function and system.

- K. Key devices to drawings as follows:
1. Floor plans
 2. Schematic drawings of piping systems

- L. Underground Warning Tapes:

1. Tape Widths:

Piping Burial Depth	Tape Width
10"	2"
20"	3"
27"	6"
30"	9"
40"	12"
50" or more	18"

- M. Recommended Tape Bury Depth:

1. Minimum Depth:
 - a. 6".
2. Distance Between Pipe and Tape:
 - a. Minimum 12".
3. Maximum Depth:
 - a. 12".

- N. Tie tape to pipe where pipe leaves the ground.

- O. Pipeline Markers for Pipe Beneath Pavement and Slabs.

1. Location:
 - a. Accuracy:
 - 1) Plus or minus 6" from piping centerline.
 - b. Flat Edge Pavement and Slabs:
 - 1) Set within 6" of pavement or slab edge.
 - c. Concrete Curbs:
 - 1) Set in top of curb.
 - d. Spacing:
 - 1) Each change in direction, each edge of pavement or slab, maximum spacing of 100'.

- P. Legend:

1. Same as tags plus an engraved or stamped line; set marker with line parallel to buried line.

- Q. Attachment:

1. Drill hole for anchor bolt, full depth of bolt plus 1/2"; set full tag and bolt in epoxy, flush with pavement or slab.

END OF SECTION

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SECTION 22 07 20
PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fiberglass insulation
 - 1. Applications:
 - a. Above ground domestic cold water
 - b. Roof drains
 - c. Horizontal portions of waste lines above grade which receive condensate from air handling units
 - d. Condensate drain lines
 - e. Domestic hot water piping
 - f. Hot water storage tanks
 - g. Storm shelter water supply tanks
- B. Closed Cell Insulation
 - 1. Closed cell insulation for piping in concrete masonry unit walls only.

1.2 RELATED SECTIONS

- A. Section 22 00 10 - Basic Plumbing Requirements
- B. Section 22 11 17 - Domestic Water Piping and Appurtenances
- C. Section 22 13 17 - Soil, Waste and Sanitary Drain Piping, Vent Piping and Appurtenances
- D. Section 22 14 01 - Roof Drainage Piping and Appurtenances

1.3 SUBMITTALS

- A. Product Data:
 - 1. Provide submittal data on all equipment specified in this section in accordance with Section 22 00 10, General Conditions, and Division 01.
 - 2. Submit product data indicating typical catalog of information.
 - 3. Submit product data sheets indicating dimensions, general assembly, and ratings.
 - 4. Submit manufacturer's installation instructions and method of application.

1.4 REFERENCES

- A. Refer to Section 22 00 10 for complete names of references identified in this section.
 - 1. ASTM E84 - Fire and Smoke Ratings
 - 2. ASTM C547 - Standard Specifications for Mineral Fiber Pipe Insulation
 - 3. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System)
 - 4. ASTM C795 - Standard Specifications for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
 - 5. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
 - 6. NFPA 255 - Surface Burning Characteristics of Building Materials
 - 7. UL 723 - Composite Surface Burning Characteristics

1.5 DEFINITIONS

- A. Concealed:
 - 1. Hidden from sight as in trenches, chases, furred spaces, walls, pipe shafts, or hung ceilings.

- B. Exposed:
 - 1. Not "concealed" as defined above. Normally open and visible to building occupants (such as gymnasiums).

1.6 QUALITY ASSURANCE

- A. Fire Hazard Rating:
 - 1. All insulation used on the project must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50 as determined by test procedures ASTM E84, NFPA 255, or UL 723. Insulation used in plenums must be listed and labeled as such.
 - 2. These ratings must be tested on the composite of insulation, jacket or facing, and adhesive.
 - 3. Components such as adhesives, mastics, and cements must meet the same individual ratings as minimum requirements.
- B. Quality Controls:
 - 1. All insulation shall be the product of reputable manufacturers.
 - 2. All insulation shall be applied by mechanics skilled in the use of various materials, and in the employ of a concern regularly engaged in the insulating business. Submit qualifications of insulator with insulation submittals.
 - 3. The materials shall be applied in accordance with the special materials as required by these specifications and by the manufacturer's standards.
 - 4. Poor workmanship or appearance will be cause for rejection.
- C. Insulations shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or polybrominated diphenyl ether fire retardants.
- D. Fiberglass insulations shall have a minimum of 50 percent recycled glass content; certified and UL Validated.
- E. Fiberglass insulations shall have a bio-based, formaldehyde-free binder and be UL GREENGUARD Gold certified.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Pipe covering insulation shall be manufactured for the sizes required for the particular system and shall be suitable for installation on piping systems defined.

2.2 PIPE INSULATION

- A. Fiberglass Insulation Manufacturers:
 - 1. Johns Manville
 - 2. Knauf Insulation
 - 3. Owens/Corning
 - 4. Manson Insulation
- B. Thickness:
 - 1. Domestic Cold Water Piping:
 - a. 1 ¼ inch pipe diameter or smaller: ½ inch thick
 - b. 1 ½ inch pipe diameter or larger: 1 inch thick
 - 2. Condensate Lines:
 - a. 1 ¼ inch pipe diameter or smaller: ½ inch thick
 - b. 1 ½ inch pipe diameter or larger: 1 inch thick
 - 3. Waste Lines Which Receive Condensate:
 - a. 1 ¼ inch pipe diameter or smaller: ½ inch thick
 - b. 1 ½ inch pipe diameter or larger: 1 inch thick
 - 4. Roof Drain Piping: 2inch
 - 5. Domestic Hot Water Piping (Up to 140°F):

- a. 1 ¼ inch pipe diameter or smaller: 1 inch thick
- b. 1 ½ inch pipe diameter or larger: 1 ½ inch thick
6. Outdoor Piping: 2 inch
- C. Construction for fiberglass insulation (Above ground and crawlspace):
 1. Fiberglass preformed pipe covering insulation complying with ASTM C547, Type I (850 degrees F) or Type IV (1000 degrees F); ASTM C585, ASTM C411, ASTM C795, and UL/ULC Classified. Fiberglass bonded with a bio-based thermosetting resin.
 2. Provide insulation with factory applied, white ASJ SSL, vapor retarder jacket complying with ASTM C1136. Thermal conductivity ASTM C 335 (k-value) at 75 degrees F mean temperature shall be 0.23 Btu x in. /h x sq. ft. x degrees F, or less. Service temperature range of 0 degrees F minimum to 1000 degrees F maximum.
 3. Flame spread/Smoke-developed Rating (ASTM E84) of 25/50. Must be UL Environment GREENGUARD Gold certified and UL Validated Formaldehyde-free.
- D. Closed Cell Insulation Manufacturers (for concrete masonry wall installations only):
 1. Armacell
 2. Aeroflex
- E. Construction for Closed Cell Insulation (for concrete masonry wall installations only):
 1. Type: EPDM Closed-cell flexible elastomeric foam pipe insulation
 - a. Performance Criteria: Resistant to ultraviolet and biological degradation as demonstrated by ASTM G7 and ASTM G90.
 - b. Temperature Range: -90°F to 220°F
 - c. Water Vapor Permeability (Dry Cup): Less than 0.03 per inch when measured by ASTM E96/E96M.
 - d. Thermal Conductivity: 0.25 BTU-IN/HR-F2-°F or less at 75°F mean temperature

2.3 FLANGE, VALVE, AND FITTING INSULATION

- A. PVC Fitting Covers/Jacket Manufacturers:
 1. Proto LoSmoke PVC
 2. Zeston PVC
- B. Metal Fitting Cover/Jacket Manufacturers:
 1. RPR Products
 2. Ideal Products
- C. Exposed Piping:
 1. Provide molded or mitered covers with full thickness matching adjacent covering.
 2. Finish with white glass, reinforced white vapor barrier coating, or white .020-inch thick PVC jacketing with self-seal lap.
- D. 2½ Inch Diameter and Larger Concealed Piping:
 1. Insulate fittings and valves with molded or mitered fitting covers.
 2. Finish with white vapor barrier coating reinforced with white 10" x 10" reinforced mesh.
- E. 2 Inch Diameter and Smaller Concealed Piping:
 1. Insulate fittings and valves with mineral wool and insulating cement to a thickness equal to or greater than adjoining straight pipe.
 2. Molded or mitered fittings finished with white vapor barrier coating reinforced with reinforced mesh may be provided.
- F. Underground Piping (hot water only):
 1. Provide mitered covers with full thickness matching adjacent covering.
 2. Field fabricated miter joints are not acceptable.
 3. No insulation is required on underground domestic cold water piping.
- G. Outdoor Piping:
 1. Metal jacketing shall be 0.016" minimum aluminum or stainless steel with moisture barrier, secured in accordance with jacket manufacturer's recommendations.

2. Use preformed fitting covers matching jacket used on straight pipe, with all joints sealed with metal jacketing sealant.

2.4 SEALANT, ADHESIVE, AND FINISH

A. Sealant:

1. Manufacturers:
 - a. Foster 95-44
 - b. Childers CP-76
 - c. Vimasco Corporation
 - d. Mon-Eco Industries
2. Usage:
 - a. Valve Covers
 - b. Anchors
 - c. Hangers
 - d. Metal Jacketing
 - e. Flashing Penetrations

B. Adhesive:

1. Manufacturers:
 - a. Foster 85-20/85-60
 - b. Childers CP-127
 - c. Vimasco Corporation
 - d. Mon-Eco Industries
2. Usage:
 - a. Longitudinal laps of the vapor barrier jacket
 - b. Butt joint covers.

C. Weather Barrier Mastic

1. Manufacturers:
 - a. Foster 46-50
 - b. Childers CP-10
 - c. Vimasco Corporation
 - d. Mon-Eco Industries
2. Usage:
 - a. Used on above ambient piping/duct to protect insulation from weather.
 - b. Use in conjunction with reinforcing mesh.

D. Vapor Barrier Coating:

1. Manufacturers:
 - a. Foster 30-33 Vapor Out
 - b. Childers CP-33 Chil Out
 - c. Vimasco Corporation
 - d. Mon-Eco Industries
2. Usage:
 - a. Glass fabric reinforcement.
 - b. Vapor stops.
 - c. Completing factory installed vapor retarders.

E. Reinforcing Mesh

1. Manufacturers:
 - a. Foster Mast Afab
 - b. Childers Chil-glass #10
 - c. Vimasco Corporation
 - d. Mon-Eco Industries
2. Usage:
 - a. Glass fabric reinforcement

2.5 INSULATION SHIELD

- A. Field-fabricated:
 - 1. Material:
 - a. High-density fiberglass insulation
 - 2. Construction:
 - a. Insulation to support the bearing area at hangers and supports with a shield of galvanized metal extending not less than 4 inches on either side of the support bearing area, covering at least half of the pipe circumference. When pipe is guided at top and bottom, metal shields should cover the whole pipe circumference. Adhere metal shield to insulation so that metal will not slide with respect to insulation.
 - 3. Schedule:
 - a. 3" and smaller pipe diameter:
 - 1) 12-inch insulated section, 18 gauge metal shield
 - b. Greater than 3" pipe diameter:
 - 1) 12-inch insulated section, 16 gauge metal shield
- B. Factory-made:
 - 1. Manufacturer:
 - a. Pipe Shields, Inc. or equal.
 - 2. Type:
 - a. Proper shield for service and pipe span.
 - 3. Construction:
 - a. Extend insulation at least 1 inch beyond metal.
- C. Insulation shall not compress at hanger.

PART 3 - EXECUTION

3.1 SITE INSPECTION

- A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.
- B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturers' recommendations.
- C. Verify, by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments, that all materials and accessories to be installed on the project comply with applicable specifications and standards and meet specified thermal and physical properties.

3.2 PROPERTIES

- A. Ensure that all pipe and fitting surfaces over which insulation is to be installed are clean and dry. Remove materials that will adversely affect insulation application.
- B. Ensure that insulation is clean, dry, and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.
- C. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.

3.3 INSTALLATION

- A. General:
 - 1. To ensure that it will achieve its highest possible performance and serve its intended purpose, install all insulation materials and accessories in accordance with manufacturer's published instructions (latest edition) and industry practices detailed by the North American Commercial and

- Industrial Insulation Standards Manual (latest edition). Install insulation on piping subsequent to installation of heat tracing, painting, and acceptance tests.
2. Install insulation on piping subsequent to installation of heat tracing, painting, and acceptance tests.
 3. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.
 4. Maintain the integrity of factory-applied vapor barrier jacketing on all pipe insulation, protecting it against puncture, tears, or other damage. All staples used on cold pipe insulation shall be coated with suitable vapor barrier coating to maintain vapor barrier integrity.
 5. All cold water, hot water, and condensate drains routed in concrete masonry units shall be insulated using closed cell insulation as noted in this specification.

3.4 PIPE

- A. Insulation size shall match pipe size.
- B. Insulation to be continuous through wall and ceiling penetrations.
- C. Apply insulation to clean, dry pipes.
- D. Butt insulation joints firmly together and apply butt strip. All pipe insulation terminations shall be tapered and sealed.
- E. Butt pipe insulation against hanger inserts. Seal jacketing according to type used.
- F. Seal longitudinal laps and butt strips with sealant in addition to the self-sealing laps.
- G. Seal joints with adhesive and staple at 2" O.C. with outwardly clenching staples.
- H. Seal all joints with vapor barrier coating.

3.5 VALVES, FLANGES, AND FITTINGS

- A. Insulate all valves, flanges, and fittings with covers secured with Velcro with equivalent thickness and composition installation on straight pipes.
- B. Finish with 1/4 inch layer of Foster 30-33 or Childers CP-33 reinforced with reinforcing mesh.
- C. Factory made covers equal to Proto Corporation or Zeston are acceptable.

3.6 CONTROL VALVE COVERS

- A. Fabricate special covers, complete with troweled-on vapor seal, shaped to accommodate the valve stem. Insulation thickness shall be same thickness as adjoining pipe.
- B. Seal covers to valve insulation properly with adhesive so that the seal may be broken with a knife blade without damage to either part. Arrange so that cover can be removed and replaced as necessary for operation of the valve.
- C. Finish valve cover with glass cloth and two coats of vapor barrier coating.
- D. Factory made covers are acceptable. Provide submittal.

3.7 ROOF DRAIN PIPING

- A. Seal vapor tight to prevent any moisture from entering into the insulation.
- B. Roof drains for canopies do not require insulation.
- C. Roof drains that are exposed shall be insulated as described in the paragraph on exposed piping.

- D. Roof drain laterals which serve primary roof drains shall be insulated.
- E. No insulation is required on concealed secondary roof drain piping.
- F. Insulate all roof drain bodies (primary and secondary), first 3-feet of vertical pipe on secondary laterals, and primary roof drain piping to a point seven feet downstream of the first elbow.

3.8 WASTE LINES WHICH RECEIVE CONDENSATE

- A. Insulate from the drain receptor (i.e. floor sink, hub drain) all the way to where the drain line changes to a vertical stack.

3.9 REPAIRS AND REPLACEMENT

- A. Replace any insulation that gets wet, whether now dry or not.
- B. Repair any damage caused by condensation due to improper insulating.

3.10 ALL EXPOSED PIPING

- A. All exposed piping insulation to be pre-formed pipe insulation with white PVC jacket and white PVC fittings (no exceptions). All exposed roof drain primary and secondary downspouts, water piping, condensate piping, and any other piping that requires insulation shall be insulated down to the floor level using the pre-formed pipe insulation and PVC jackets and fittings.

3.11 OUTDOOR PIPING

- A. Metal jacket shall be applied per manufacturer's recommendations. Longitudinal joints shall be applied so they will shed water completely and be sealed completely with 1/8" bead of metal jacketing sealant under each lap. Circumferential joints shall be closed using preformed butt strips in accordance with manufacturer's recommendations.

3.12 SHIELDS

- A. Metal jacketing shall be 0.016-inch minimum aluminum or stainless steel with moisture barrier, secured in accordance with jacket manufacturer's recommendations. Use bands and seals of the same material. Use preformed fitting covers matching jacket used on straight pipe, with all joints weather sealed with 1/8" bead of metal jacketing sealant under each lap.

3.13 SHIELDS AND HANGERS

- A. Piping hangers or anchors are not to be in direct contact with pipe. Hangers are to be on the outside of the insulation with pipe shields at each hanger.
- B. At the location of hangers or supports for pipes run above ground and finished with a vapor seal insulation, provide rigid sections of cork, high density fiberglass, Foamglas, calcium silicate, or high density polyurethane, the same thickness as adjacent insulating material to adequately support the pipe without compression of the insulating material and cover with a vapor seal that is bonded to the adjacent insulation as described for fittings in the lines. Wood inserts shall not be allowed. Hangers and supports for piping insulation to receive a vapor barrier shall be installed exterior to the insulation.
- C. Material Changes:
 - 1. Wherever there is a change in materials on lines that are vapor sealed, apply a suitable adhesive that is compatible with both materials, tapes, etc., as required to maintain the vapor barrier.
- D. Apply insulation around the hanger ring or anchor and pipe and carry vapor barrier upward and outward along the hanger rod or anchor members to a point not less than 12 inches from the adjacent pipe.
- E. Take care to avoid puncturing the vapor seal.
- F. Finish insulation as specified for flanges, and seal over adjacent vapor barrier jacket.

3.14 FIELD QUALITY ASSURANCE

- A. Upon completion of all insulation work covered by this specification, visually inspect the work and verify that it has been correctly installed. This may be done while work is in progress, to assure compliance with requirements herein to cover and protect insulation materials during installation.

3.15 PROTECTION

- A. Replace damaged insulation which cannot be satisfactorily repaired, including insulation with vapor barrier damage and moisture-saturated insulation.
- B. The insulation contractor shall advise the general and/or the mechanical/plumbing contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

END OF SECTION

SECTION 22 08 00
COMMISSIONING OF PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes commissioning process requirements for Plumbing systems, assemblies, and equipment.
- B. Related Section:
 - 1. Division 01 Section "Building Systems Commissioning" for general commissioning process requirements.

1.2 DESCRIPTION

- A. Refer to Division 01 Section "Building Systems Commissioning" for the description of commissioning.

1.3 DEFINITIONS

- A. Refer to Division 01 Section "Building Systems Commissioning" for definitions.

1.4 SUBMITTALS

- A. Refer to Division 01 Section "Building Systems Commissioning" for CxA's role.
- B. Refer to Division 01 Section "Submittals" for specific requirements. In addition, provide the following:
 - 1. Certificates of readiness
 - 2. Certificates of completion of installation, prestart, and startup activities.
 - 3. O&M manuals
 - 4. Test reports

1.5 QUALITY ASSURANCE

- A. Test Equipment Calibration Requirements: Contractors will comply with test manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to CxA upon request.

1.6 COORDINATION

- A. Refer to Division 01 Section "Building Systems Commissioning" for requirements pertaining to coordination during the commissioning process.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. All standard testing equipment required to perform startup, initial checkout, and functional performance testing shall be provided by the Contractor for the equipment being tested. For example, the plumbing contractor of Division 22 shall ultimately be responsible for all standard testing equipment for the plumbing systems and controls systems in Division 22. A sufficient quantity of two-way radios shall be provided by each contractor.
- B. Special equipment, tools, and instruments (specific to a piece of equipment and only available from vendor) required for testing shall be included in the base bid price to the Owner and left on site, except for stand-alone data logging equipment that may be used by the CxA.

- C. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the commissioning process.
- D. Data logging equipment and software required to test equipment will be provided by the CxA, but shall not become the property of the Owner.
- E. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.

PART 3 - EXECUTION

3.1 GENERAL DOCUMENTATION REQUIREMENTS

- A. With assistance from the installing contractors, the CxA will prepare Functional Testing Forms for all commissioned components, equipment, and systems
- B. Red-lined Drawings:
 - 1. The contractor will verify all equipment, systems, instrumentation, wiring, and components are shown correctly on red-lined drawings.
 - 2. Preliminary red-lined drawings must be made available to the Commissioning Team for use prior to the start of Functional Performance Testing.
 - 3. Changes, as a result of Functional Testing, must be incorporated into the final as-built drawings, which will be created from the red-lined drawings.
 - 4. The contracted party, as defined in the Contract Documents will create the as-built drawings.
- C. Operation and Maintenance Data:
 - 1. Contractor will provide a copy of O&M literature within 45 days of each submittal acceptance for use during the commissioning process for all commissioned equipment and systems.
 - 2. The CxA will review the O&M literature once for conformance to project requirements.
 - 3. The CxA will receive a copy of the final approved O&M literature once corrections have been made by the Contractor.
- D. Systems manual requirements:
 - 1. The Systems Manual is intended to be a useful information resource containing all of the information related to the systems, assemblies, and Commissioning Process in one place with indexes and cross-references.
 - 2. The GC shall include final approved versions of the following information for the Systems Manual:
 - a. As-Built System Schematics
 - b. Verified Record Drawings
 - c. Test Results (not otherwise included in Cx Record)
 - d. Periodic Maintenance Information for computer maintenance management system
 - e. Recommendations for recalibration frequency of sensors and actuators
 - f. A list of contractors, subcontractors, suppliers, architects, and engineers involved in the project along with their contact information
 - g. Training Records, Information on training provided, attendees list, and any ongoing training
 - 3. This information shall be organized and arranged by building system, such as fire alarm, chilled water, heating hot water, etc.
 - 4. Information should be provided in an electronic version to the extent possible. Legible, scanned images are acceptable for non-electronic documentation to facilitate this deliverable.

3.2 CONTRACTOR'S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend construction phase controls coordination meetings.
- C. Participate in Plumbing systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- D. Provide information requested by the CxA for final commissioning documentation.
- E. Include requirements for submittal data, operation and maintenance data, and training in each purchase order or sub-contract written.
- F. Prepare preliminary schedule for Plumbing system orientations and inspections, operation and maintenance manual submissions, training sessions, equipment start-up, and task completion for owner.
- G. Update schedule as required throughout the construction period.
- H. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CxA.
- I. Assist the CxA in all verification and functional performance tests.
- J. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.
- K. Gather operation and maintenance literature on all equipment, and assemble in binders as required by the specifications. Submit to CxA 45 days after submittal acceptance.
- L. Participate in, and schedule vendors and contractors to participate in the training sessions.
- M. Provide written notification to the CM/GC and CxA that the following work has been completed in accordance with the contract documents, and that the equipment, systems, and sub-system are operating as required.
 - 1. Service Water Heating Systems and components such as hot water heaters, circulation pumps, and controls.
- N. The equipment supplier shall document the performance of his equipment.
- O. Provide a complete set of red-lined drawings to the CxA prior to the start of Functional Performance Testing.
- P. Provide training of the Owner's operating staff using expert qualified personnel, as specified.
- Q. Equipment Suppliers
 - 1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner, to keep warranties in force.
 - 2. Assist in equipment testing per agreements with contractors.
 - 3. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.
- R. Refer to Division 01 Section "Building Systems Commissioning" for additional Contractor responsibilities.

3.3 OWNER'S RESPONSIBILITIES

- A. Refer to Division 01 Section "Building Systems Commissioning" for Owner's Responsibilities.

3.4 DESIGN PROFESSIONAL'S RESPONSIBILITIES

- A. Refer to Division 01 Section "Building Systems Commissioning" for Design Professional's Responsibilities.

3.5 CxA'S RESPONSIBILITIES

- A. Refer to Division 01 Section "Building Systems Commissioning" for CxA's Responsibilities.

3.6 TESTING PREPARATION

- A. Certify in writing to the CxA that Plumbing systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify in writing to the CxA that Plumbing instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify in writing that testing procedures have been completed and that testing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Place systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- F. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.7 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of Plumbing testing shall include the service water heating system.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. Tests will be performed using design conditions whenever possible.
- E. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- F. The CxA may direct that set points be altered when simulating conditions is not practical.
- G. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- H. If tests cannot be completed because of a deficiency outside the scope of the Plumbing system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- I. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.8 PLUMBING SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

- A. Functional Performance Tests: The CxA may modify these procedures during the Construction Phase once all systems are known and all required documentation has been provided.
- B. Plumbing Instrumentation and Control System Testing: Assist the CxA with preparation of testing plans.

3.9 DEFICIENCIES/NON-CONFORMANCE, COST OF RETESTING, FAILURE DUE TO MANUFACTURER DEFECT

- A. Refer to Division 01 Section "Building Systems Commissioning" for requirements pertaining to deficiencies/non-conformance, cost of retesting, or failure due to manufacturer defect.

3.10 APPROVAL

- A. Refer to Division 01 Section "Building Systems Commissioning" for approval procedures.

3.11 DEFERRED TESTING

- A. Refer to Division 01 Section "Building Systems Commissioning" for requirements pertaining to deferred testing.

3.12 OPERATION AND MAINTENANCE MANUALS

- A. The Operation and Maintenance Manuals shall conform to Contract Documents requirements as stated in Division 01.
- B. Refer to Division 01 Section "Building Systems Commissioning" for the AE and CxA roles in the Operation and Maintenance Manual contribution, review, and approval process.

END OF SECTION

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SECTION 22 11 17

DOMESTIC WATER PIPING AND APPURTENANCES COPPER

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Domestic hot water piping.
- B. Domestic cold water piping.

1.2 RELATED SECTIONS

- A. Section 22 00 10 - Basic Plumbing Requirements
- B. Section 22 05 24 - Valves - General
- C. Section 22 05 30 - Pipe and Pipe Fittings - General
- D. Section 22 33 34 - Access Doors
- E. Section 22 40 01 - Plumbing Fixtures and Fixture Carriers

1.3 REFERENCES

- A. ASTM 763 - Standard Specification for Copper Alloy Sand Castings for Valve Applications
- B. ASTM 61 - Standard Specification for Steam or Valve Bronze Castings
- C. ASTM C27450 - Standard Specification for Brass Rod, Bar & Shapes
- D. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges & Pipe Fittings
- E. ASTM A105/A105M - Standard Specification for Carbon Steel Forgings for Piping Applications
- F. ASTM - American Society of Testing Materials
- G. ASTM B813 - Standard Specification for Liquid & Paste Fluxes for Soldering of Copper & Copper Alloy Tube
- H. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
- I. ASTM B88 - Standard Specification for Seamless Copper Water Tube
- J. PDI - Plumbing & Drainage Institute
- K. ANSI/NSF 61

1.4 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 22 00 10, General Conditions, and Division 01.
- B. Submit product data sheets.

PART 2 - PRODUCTS

2.1 UNDERGROUND PIPING

- A. Type:
 - 1. 2 Inch Diameter and Smaller:
 - a. Type "L" soft drawn commercially pure copper
 - 2. 2½ Inch Diameter:
 - a. Type "L" hard drawn commercially pure copper
 - 3. 3 Inch Diameter or Larger:
 - a. Type "L" hard drawn commercially pure copper

B. All copper meets ASTM B88 Standards.

2.2 UNDER SLAB PIPING

- A. Type:
 - 1. 2 Inch Diameter and Smaller:
 - a. Type "K" soft drawn commercially pure copper
 - 2. 2½ Inch Diameter and Larger:
 - a. Type "K" hard drawn commercially pure copper

B. No joints will be permitted in piping runs beneath concrete slabs. All joints shall be made in accessible areas above the slab (behind access doors in walls, in mechanical closets, etc.).

C. All copper meets ASTM B88 Standards.

2.3 INTERIOR PIPING

- A. Type:
 - 1. Type "L" hard drawn commercially pure copper.

B. All copper meets ASTM B88 Standards.

2.4 PIPE FITTINGS

- A. Copper Piping:
 - 1. Unions:
 - a. 150 lb. standard, 300 lb. water-oil-gas service copper with ground joints.

B. Dissimilar Metal:

- 1. Di-Electric Unions

2.5 PIPE JOINTS

- A. Copper Piping:
 - 1. Type: Solder fittings
 - a. Solid string, hard solder
 - b. Wire, hard solder
 - c. Cored solder will not be allowed
 - 2. Type: Grooved
 - a. Coupling Gaskets: Grade "P" Fluoroelastomer compound with red and blue color code designed for operating temperatures from 0 deg F to +180 deg F.
 - b. Center-leg gasket with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth.
 - c. Installation Ready direct-push-installation
 - d. Reference shall always be made to the latest published Victaulic Selection Guide for Gaskets for proper gasket selection for the intended service.
 - e. Basis of design Victaulic Style 607 or engineer approved equal
 - 3. Type: Press-connect fittings
 - a. Copper and copper alloy fittings with EPDM elastomeric sealing element.
 - b. Unpressed fittings shall leak and not hold pressure.
 - c. Press connect fittings may not be used on elbow at main water entry. Use Silfos sweat fittings on all elbows on main water entry until down stream of the riser room.

4. Approved Manufacturers:
 - a. Viega ProPress
 - b. Nibco
 - c. Mueller Industries Streamline PRS
 - d. Apollo
 - e. Merit Brass
5. Material:
 - a. Solder (1/2" and Smaller):
 - 1) 95-1/2% tin, 4% copper, and 1/2% silver
 - b. Solder (2" and Larger):
 - 1) "SILFOS15", 15% silver, 80% copper, 5% phosphorous
 - c. Flux:
 - 1) Non-corrosive, lead-free paste
6. Use a cast brass adapter when connecting copper pipe to screwed brass pipe.
7. Brand:
 - a. Silvabrite or similar brand

B. Conform to ASTM B813 and ASTM B828.

2.6 VALVES

- A. Type:
1. Check Valves:
 - a. 125 lb. bronze check valve with "Buna-N" disc.
 2. Ball Valves:
 - a. 150 psi, bronze 1/4 turn ball valve with full port, stainless steel ball.
 - b. 300 psi, bronze 1/4 turn ball valve with full port, stainless steel ball. ASTM 61
 - c. 125 psi, lead-free dezincification resistant arsenical brass 1/4 turn ball valve with full port, stainless steel ball C46500 or CW 511L, ASTM 763, or C46750.
 3. Temperature and Pressure Relief Valves:
 - a. ASME rated valve
 4. Copper Grooved Butterfly Valves:
 - a. Valves 2-1/2" - 6", 300 psi (2065 kPa) maximum pressure rating, with copper tubing sized grooved ends. Cast bronze body to UNS C87850. (Alloy code shall be cast or stamped into the valve body.) Elastomer encapsulated ductile iron disc, ASTM A536, Grade 65-45-12, with integrally cast stem. Bubble tight, dead-end, or bi-directional service, with memory stop for throttling, metering, or balancing service. Valve may be automated with electric, pneumatic, or hydraulic operators. Basis of design Victaulic Series 608 or engineer approved equal.
 5. Balancing Valves:
 - a. All domestic cold water and hot water balancing valves 2" down will be s NSF Certified in accordance with ANSI/NSF 61 for cold +73°F/+23°C and hot +180°F/+82°C potable water service and ANSI/NSF 372. Valves 1/2" to 3/4" will have removable flow cartridge that limits flow within +/-5% of flow range. Basis of design Victaulic 76X or 78BL or engineer approved equal.
 6. Gate Valves:
 - a. 125 lb. rising stem, double-disc bronze gate valves larger than 3 inches.
 7. Water Main Valves:
 - a. 150 lb. AWWA valve.
 - b. 300 lb. bronze sealed spring cage, strainer
 8. Cast Iron: ASTM A126, Class B
 9. Cast Carbon Steel: ASTM A126, Grade WCB
 10. Forged Carbon Steel: ASTM A105/A105M, Grade II
 11. Backflow Preventers: Refer to Section 22 40 01 - Plumbing Fixtures and Fixture Carriers.
 12. Pressure Reducing Valves
 - a. All domestic cold water and hot water systems requiring pressure reduction will utilize factory assembled pressure reducing valve stations. Station will be consisting of a Victaulic Style 972S-H Watchdog valve combo, main branch PRV with a low-flow bypass branch. Assembly shall be Schedule 10S, type 304L, stainless steel pipe conforming to ASTM A312/A312M, with Victaulic stainless steel fittings, Victaulic Series 461 butterfly valves for isolation, Victaulic

968 wye pattern strainers, Victaulic installation-ready rigid couplings, Style 807N (Grade-P Gasket). All components shall be UL classified in accordance with ANSI/NSF 61 for potable water hot and cold service and shall be certified to the low lead requirements of NSF 372. Basis of design Victaulic 386A or engineer approved equal.

- B. Manufacturers:
 - 1. Apollo
 - 2. Crane
 - 3. Grinnell
 - 4. Jenkins
 - 5. Jomar, T-100NGDZ
 - 6. Kennedy
 - 7. Milwaukee Valve Company
 - 8. Nibco
 - 9. Stockham
 - 10. Walworth
 - 11. Watts
 - 12. Hammond
 - 13. Kitz
 - 14. Victaulic
- C. Provide valves where required to adequately control and isolate the various domestic water piping systems.
- D. Provide valves at the connection point of all equipment.
- E. Provide Di-Electric Unions at connection of dissimilar metal.

2.7 CONSTRUCTION

- A. Provide valves designed for repacking under pressure when fully opened.
- B. Equip with packing suitable for intended service.
- C. Furnish with gland followers.
- D. Provide valves rated greater than the design temperature and pressure for the intended system.
- E. All domestic cold water and hot water valves 2" and less shall be full port ball valves.

2.8 WATER HAMMER ARRESTORS

- A. Water Hammer Protective Devices:
 - 1. Usage:
 - a. Provide on hot and cold water supply lines. Locate between last two flush/solenoid valves on supply lines or per manufacturer's recommendations.
 - b. In single toilets locate within 3 feet of fixture or per manufacturer's recommendation.
 - 2. Type:
 - a. As recommended by the manufacturer for the particular application.
 - b. Locate arrestor on shop drawings with size.
 - 3. Manufacturer/Model:
 - a. Wade "Shokstop"
 - b. Sioux Chief "Hydra-Rester"
 - c. PPP "SC Series"
 - d. Mifab "MWH Series"
 - 4. Air chambers are not allowed.

2.9 FREEZE PROTECTION HEAT TRACE AND DOMESTIC HOT WATER LAYOUT FOR ICC (IECC)-2015

- A. Freeze Protection Heat Trace Tape:
 - 1. Usage:

- a. Provide on hot and cold water supply lines where freezing of the piping is a concern.
 2. Type:
 - a. Self-regulating heating cable, 5 watt per liner foot. Provide control panel and all necessary controls and wiring.
 3. Manufacturer/Model:
 - a. Raychem XL-Trace
- B. Domestic Hot Water Layout for ICC (IECC)-2015:
1. Usage:
 - a. At all sinks/lavatories associated with water closets and/or urinals and handwashing lavatories in kitchens require the domestic hot water circulation loop will be routed down in wall to within two feet of the faucet, routed horizontally for multiple sinks/lavatories, then routed back up to above ceiling in order to meet the 2015 International Energy Conservation Code.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All products to comply with ANSI/NSF 61.
- B. Install in accordance with the plans and Section 22 05 30.
- C. Drainage:
 1. Minimum Slope:
 - a. 1/8 inch per 10 feet.
 2. Where constant pitch cannot be maintained for long runs, establish intermediate low points and rise to higher level.
 3. Slope branches to drain toward mains or risers.
 4. Terminate low points of risers with drain valve piped to nearest hub or floor drain unless otherwise indicated.
- D. Water Hammer Arrestors:
 1. Install in accordance with PDI-WH 201.
- E. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
- F. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified.
- G. See the latest copy of the manufacturer's Field Assembly and Installation Instruction Pocket Handbook (I-100).

3.2 VALVES

- A. All valves, trap primers, etc. that are located behind access doors shall be located directly behind door and within 24" of plane of door.

3.3 INSTALLATION

- A. ProPress elbow is not acceptable on water supply elbows at location of main water stub up. Use SilFos sweated fittings on all water supply elbows larger than 2". 2" water supply line can be soft drawn copper with no elbow.
- B. Install valves and stops in accessible locations.
- C. Provide where shown or as required to make system complete and readily maintained.
- D. Plumbing contractor to provide strainers, spools (for future pressure reduction valve), associated cut-off valves, reduced pressure zone, and flood control valve at all building main water entry backflow

preventer assemblies. Also, route drain from the backflow preventer (RPZ) to the exterior of the building.

- E. Isolation valves shall be located:
1. Restroom Gang - Above lay-in ceilings adjacent to gang restrooms. When hard ceilings are present provide 18"x18" (minimum) ceiling access panel to access valves.
 2. Individual (private) Restrooms - Above lay-in ceilings adjacent to restroom. When hard ceilings are present provide 18"x18" (minimum) ceiling access panel to access valve.
 3. Individual Fixtures - Above lay-in ceilings adjacent to restroom. When hard ceilings are present provide 18"x18" (minimum) ceiling access panel to access valve
 4. Isolation valves on the domestic cold water shall be provided in corridors to allow isolation of buildings wings, sections, and areas.
 5. Provide cut-off valve on main water entry upstream of strainer and backflow preventer (if backflow preventer is inside building).
 6. Each exterior wall hydrant and each roof hydrant shall be provided with an accessible cut-off valve.
- F. Press fitting manufacturer shall provide a duplicate set of all tools required to maintain and/ or modify press fittings. Required tools are to be given to the owner. One set of tools shall be provided for each campus.

3.4 FIELD QUALITY CONTROL

- A. Properly test water distribution systems with 80 PSI hydrostatic pressure test.
- B. Do not install trap primers, flush valves, or other pressure sensitive devices until all tests are completed.
- C. Repair all leaks in pipes, fittings, and accessories during this test period.
- D. Repeat 80 PSI hydrostatic test until no leaks are found for an entire 8-hour period.
- E. Make joints in accordance with ASTM B828.
- F. A factory trained field representative (direct employee) shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products.

3.5 STERILIZATION

- A. Solution:
1. Strength:
 - a. Minimum 50 parts per million
 2. Agents:
 - a. Liquid Chlorine:
 - 1) Conform to U.S. Army Specification #4-1
 - b. Calcium Hydrochloride:
 - 1) Federal Specification O-C-114
 - c. Chlorinated Lime:
 - 1) Federal Specification O-C-114
- B. Procedure:
1. Perform sterilization after testing has been satisfactorily completed.
 2. Pump solution into a 1/4 inch opening provided in the water main next to the water meter.
 3. Conduct the sterilization process under the direction of the local health department.
 4. After sterilization, flush the system with clean water until the residual chlorine content is less than 3 ppm.
 5. After flushing, the local health department will test and verify the cleanliness of the system.

3.6 PLUMBING SCHEDULE

- A. Minimum Size:
1. Water Closets (flush valve):
 - a. 1-1/4" cold water

2. Urinals:
 - a. 3/4" cold water
3. Sinks:
 - a. 1/2" cold water, 1/2" hot water
4. Mop & Service Sinks:
 - a. 1/2" cold water, 1/2" hot water
5. Hose Bibbs:
 - a. 3/4" cold water
6. Drinking Fountains:
 - a. 1/2" cold water
7. Lavatories:
 - a. 1/2" cold water, 1/2" hot water

3.7 EMCS FLOW SENSOR

- A. EMCS contractor to furnish flow sensor (full water main size) and the plumbing contractor to install inside the building downstream of the backflow preventer (RPZ) or downstream of the initial water main stub up inside the building if the backflow prevention device is located in the yard. EMCS contractor to make all necessary connections for EMCS interface.

END OF SECTION

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SECTION 22 13 17

SOIL, WASTE AND SANITARY DRAIN PIPING, VENT PIPING, AND APPURTENANCES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Drain and vent piping within the building and underground laterals.
- B. Sand embedment for cast iron piping below slab.
- C. Pea gravel embedment for schedule 40 PVC piping below slab.

1.2 RELATED SECTIONS

- A. Section 22 00 10 - Basic Plumbing Requirements
- B. Section 22 11 17 - Domestic Water Piping and Appurtenances
- C. Section 22 13 18 - Condensate Piping
- D. Section 22 33 34 - Access Doors
- E. Section 22 40 01 - Plumbing Fixtures and Fixture Carriers
- F. Section 22 66 54 - Chemical Waste and Vent Piping

1.3 REFERENCES

- A. Refer to Section 22 00 10 for complete names of references identified in this section.
 - 1. Commercial Standard CS-188-59
 - 2. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
 - 3. ASTM 888-04 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary & Storm Drain, Waste & Vent Pipe Applications
 - 4. ASTM D2665 - Standard Specifications for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
 - 5. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings

1.4 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 22 00 10, General Conditions, and Division 01.
- B. Submit product data on pipe, pipe fittings, trap primers, covers, cleanouts, etc.

PART 2 - PRODUCTS

2.1 DRAIN PIPE AND FITTINGS

- A. Material: (Pipe material for above and below slab for ducted return mechanical system)
 - 1. Schedule 40 PVC pipe and fittings conform to ASTM D2665.
 - 2. "Foam Core PVC" not allowed.
- B. Material: (Pipe material for below slab for plenum return mechanical system)
 - 1. Schedule 40 PVC pipe and pipe fittings conform to ASTM D2665.
 - 2. "Foam Core PVC" not allowed.
- C. Material: (Pipe material for above slab for plenum return mechanical system).

SOIL, WASTE AND SANITARY DRAIN PIPING, VENT PIPING, AND APPURTENANCES

22 13 17 - 1

1. Type:
 - a. Cast Iron:
 - 1) Coated and labeled with C.I. mark of quality, Class "SV".
 2. Joints:
 - a. Cast Iron:
 - 1) Bell and spigot with elastomeric seals
 - 2) No-hub joints
 3. Schedule 40 CPVC piping and fittings conform to ASTM F441/F441M.
- D. Conform to ASTM A74, ASTM 888 and ASTM C564.

2.2 VENT PIPE AND FITTINGS

- A. Material: (Pipe material for above and below slab for ducted return mechanical system)
1. Schedule 40 PVC pipe and fittings conform to ASTM D2665.
- B. Material: (Pipe material for above slab for plenum return mechanical system)
1. Below slab: Schedule 40 PVC pipe and pipe fittings conform to ASTM D2665.
 2. Above slab: 1½ Inch Diameter:
 - a. Galvanized Steel: Schedule 40 pipe with city screwed, malleable iron fittings.
 - b. Copper:
 - 1) Type "M" or "DWV" hard drawn pipe with copper fittings connected as specified in Section 22 11 17.
 3. Above Slab: Larger Than 1½ Inch Diameter:
 - a. Cast Iron:
 - 1) Coated and labeled with C.I. mark of quality, Class "SV" with bell and spigot fittings. Comply with ASTM A74.
- C. Comply with ASTM A74 and ASTM C564.

2.3 CLEANOUTS

- A. Size:
1. Identical with the line size up to a maximum diameter of 4 inches.
- B. Type:
1. Compatible with the surrounding floor/wall.
- C. Manufacturers:
1. Jay R. Smith
 2. Josam
 3. Mifab
 4. Sioux Chief
 5. Wade W-6000
 6. Zurn

2.4 PLUGS

- A. Wade 8590, Tapped brass cleanout plug only. PVC plugs not allowed.
- B. Applications:
1. Each change in direction of soil lines
 2. End of each continuous waste line
 3. Foot of each riser within the building
 4. 50 ft. intervals in interior horizontal lines
- C. Construction: Secure covers with vandal-proof screws
- D. Finished Floors:
1. Covers: Chromium-plated, flush mounted, cast bronze with scoriated top surface.

- E. Walls/Painted Surfaces:
 - 1. Covers:
 - a. Furnish stainless steel covers.
- F. Exterior Locations:
 - 1. Traffic Areas:
 - a. Covers: Flush mounted, cast bronze covers with scoriated top surface
 - 2. Non-Traffic Areas:
 - a. Encase in a 14" x 14" x 6" concrete pad
 - b. Manufacturer/Model:
 - 1) Wade W-8500 series

2.5 CLOSET FLANGE

- A. Size: 4" to match sanitary sewer piping.
- B. Type:
 - 1. PVC or cast iron to match sanitary sewer piping.
 - 2. PVC flanges to be provided with stainless steel ring for reinforcement.
 - 3. Offset toilet flanges are not allowed.
- C. Manufacturer:
 - 1. Oatley or equal

2.6 TRAP PRIMERS - AUTOMATIC

- A. Type:
 - 1. Fully automatic valve with diaphragm operated piston.
- B. Size:
 - 1. Inlet:
 - a. 1/2 inch
 - 2. Outlet:
 - a. 1/2 inch
- C. Features:
 - 1. Activated by a pressure drop.
 - 2. No adjustment required.
 - 3. Equipped with distribution unit for 1 to 4 traps.
 - 4. Can be located anywhere in an active cold water line of 1½ inch or less that is directly serving one or more flush valves.
 - 5. Provide copper tubing (type K) from trap primer to protected trap.
- D. Application:
 - 1. Provide automatic trap primers at all floor drains and floor sinks on entire project that are within 20 feet of a water closet supply line.
 - 2. Provide a minimum of one union on each side of each trap primer, unless a means of detaching the trap primer is provided integrally in the trap primer, in which one union is permissible.
- E. Manufacturer/Model:
 - 1. Precision Plumbing Products, Inc. PO-500.
- F. Furnished with AG-500 air gap fitting with alignment legs.

2.7 TRAP PRIMERS - ELECTRONIC

- A. Type:
 - 1. Fully electronic trap primer valve.
- B. Size:
 - 1. Sized per manufacturer according to the number of trap primer tie-ins required.

- C. Features:
 - 1. Atmospheric vacuum breaker
 - 2. Pre-set 24-hour adjustable timer
 - 3. Manual override switch
 - 4. 120 volt electrical
 - 5. 3/4 inch FNPT connection
 - 6. Calibrated manifold for equal flow (total as required)
 - 7. Flush mount cabinet
- D. Application:
 - 1. Provide electronic trap primer systems as noted on the drawings. Coordinate with the electrical contractor.
 - 2. Allow one foot of elevation for every 20 foot of trap primer supply line.
 - 3. Provide a minimum of one union on each side of each trap primer system, unless a means of detaching the trap primer is provided integrally in the trap primer, in which one union is permissible.
- E. Manufacturers:
 - 1. Precision Plumbing Products, Inc. Model PT (coordinate the number of outlets required).
 - 2. Furnished with flush mount cabinet with Model D-1416 access door.

2.8 SAND BACKFILL/EMBEDMENT FOR CAST IRON PIPING BELOW SLAB

- A. Sand for embedment shall be a free flowing material which contains no clay, is reasonably free from organic material, and does not form a muck or mud when wet. The gradation shall be such that a minimum of 95% is retained on a #100 sieve. The P.I. of the soil fraction passing the No. 40 sieve shall not be greater than 5.

2.9 3/8 INCH PEA CLEAN PEA GRAVEL FOR SCHEDULE 40 PVC PIPING BELOW SLAB

- A. Provide 3/8" clean pea gravel aggregate as backfill for all schedule 40 PVC piping below slab. Provide a minimum of 6 inches of pea gravel cover over pipe and under pipe. Compact to 85% to 95%.

2.10 EXPOSED INDIRECT WASTE LINES IN KITCHENS AND CONCESSIONS

- A. All exposed indirect waste lines in kitchens and concessions to be DWV copper material. All joints to be soldered and turned down with elbow above floor sink or hub drain (discharge below elbow to be cut at 45-degree angle).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Location:
 - 1. Install a 12-gauge copper tracer wire on all underground sewers outside of building.
 - 2. Cast iron pipe and pipe fittings to be used in all renovated areas C, E, F, and H (plenum return).
 - 3. Schedule 40 PVC pipe and pipe fitting to be used in all new additions areas A1, A2, and B (ducted return).
- B. Slope:
 - 1. Desired: 1/4 inch per foot
 - 2. Minimum:
 - a. 1/8 inch per foot for diameter of 4 inch and larger if approved by local authority and it is impractical to use 1/4 inch per foot.
- C. Drain Pipe and Fittings:
 - 1. Reduction fittings:
 - a. Use to connect two pipes of different diameter.
 - 2. Directional changes:

- a. Use 45-degree wyes, long sweep quarter bends, and sixth, eighth, and sixteenth bends. Sanitary tees may be used on vertical stacks. Use long sweeps at all locations sanitary tees are used.
 - b. Embed pipe on sand cushion approximately 2 pipe diameters below (minimum 4") and at least one diameter on each side and top in trench.
 - c. No hub couplings of any type cannot be used underground.
- D. In kitchens install schedule 40 cast iron pipe and fittings from dishwasher, braising pans, and steamer discharges to grease interceptor inlet. All fittings picking up PVC branches along the way must be schedule 40 cast iron, as well.
- E. Crawlspace Location:
 1. All pipe to be suspended from structure with hangers.
- F. Traps:
 1. Provide at each fixture unless a trap is built into the fixture.
 2. Provide a deep seal trap and trap primers at each floor drain and hub drain.
 3. Place traps so that the discharge from any fixture will pass through only one trap before reaching a building drain.
 4. Place each trap as near to the fixture as possible. Do not exceed the distances stated in the governing codes up to a maximum of 8 feet.
- G. Trap Guards:
 1. Install per manufacturer's recommendations.
- H. Trap Primers:
 1. Provide trap primers at all floor drains, floor sinks and hub drains on entire project.
 2. Provide unions on each side of trap primer for service.
 3. Manufacturer shall provide field start-up and review of installation on trap primers.
 4. Use PEX tubing
- I. Hub Drains:
 1. Install with the top of the hub 1/2 inch above the finished floor, unless otherwise shown on the drawings.
- J. Cleanouts:
 1. See table below for cleanout requirements whether shown on plans or not.
 2. Install so that they open in a direction opposite to the pipe flow or at a right angle.
 3. At all wall cleanouts, install tapped brass cleanout plug behind wall escutcheons.
 4. Install vertically above the flow line of the pipe for "wye" branch and end-of-line cleanouts.
 5. Place cleanouts above the floors in pipe chases so that they will be accessible through doors or bring through a wall and provide with flush covers.
 6. Set cleanouts flush in floor slabs.
 7. Place cleanouts in accessible locations. Exact locations of each shall be approved by the Architect before installation. Locate all cleanouts within 2-feet of access door or cover.
 8. Location of all cleanouts shall be shown on the shop drawings.

INTERIOR AND EXTERIOR CLEANOUTS		
LOCATION	DESCRIPTION	ACCESSORIES
Interior horizontal drain lines.	Every 100'-0" (O.C.)	All cleanouts in walkways and floors to have scoriated non-slip cover.
Change in direction of the building drain.	At the change in direction greater than 45 degrees. If multiple changes in direction occur in a maximum of 40 feet only one cleanout is required (at the first change in direction)	
Base of stack.	A cleanout shall be provided at	Provide with access door

INTERIOR AND EXTERIOR CLEANOUTS		
LOCATION	DESCRIPTION	ACCESSORIES
	the base of each waste or soil stack.	or escutcheon. No more than 2 inches from cleanout.
Junction of building drain and building sewer.	Provide a two-way cleanout exterior of building at junction of building drain and sewer.	Two-way cleanout to be installed per detail with concrete cover.
Concealed piping cleanouts.	Cleanouts on concealed piping or under a floor less than 24 inches in height must extend up through the finished wall or floor.	Provide with scoriated non-slip cover.

9. All cleanouts must be the same size as the piping they serve. On all lines larger than 4 inches, the cleanout shall not be less than 4 inches.
10. Cleanouts up to 4 inches in diameter must have 18-inch clearance. All cleanouts larger than 4 inches must have 36-inch clearance.
11. Access shall be provided at all cleanouts.
12. All cleanouts shall have long radius sweeps at change in direction to allow the insertion of the plumbing snake for cleaning purposes. Short radius fittings will not be allowed.
13. Provide wall cleanout after last plumbing fixture and in the ADA stall. Wall cleanout to be installed 12" above the flood rim of the ADA water closet.

K. Plugs:

1. Install temporary plugs in all open sanitary drain pipes during construction to prevent any foreign objects from entering the pipe.
2. All floor drains to have plugs until substantial completion.

L. Vent Piping:

1. Connections:
 - a. Connect two or more vents together and extend as one vent through the roof, where practical.
 - b. Make vent and waste connections to stacks by using 45-degree wyes, long sweep quarter bends, sixth, eighth, or sixteenth bends. Sanitary tees may be used on the vertical stacks.
2. Flashing:
 - a. Use minimum 10-inch square, 4-pound lead flashing.
 - b. Flange the flashing to the lead sleeve.
 - c. Extend the flashing up and around the vent pipe.
 - d. Turn the flashing down inside the pipe at least 2 inches to make an absolutely watertight joint.
 - e. For single-ply rooftop systems, flash according to the roofing specifications.
3. Location:
 - a. Do not locate any vent within 15 feet of an outside air intake.
4. Mop Sinks:
 - a. Mop sinks to be installed after substantial completion.
5. Termination:
 - a. 12 inch above roof deck or 2 inch above parapet, whichever is greater.

3.2 TESTING

- A. Temporarily plug sanitary drain piping.
- B. Fill the pipes with water.
- C. Test the system in sections so that no section has a pressure less than 10 feet of water.
- D. If the level of water has been decreased by leakage after a 24-hour period, then locate and repair all leaks.
- E. Repeat the test until there is no perceptible decrease in the water level over a 24-hour period.

- F. Sewer Pressurization Test:
1. Provide smoke pressure test after plumbing top out/before sheetrock is installed and again at substantial completion.
 2. All smoke test on the sanitary sewer system is to be performed before ceiling tiles are installed, no exception.
 3. After all water tests are complete, perform smoke test to ensure there are no air leaks in building. Fill all p-traps with water and temporarily cap all vents prior to testing.
 4. Procedure for Plumbing Sewer Pressurization Test Using a Visual Smoke Indicator:
 - a. Contact your local city water department, some cities may provide and supervise a smoke test for your facility.
 - b. Prior to the test, notify the local fire and police departments that you are conducting a smoke test of the facility.
 - c. Prior to the test, turn off the fire alarms. The smoke will activate the alarm. After the test is complete the building will have to be ventilated to clear smoke and then the alarm can be reactivated.
 - d. You are required to have a blower with adjustable pressure control and liquid smoke or white smoke bombs.
 - e. Inflatable ball stops are required to block off the sewer line at the building manhole that connects to the city sewer main line.
 - f. All sewer vents on the facility have to be sealed to properly conduct the test. (Duct tape over the openings is acceptable.)
 - g. Ladders, portable lights, two-way radio communication, and standard hand tools are required for access above ceilings, floor drains, etc.
 - h. A minimum of three helpers are required to conduct the test.
 - i. Prior to the test, identify rooms or problem areas that should be observed first. Plumbing drawings are required to identify the locations of vents, traps, restrooms, etc.
 - j. This test will pressurize the sewer piping (approximately 1.25" S.P.) and identify any deficiencies.
 - k. If there are questions, contact EMA Engineering & Consulting: Phone 903-581-2677.
 5. Provide TV video of all main sanitary sewers in building and to city main. Notify Owner's representative when video is to be made 48 hours prior to work.
- G. Job Photographs:
1. Contractor is to provide digital photographs of all pipe showing sand embedment prior to covering trenches.

3.3 PLUMBING BRANCH SCHEDULES

- A. Minimum size:
1. Water Closets (flush valve):
 - a. 3" waste, 2" vent
 2. Urinals:
 - a. 2" waste, 1-1/2" vent
 3. Sinks:
 - a. 2" waste, 1-1/2" vent
 4. Mops & Service Sinks:
 - a. 3" waste, 1-1/2" vent
 5. Floor Drains:
 - a. 3" waste, 1-1/2" vent
 6. Drinking Fountains:
 - a. 2" waste, 1-1/2" vent
 7. Lavatories:
 - a. 2" waste, 1-1/2" vent

END OF SECTION

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SECTION 22 13 18
CONDENSATE PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Condensate piping for cooling units.

1.2 RELATED SECTIONS

- A. Section 22 00 10 - Basic Plumbing Requirements
- B. Section 22 05 30 - Pipe and Pipe Fittings - General
- C. Section 22 07 20 - Piping Insulation
- D. Section 22 13 17 - Soil, Waste, and Sanitary Drain Piping, Vent Piping, and Appurtenances
- E. Section 22 33 34 - Access Doors

1.3 REFERENCES

- A. ASTM B88 - Seamless Copper Tube for Water, Gas & Sanitation
- B. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV)
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials

1.4 DEFINITIONS

- A. Draw-through Unit:
 - 1. A unit in which the cooling coil operates under a negative static pressure.
- B. Blow-through Unit:
 - 1. A unit in which the cooling coil operates under a positive static pressure.

1.5 SUBMITTALS

- A. Product Data:
 - 1. Provide submittal data on all equipment specified in this section in accordance with Section 22 00 10, General Conditions, and Division 01.
 - 2. Submit product data indicating typical catalog of information.
 - 3. Submit product data sheets indicating dimensions, general assembly, and ratings.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide condensate lines for all cooling units even if not shown on the plans.
- B. Provide a secondary condensate drain pan and secondary condensate piping for all horizontal air handlers above ceiling, even if not shown on plans.
- C. Minimum size:
 - 1. 1", but no smaller than the coil nipple.

2.2 PIPING

- A. Type:
 - 1. Hard drawn type DWV or type M copper.
 - 2. Other type as noted on plans.
 - 3. Conform to ASTM B306 or ASTM B88.

2.3 FITTINGS

- A. Type: Cast Copper Alloy Solder Joint Drainage Fitting-DWV
 - 1. Conform to ASME B16.23
 - 2. Provide dielectric insulating couplings between ferrous and copper piping systems.
- B. Type: Press-connect fittings
 - 1. Copper and copper alloy fittings with EPDM elastomeric sealing element.
 - 2. Unpressed fittings shall leak and not hold pressure.
 - 3. Press connect fittings may not be used on elbow at main water entry under slab. Use Silfos sweat fittings on all elbows on main water entry.
- C. Approved Manufacturers:
 - 1. Viega ProPress
 - 2. Nibco
 - 3. Mueller Industries Streamline PRS
 - 4. Apollo
 - 5. Merit Brass

2.4 INSULATION

- A. All condensate lines shall be insulated per Section 22 07 20.

2.5 CONNECTIONS

- A. Type:
 - 1. Solid string hard solder
 - 2. Wire hard solder
 - 3. Cored solder will not be allowed.
- B. Material:
 - 1. Solder:
 - a. 95% tin and 5% antimony
 - 2. Flux:
 - a. Non-corrosive paste type
- C. Use a cast adapter when connecting soldered copper piping to screwed brass pipe.

2.6 ROOF PIPE SUPPORTS

- A. Manufacturers:
 - 1. MAPA MS-5
 - 2. Miro Industries Model 3 RAH (3-inch or less)
 - 3. Pipe Hangers and Devices (PHP) Model PP10
 - 4. Portable Pipe Hangers (PHP) Model PP10
 - 5. ERICO RPS 360407
- B. All roof supports to be equal to MAPA Products Model MS-5, adjustable height, select size designed for size of pipe supported. MS-5 for 4" and smaller.
 - 1. Install ½" rubber walk pad under each pipe support.
- C. MAPA MWP ½" thick rubber walk pad.
 - 1. Coordinate exact locations of supports with roofing contractor.
- D. Roof supports to support all gas piping a minimum of 6" above roof.
 - 1. Coordinate exact locations of supports with roofing contractor.

2. Install $\frac{1}{2}$ " rubber walk pad under each pipe support.
- E. Spacing of Supports (Horizontal):
1. $\frac{1}{2}$ " 6 feet or less
 2. $\frac{3}{4}$ " or 1" 8 feet or less
 3. $1\frac{1}{4}$ " or larger 10 feet or less
 4. Install supports within 2 feet of every change of direction.

2.7 ACCESSORIES

- A. Traps:
1. Draw-through units:
 - a. Required on all units, unless noted otherwise on plans.
 2. Blow-through units:
 - a. As recommended by the unit manufacturer or as shown on the plans.
- B. Clean-outs
- C. Unions
- D. Neutralization kits for all condensing furnaces and condensing water heaters.
1. Equal to JJM Boiler Works, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Traps:
1. Install in each line serving a draw-through unit. Coordinate size and configuration with air conditioning unit manufacturer.
- B. Cleanouts:
1. Install cleanouts as shown on plans.
 2. Install cleanouts at changes in direction (greater than 45°).
 3. Provide insulation caps on cleanouts for easy removal and reinstall.
- C. Unions:
1. Install unions on both sides of the trap.
- D. Minimum Drain Line Slope:
1. $\frac{1}{8}$ inch per foot
 2. Insulate all condensate lines inside buildings.
- E. Size and install Neutralization kits per manufacturer's recommendations.
- F. At all rooftop units on the roof, contractor to connect to the side outlet on the rooftop unit condensate drain pan and then route condensate drain down through roof in roof penetration per the roofing consultant's roof penetration detail. The bottom outlet on the rooftop unit condensate drain pan is unacceptable. The P-trap must be accessible on the roof.
- G. Testing:
1. Pressure test all sections of the condensate drainage system at a 10-foot head pressure for a 24-hour period. Repeat test until no leaks exist.

END OF SECTION

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SECTION 22 13 19
INTERCEPTORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Provisions for grease interceptors and solids interceptors each having inspectors' ports per the city and IPC.
- B. Per the kitchen plumbing design all floor drains, floor sinks, hand sinks, pot sinks, prep sink, washing machine, mop sink, and dishwasher shall be piped to the grease interceptor.
- C. Per the kitchen design, all food disposal discharge shall be piped to the solids interceptor. Solids interceptor discharge to be piped to the grease interceptor or the sanitary sewer (verify with the city).

1.2 SECTION INCLUDES

- A. Grease interceptors
- B. Solids interceptors
- C. Inspector's ports

1.3 RELATED SECTIONS

- A. Section 22 00 10 - Basic Plumbing Requirements
- B. Section 22 05 30 - Pipe and Pipe Fittings - General
- C. Section 22 13 17 - Soil, Waste and Sanitary Drain Piping, Vent Piping, and Appurtenances
- D. Section 22 40 01 - Plumbing Fixtures and Fixture Carriers

1.4 REFERENCES

- A. TCEQ (Texas Commission of Environmental Quality)
- B. ASTM A48/A48M - Standard Specification for Steel Castings
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet Bars
- D. ASTM C890 - Standard Practice for Minimum Structural Design loading for Monolithic or Sectional Precast Concrete
- E. ASTM C1613 - Standard Specification for Precast Concrete

1.5 SUBMITTALS

- A. Submit product data under provisions of Section 22 00 01. General Conditions and Division 01.
- B. Product Data
 - 1. Installation instructions
- C. Drawings
 - 1. Drawings of the precast concrete interceptors and ports shall be furnished by the manufacturer for review. Drawings to include dimensional information and all pertinent information to inform that the interceptor will include all necessary appurtenances to perform properly.
 - 2. Provide all necessary information to show required lifting points and anchoring points.

3. Provide information for all accessories (sealants, gaskets, pipe entry connectors, etc.)
4. As a minimum provide live loads design(HS-20), vertical and lateral earth loads, depth of soil fill on the structure, and water table depth used in the calculations.
5. Proper anti-flotation detail.

1.6 QUALITY ASSURANCE

- A. Comply with requirements in the following order:
 1. Codes, laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction over installation, inspection, and testing, including local codes.
 2. Provisions specified in this section.
 3. Local plumbing code.
 4. Interceptors to be designed and tested in accordance with ASME A112.14.6 and IAPMO/ANSI Z1001.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handling
 1. Follow all manufacturer instructions when lifting all interceptors.
- B. Storage
 1. Store all interceptors and inspectors' ports in a manner that will minimize damage.
- C. Delivery
 1. Delivery shall meet the predetermined delivery schedule. All interceptors delivered to the site must be inspected for damage.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Substitutions allowed per Section 22 00 90 Plumbing Submittal Procedure.
- B. Precast concrete interceptors to withstand design load conditions per the applicable industry design standards.
- C. Joints and sealants shall be the type meeting specified design and performance requirements.
- D. Concrete mix design to meet 4500 psi within 28 days.
- E. Interceptor must be a monolithic construction floor, first stage of wall and baffle with sectional riser to required depth
- F. All baffles shall be monolithic construction (slide-in baffles are not acceptable).
- G. Concrete construction to be reinforced with Grade 60 steel rebar conforming to ASTM A615/A615M on required centers or equal.
- H. Grey cast iron manhole frames, covers conforming to ASTM A48/A48M Class 30. Twenty-four-inch diameter manholes that are traffic rated.
- I. Provide with anti-flotation base as site conditions require.
- J. Provide inspector's port. 15-inch diameter for depths up to six feet. All depths over six feet to be 24-inch diameter.
- K. Concrete Interceptors Approved Manufacturers:
 1. Park USA
 2. American Precast

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify that all existing utilities at location of excavation for the interceptor has been properly reviewed/surveyed before any digging begins.
- B. Properly excavate for the interceptor meeting all laws and regulations for trenching/digging beyond 5-foot depths.
- C. Properly stake off excavation and tape off using caution tape.
- D. Ensure that bottom of excavated hole is compacted and level before setting interceptor.
- E. Excavation shall be large enough to allow access to all four sides.

3.2 INSTALLATION

- A. Compact the subgrade to 95% of the ASTM D558/D558M density. The subgrade shall be a minimum of 6 inches in depth. Use a granular material to create the level base to set the interceptor. Backfill shall be free of large stones, rocks, pavement, and chunks of concrete. Backfill shall not be expansive in nature.
- B. The construction manager is responsible for providing access to the site for proper delivery of the interceptor.
- C. Backfilling to be performed as soon as possible. No liquids shall be allowed in the interceptor before backfilling.

3.3 FIELD QUALITY CONTROL

- A. Perform water test to ensure no leaks occur around top lid and at pipe penetrations.
- B. Notify engineer/owner one day in advance before backfilling interceptor for visual review.
- C. Be sure that all debris has been removed from inside interceptor and inspector's port.
- D. Check all drain lines in and out of interceptor and inspector's port, including vent lines, to ensure proper slope is met and that there are no blockages.

END OF SECTION

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SECTION 22 14 01

ROOF DRAINAGE AND APPURTENANCES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Roof drains
- B. Drain piping within the building
- C. Sand embedment for cast iron piping below slab.
- D. Pea gravel embedment for schedule 40 PVC piping below slab.

1.2 RELATED SECTIONS

- A. Section 22 00 10 - Basic Plumbing Requirements
- B. Section 22 05 30 - Pipe and Pipe Fittings - General

1.3 REFERENCES

- A. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings
- B. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
- C. ASTM 888-04 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Pipe Applications
- D. ASTM D2665 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

1.4 SUBMITTALS

- A. Product Data:
 - 1. Provide submittal data on all items specified in this section in accordance with Section 22 00 10, General Conditions, and Division 01.
 - 2. Submit product data sheets.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. Material:(Pipe material for above and below slab for ducted return mechanical system)
 - 1. Material: Schedule 40 PVC pipe and pipe fittings conform to ASTM D2665.
 - 2. "Foam Core PVC" not allowed.
- B. Material: (Pipe material for below slab for plenum return mechanical system)
 - 1. Schedule 40 PVC pipe and pipe fittings conform to ASTM D2665.
 - 2. "Foam Core PVC" not allowed.
- C. Material: (Pipe material for above slab for plenum return mechanical system)
 - 1. Type
 - a. Cast Iron to be coated and labeled with C.I. mark of quality, Class "SV"
 - b. Joints: Cast iron no-hub joints.
 - c. Hot-dipped coated, standard weight cast iron.

- D. Owner Preferred Material Below Slab:
 - 1. Type:
 - a. Cast iron to be coated and labeled with C.I. mark of quality, Class "SV"
 - b. Joints: Bell and spigot with elastomeric seals
 - c. Hot-dipped coated standard weight cast iron.

- E. Primary Roof Drains
 - 1. Type:
 - a. Cast Iron
 - b. Straight down outlet
 - c. Side outlet
 - d. Select type based on application and clearance
 - 2. Construction:
 - a. Equip with low dome strainer
 - b. Provide cast iron mushroom dome.
 - c. Provide inside screw connections with underdeck clamping rings
 - d. Use corrosion resistant bolts
 - e. Coordinate roof attachment with Architect for proper installation.
 - 3. Manufacturer/Model:
 - a. Straight Down Outlet:
 - 1) Wade W-3000
 - 2) Watts RD-300
 - 3) Mifab R1200
 - 4) Josam 21500
 - 5) J.R. Smith 1010
 - 6) Zurn Z100F
 - b. Side Outlet:
 - 1) Wade W-3030
 - 2) Watts RD-100-SD
 - 3) Mifab R1200-90
 - 4) Josam 21500-66
 - 5) J.R. Smith 1020
 - 6) Zurn Z100F-90

- F. Secondary Roof Drains (also known as emergency roof drains and overflow roof drains)
 - 1. Type:
 - a. Cast Iron
 - 2. Features:
 - a. Flashing ring and gravel stop
 - b. Adjustable plastic standpipe
 - 3. Height:
 - a. 2 inches above top of roof grade at a point 10 feet out from roof drain.
 - b. Cast iron mushroom dome
 - 4. Manufacturer/Model:
 - a. Wade W-3004-SD
 - b. Watts RD-300-W
 - c. Mifab R1204-W
 - d. Josam 21500-16
 - e. Jay R. Smith 1080
 - f. Zurn Z100F-W2

- G. Storm Shelter Roof Drains
 - 1. Roof Penetration Housings, LLC:
 - a. Primary Roof Drain- CRD series
 - b. Secondary Roof Drain-COFRD series

- H. Insulation

1. Provide insulation per Section 22 07 20.
 - I. Downspout Nozzles
 1. Material:
 - a. Cast Bronze
 - b. Provide bird screen on sizes 6 inches and larger.
 2. Manufacturers:
 - a. J. R. Smith
 - b. Mifab
 - c. Wade
 - d. Watts
 - e. Josam
 - f. Zurn
 - J. Roof Drain Ty-Seal and No-Hub Fitting Adhesive
 1. Manufacturer:
 - a. Black Swan No-Hub Sealant
- 2.2 SAND BACKFILL/EMBEDMENT FOR CAST IRON PIPING BELOW SLAB
- A. Sand for embedment shall be a free flowing material which contains no clay, is reasonably free from organic material, and does not form a muck or mud when wet. The gradation shall be such that a minimum of 95% is retained on a #100 sieve. The P.I. of the soil fraction passing the No. 40 sieve shall not be greater than 5.
- 2.3 3/8 INCH PEA CLEAN PEA GRAVEL FOR SCHEDULE 40 PVC PIPING BELOW SLAB
- A. Provide 3/8" clean pea gravel aggregate as backfill for all schedule 40 PVC piping below slab. Provide a minimum of 6 inches of pea gravel cover over pipe and under pipe. Compact to 85% to 95%.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Minimum Slope:
 1. 1/8 inch per foot unless otherwise shown
 2. Cast iron pipe and pipe fittings to be used in all renovated areas C, E, F, and H (plenum return).
 3. Schedule 40 PVC pipe and pipe fitting to be used in all new additions areas A1, A2, and B (ducted return).
- B. Drain Pipe and Fittings:
 1. Use reduction fittings to connect pipes of different diameter
 2. Use 45-degree wyes, long-sweep quarter bends, and sixth, eighth, and sixteenth bends to change directions.
 3. Use long sweeps at the base of risers.
 4. Provide cleanouts at every 100' of piping and every change of direction.
 5. Horizontal pipe and fittings five (5) inches and larger must be suitably restrained to prevent horizontal movement and possible joint separation. This must be done at every branch opening or change in direction by the use of a brace, block, rodding or other suitable method, to prevent movement or joint separation.
 6. Support horizontal piping and fittings at intervals sufficiently close to maintain correct pipe alignment and to prevent sagging or grade reversal. Support each length of pipe with an approved hanger located as close to the joint as possible, and not more than 18 inches from the joint. For 12" and 15" hubless pipe, hangers should be placed on both sides of the coupling when installing full ten-foot lengths.
- C. Downspout nozzles:
 1. To be installed no higher than 18" above adjacent grade to bottom of nozzle. Contractor to be sure to coordinate rough-in for all projects with stem walls and low brick ledges so that the pipe and elbow is roughed in before grade beam/stem wall is poured.

- D. Cleanouts
 - 1. Provide cleanouts as required by applicable code and/or authority having jurisdiction.
- E. Painting
 - 1. Paint any visible pipe in all drains or downspout nozzles flat black.
- F. Roof Drains:
 - 1. Secure flashing and roof material to drain with an underdeck clamp ring.
- G. Water dams and standpipes on emergency roof drains shall be installed and adjusted so top of water dam/standpipe is no more than 2 inches higher than the roof inlet to the associated primary roof drain. Coordinate this with the roofing contractor.
- H. Field Quality Control
 - 1. Test new drainage system before backfilling and connecting to storm sewers.
 - 2. Maintain greater than 15 feet of hydrostatic head for 2 hours without a leak.
 - 3. Any leaks detected shall be repaired and the system shall be retested until no leaks are found.
 - 4. Check and record heights of all emergency roof drains above roof grade and 10 feet from roof drain.
 - 5. Submit test report and record of heights with close-out documents for Owner.
 - 6. Refer to Section 22 00 10 for backfilling and excavation.
- I. Apply "Black Swan Sealant" to Ty-Seal, roof drain pipe, and/or No-Hub coupling before installing roof drain pipe to roof drain. Only apply at initial roof drain pipe to roof drain connection.

END OF SECTION

SECTION 22 14 29

SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Comply with Division 01 - General Requirements and referenced documents.
- B. Comply with Division 22 Sections, as applicable. Refer to other Divisions for coordination of work with other portions of the work.

1.2 SYSTEMS DESCRIPTION

- A. Provide a complete sump pump system as indicated herein and as indicated on the Drawings.
- B. Provide connections to drainage system as otherwise indicated on the Drawings.
- C. Sump pumps in this section are for elevator sumps and groundwater sumps.

1.3 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 22 00 90.
- B. Indicate on submittal piping material and joining method for each system and for the various sizes of piping systems to be installed. This shall be in tabular form in one location.
- C. Product Data:
 - 1. Pipe
 - 2. Fittings
 - 3. Joining Methods
 - 4. Pumps
 - 5. Controls
 - 6. Pump Performance Curves and Dimensions
- D. Certification: Submit certification that completed system complies with test requirements of municipality, State, and other public authorities having jurisdiction.
- E. Provide closeout documents as required in Section 22 00 90.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements in the following order of precedence:
 - 1. Codes, laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction over installation, inspection, and testing.
 - 2. Provisions specified in this Section.
 - 3. Local Plumbing Code.
- B. Installer shall have been doing related work as described herein for a minimum of 5 years.

PART 2 - PRODUCTS

2.1 ELEVATOR PIT SUMP PUMPS

- A. Provide simplex submersible sump pump for commercial drainage applications. Pumps, end bells, and motor constructed of cast iron; motor shall be hermetically sealed capacitor start with built-in overload protection; size as scheduled on the Drawings. Bronze impeller, Series 300 stainless steel shaft, factory sealed grease lubricated ball bearings. Components of mechanical seal shall be stainless steel, ceramic,

brass, and Buna-N. Pump furnished with 15 feet of power cable and sensor cable.

- B. Simplex submersible sump pumps shall be as scheduled on Drawings.
- C. Installation shall be as defined on the Drawings and in compliance with the State Elevator Codes.
- D. Coordinate with Electrical Contractor for power supply requirements.
- E. Submersible sump pump with two-inch (2") discharge able to pass 1/2" solids.
- F. Provide mercury float switch for sensing controls. Provide quantity and location elevation for proper pump operation.

2.2 DUPLEX SUBMERSIBLE SUMP PUMPS WITH REMOTE CONTROL PANELS

- A. Acceptable Manufacturers:
 - 1. Paco
 - 2. Aurora
 - 3. Weil
- B. Provide a check valve and free-flow cut-off valve for each pump.
- C. Equip each pump system with four (4) "Series 8230" NEMA-6 submersible mercury float switches with complete automatic accessories and cover plate mounting.
- D. Provide a "Series 8100" NEMA-1 duplex wall mounted Remote Control Panel when located inside the Building. Furnish duplex Control Panel complete with (panel design features with no exceptions):
 - 1. One lockable panel disconnect thru door with door interlock on inner door.
 - 2. Two lockable pump disconnects on motor overload protector.
 - 3. Two control transformers with fused primary and fused secondary on all three phases and single phase 208 and 230 volt. Single phase 115 volt has two fused control circuits.
 - 4. Test-Off-Automatic Selector Switches
 - 5. Green running lights
 - 6. Control circuit transformers
 - 7. Wired and numbered terminal strips
 - 8. High water alarm with:
 - a. HWA red light and test auto silence switch on inner door.
 - b. HWA horn and silence button mounted on side of enclosure.
 - c. Alarm dome light red flashing on top of enclosure. Light indicates motor overload or high water alarm condition.
 - d. Switch with transformer and one (1) set of 24 volt AC rated normally-open "dry" contacts for connection to a Building Automation System.
- E. Provide an automatic electric alternator to:
 - 1. Switch the starting of the pumps from one to the other after each cycle for even ware of pumps.
 - 2. Cause both pumps to operate simultaneously as necessary to handle the load.
 - 3. The alternator shall also cause the "lag" pump to start if the "lead" pump should fail to operate for any reason.
- F. Submersible sump pump with two-inch (2") discharge able to pass 2" solids.
- G. Provide mercury float switch for sensing controls. Provide quantity and location elevation for proper pump operation.

2.3 SUBMERSIBLE SUMP PUMP QUICK REMOVAL SYSTEM

- A. Provide a quick removal system equivalent to Weil Fig. 261-D to allow pump removal or re-installation into the basin without disturbing any valve or pipe connections.
- B. Basic System Components shall include:
 - 1. A steel base plate with stationary discharge fitting and spool support.
 - 2. Two (2) cast iron discharge elbows, one (1) stationary, one (1) movable.

3. Two (2) galvanized guide poles with connecting bars.
4. Stainless steel wire rope and complete fittings.
5. Rectangular hinged steel cover plate with drop handles and hinges with lockable latch.

2.4 PUMPED STORM SEWER PIPING

- A. Discharge piping off of pumps shall be Schedule 40 galvanized steel pipe with either grooved ends with drainage pattern fittings and Victaulic Style 75 grooved connections, or threaded ends with ASTM A126 galvanized threaded fittings.

2.5 DUPLEX SUBMERSIBLE SUMP PUMP PITS

- A. Pits Located Outside of Building:
 1. Pit shall be FRP (fiberglass reinforced plastic).
 2. Seal joints in pit and pipe penetrations watertight.
 3. Provide heavy-duty cast iron manhole frame and cover. Parts shall be machine-fit, gasketed airtight.
- B. Pit Located Inside Building:
 1. Pit shall be FRP (fiberglass reinforced plastic).
 2. Seal joints in pit and pipe penetrations watertight.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 1. Install reducers, increasers, flanges, and fittings between piping and pumps in accordance with manufacturer's recommendations.
 2. Provide 3/4" fill line to sump basin with in-line manual fill and trap primer assembly for automatic fill of pit to insure periodic operation of sump pumps.
 3. Install pumps per manufacturer's recommendations. Pumps shall be installed for easy access for maintenance and removal.
 4. Coordinate with Electrical Contractor to provide necessary power and conduits as noted and detailed on Drawings.
 5. Make offsets necessary to avoid construction interferences.
 6. Protect piping from damage and corrosion.
 7. Coordinate precast or poured in place sump pits with other trades for installations.

3.2 FIELD QUALITY CONTROL

- A. Furnish instruments, equipment, and labor necessary to conduct tests.
- B. Methods of sampling, inspecting, and testing shall conform to local codes.
- C. Test sump pump and piping before backfilling.
- D. Water Test:
 1. Apply water test to entire system or in sections.
 2. If entire system is tested, tightly plug openings in pipes except highest opening.
 3. Fill system with water to point of overflow.
 4. If system is tested in sections, tightly plug openings except highest opening of section under test.
 5. Fill section with water to 10 feet head of water.
 6. In testing successive sections, upper 10 feet of next preceding section shall be tested so that each joint of pipe in building except uppermost 10 feet of system has been subjected to test of 10 feet of system has been subjected to test of 10 feet head of water.
 7. Keep water in system or in portion under test for one hour before inspection starts.
 8. System shall be made tight at all joints.
 9. Repair leaks.
 10. Repeat test until system holds water for six hours without drop in water level.

END OF SECTION

SECTION 22 15 14

COMPRESSED AIR PIPING AND APPURTENANCES (SHOPS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 01 Specifications, and Section 22 00 10, apply to this Section.

1.2 SCOPE

- A. Compressed air piping for the compressed air system serving the shop areas.

1.3 RELATED SECTIONS

- A. Section 22 00 10 - Basic Plumbing Requirements
- B. Section 22 05 30 - Pipe and Pipe Fittings - General
- C. Section 22 16 01 - Natural Gas Piping and Appurtenances

1.4 REFERENCES

- A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded, and Seamless

1.5 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 22 00 10, General Conditions, and Division 01.
- B. Submit layout drawing with all drops and valves.
- C. Submit product data indicating dimensions, general assembly, and materials.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

- A. Schedule 40 black steel pipe with black malleable iron screw fittings.
- B. Conform to ASTM A53/A53M.

2.2 VALVES

- A. Globe Valves:
 - 1. Type:
 - a. Bronze
 - 2. Manufacturer/Model:
 - a. Nibco No. T-211.
- B. Ball Valves:
 - 1. Type:
 - a. Bronze
 - b. Full Port
 - c. 400 PSI
 - 2. Manufacturer/Model:

- a. Nibco No. T-585

2.3 QUICK CONNECT FITTING

- A. Type:
 - 1. One way shut off, female
- B. Manufacturer:
 - 1. DynaFlo or equal

2.4 ROTARY SCREW AIR COMPRESSORS

- A. Electric Driven Two Stage:
 - 1. Mounted Motor Starter (3-Phase Models)
 - 2. Cast Iron Pump
 - 3. NEMA 1 and Open Drip Proof Motor for indoor applications only
 - 4. NEMA 4 and TEFC motor for all outdoor applications
 - 5. Automatic Control Pressure Switch
 - 6. Vibration Isolators
 - 7. Automatic Condensate Drain
 - 8. Air Cooled After Cooler
 - 9. Intake Filter (4 Micron)
- B. Receiver:
 - 1. ASME Coded
 - 2. Size and Orientation Per Schedule
- C. Filters:
 - 1. Particulate Filter
 - a. 99.95% D.O.P. Efficiency
 - b. 1.0 Micron
- D. Approved Manufacturers:
 - 1. Ingersoll Rand
 - 2. Chicago Pneumatic

2.5 RECIPROCATING AIR COMPRESSORS

- A. Electric Driven Two Stage or Duplex:
 - 1. Mounted Motor Starter (3-Phase Models)
 - 2. Cast Iron Pump
 - 3. NEMA 1 and Open Drip Proof Motor for indoor applications
 - 4. NEMA 4 and TEFC motor for outdoor applications
 - 5. Automatic Control Pressure Switch
 - 6. Vibration Isolators
 - 7. Automatic Condensate Drain
 - 8. Air Cooled aftercooler
 - 9. Intake Filter (4 Micron)
 - 10. 175 PSI maximum operating pressure
- B. Receiver:
 - 1. ASME Coded
 - 2. Size and Orientation Per Schedule
- C. Filters:
 - 1. Particulate Filter
 - a. 99.95% D.O.P. Efficiency
 - b. 1.0 Micron
- D. Approved Manufacturers:
 - 1. Ingersoll Rand

2. Chicago Pneumatic
- E. Refrigerated Air Dryer:
 1. Install in a conditioned space interior of building.

PART 3 - EXECUTION

3.1 PIPING

- A. Install Schedule 40 black steel piping with malleable iron fittings including necessary supports, hangers, etc.
- B. All branch piping to be tapped off the top of the supply loop.
- C. Conform to ASTM A53/A53M.

3.2 DRIP LEGS AND VALVES

- A. Provide condensate drip legs at low points in piping system with full port ball valves for bleed-off.
- B. Install globe valve and female quick connect fitting in each branch line at outlet drop in compressed air system.

3.3 AIR COMPRESSORS

- A. Provide vibration isolation on all compressors. Provide Neoprene pads if ground level. Provide spring isolators if located on mezzanines or equipment platforms.

3.4 TESTING

- A. Test all piping at 150 psi for an 8-hour period.
- B. Be sure to test all connections once air compressor and air dryer are installed.

END OF SECTION

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SECTION 22 16 01

NATURAL GAS PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Natural gas piping

1.2 RELATED SECTIONS

- A. Section 22 00 10 - Basic Plumbing Requirements
- B. Section 22 05 24 - Valves - General
- C. Section 22 05 30 - Pipe and Pipe Fittings - General
- D. Section 22 33 34 - Access Doors
- E. Section 22 40 01 - Plumbing Fixtures and Fixture Carriers

1.3 REFERENCES

- A. ASTM A53/A53M - Pipe, steel, black and hot-dipped, zinc coated, welded, and seamless
- B. ASTM A240/A240M - Standard specification for chromium and chromium-nickel stainless steel plate, sheet, and strip for pressure vessels and for general applications
- C. ASTM D2774 - Underground installation of thermoplastic pressure piping
- D. ASTM E84 - Standard test method for surface burning characteristics of building materials
- E. ASTM F-1668 - Construction procedures for buried plastic pipe
- F. UL 181BM - Procedures for HVAC system design and installation
- G. NFPA 54 - National Fuel Gas Code
- H. AWS - American Welding Society
- I. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings
- J. ASME B16.44 - Manually operated metallic gas valves for use in gas piping systems up to 5 psi.
- K. ANSI Z21.15 - Manually operated gas valves for appliances, appliance connector valves, and hose end valves.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Provide submittal data on all equipment specified in this section in accordance with Section 22 00 10, General Conditions, and Division 01.
- B. Submittals shall include:
 - 1. Pipe
 - 2. Pipe Supports
 - 3. Fittings
 - 4. Regulators
 - 5. Sleeving Materials

- 6. All accessories
 - C. Submit product data indicating typical catalog of information including arrangements.
 - D. Submit product data sheets indicating dimensions, general assembly, and materials used in fabrication.
- 1.5 COORDINATION
- A. Coordinate installation of the gas piping with the City.
 - B. Obtain approval from the City of all pipe sizes before installing any piping.
 - C. Call gas company and Notification Center before digging.
- 1.6 QUALITY ASSURANCE
- A. All welders shall be certified by AWS or other accredited program.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

- A. Outside the building and on roof:
 - 1. Viega MegaPressG Carbon Steel Press-Connect Fittings
 - a. Approved for underground applications in accordance with local codes and authorities having jurisdiction.
 - b. Approved for swing-joint applications.
 - c. Shall be listed to CSA 6.32 / ANSI LC-4.
 - d. Carbon steel alloy fitting with corrosion-resistant zinc/nickel coating.
 - e. 1/2" to 4" Iron Pipe Size.
 - f. Sealing Element: HNBR elastomeric sealing element rated to 125 psi (max) with a temperature range of -40 to 180 degrees (F). Sealing element shall be uniform in size/thickness and shall be free from manufactured deformities or indentations.
 - g. 420 stainless steel grip ring.
 - h. 304 stainless steel separator ring for 1/2" to 2", graphite separator ring for 2-1/2" to 4".
 - i. Press Connect fitting shall have Smart Connect Technology to detect unpressed fittings during the testing process.
 - j. Color-coded markings on exterior of fitting for readily identifying/inspecting sealing element type.
 - 2. Single source manufacturer. Technology and installation instructions vary between manufacturers.
 - 3. Approved manufacturer: Viega LLC
- B. Above the slab, within the interior of the building, and on roof:
 - 1. Standard weight, Schedule 40 black steel pipe with malleable iron fittings. Conform to ASTM A53/A53M. Threaded on all gas piping on roof 2 inches in diameter and smaller, butt joint welded on roof on all 2-1/2" diameter and larger, and socket welded fittings on ALL fittings and joints inside the building.
- C. Outside of the building and below grade:
 - 1. Polyethylene gas pressure pipe and fittings with fused joints.
- D. Transition Service Riser:
 - 1. Manufacturer/Model:
 - a. Central Plastics Co. (Shawnee, OK) 610-0111
 - 2. Use for the underground riser leading into the building.

2.2 GAS COCKS

- A. Type:
 - 1. Brass with tee or square head for wrench operation.

2.3 UNIONS

- A. Type:
1. Malleable iron, insulating type.

2.4 PIPE FLANGED FITTINGS

- A. Type
1. Per ANSI B16.5 Class 150 flanges.

2.5 VALVES

- A. Provide an approved design which does not allow locking in the open position.
- B. Larger than 2 inches:
1. Provide with a lubricated stop.

2.6 GAS PIPE SLEEVING

- A. Pipe:
1. Schedule 40 PVC for ducted return mechanical systems.
 2. Sleeving material in accordance with Local Authority having jurisdiction and per mechanical system type
- B. Prior to installation, verify with City all approved methods of gas pipe sleeving.

2.7 SOCKET WELD FITTINGS

- A. Manufacturer:
1. Anvil

2.8 ROOF PIPE SUPPORTS

- A. Manufacturers:
1. MAPA MS-5
 2. Miro Industries Model 3 RAH (3-inch or less)
 3. Pipe Hangers and Devices (PHP) Model PP10
 4. Portable Pipe Hangers (PHP) Model PP10
 5. ERICO RPS 360407
- B. Manufacturer to select correct size for size and weight of pipes.
- C. Pipe models listed above are for 3-inch or smaller gas pipe.
- D. All roof supports to be equal to MAPA Products Model MS-5, adjustable height, select size designed for size of pipe supported. MS-5 for 4" and smaller. For pipe sizes 6" and larger provide trapeze style roof supports MAPA Master Base series or equal.
1. Install ½" rubber walk pad under each pipe support.
- E. MAPA MWP ½" thick rubber walk pad.
1. Coordinate exact locations of supports with roofing contractor.
- F. Roof supports to support all gas piping a minimum of 6" above roof.
1. Coordinate exact locations of supports with roofing contractor.
 2. Install ½" rubber walk pad under each pipe support.
 3. Spacing of Supports (Horizontal):
 - a. ½" 6 feet or less
 - b. ¾" or 1" 8 feet or less
 - c. 1¼" or larger 10 feet or less
 - d. Install supports within 2 feet of every change of direction.
 4. Spacing of Supports (Vertical):

- a. 1/2" 6 feet or less
- b. 3/4" or 1" 8 feet or less
- c. 1 1/4" or larger 10 feet or less
- d. Install supports within 2 feet of every change of direction.
- e. At least every floor level install supports within 2 feet of every direction.

2.9 MEDIUM PRESSURE REGULATORS

- A. Manufacturers:
 1. Itron B34 Series or as shown on drawings.
 2. Fisher or equivalent

2.10 GAS METERS

- A. Make all arrangements with local gas utility company to obtain gas service. Coordinate exact location of meter, correct size, and pressure with gas utility company as indicated on plans.

PART 3 - EXECUTION

3.1 POLYETHYLENE PIPING

- A. Install a minimum of 18 inches deep.
- B. Attach a number 18 copper tracer wire to the piping and terminate above grade at both ends.
- C. Do not bend the piping to a radius of less than 20 times the nominal diameter of the pipe.
- D. Installed piping with enough slack to ensure that it will not be subjected to thermally induced strain which could damage the piping system.
- E. Fusion joints according to manufacturer's instruction.

3.2 BLACK STEEL PIPING

- A. Make all joints above grade and on roof gas piping 2-1/2" and larger by welding.
- B. Do not install steel piping underground, except at risers.
- C. Protect all underground black steel piping, (including underground riser to a point at least 6 inches above grade) where exposed on the exterior against corrosion by means of yellow "polyken" wrapping, 3M #51 "Scotchwrap", or Republic Steel's "X-Tru-Coat". Gas pipe protective coatings shall be approved types, machine applied conforming to recognized standards.
- D. Field wrapping shall provide equivalent protection and is restricted to those short sections and fittings necessarily stripped for threading or welding.
- E. Provide a #17 anode, insulating fittings, etc., for cathodic protection at the meter and each entry underground.

3.3 GAS COCKS

- A. Provide all final connections with gas cocks.
- B. Mount gas cocks in vertical pipes only on all rooftop gas-fired equipment.

3.4 GAS TURRETS IN SCIENCE/BIOLOGY/CHEMISTRY LABS

- A. Plumbing contractor to provide low-pressure gas piping routed behind casework or in wall to each and every gas turret on laboratory casework. Coordinate all turret locations with the architect's laboratory casework plan.

3.5 VALVES

- A. Provide all outlets at individual sites and any building supplied by the system with a readily accessible approved valve.
- B. Install valves in the gas piping within 3 feet of each appliance and ahead of the union connection.

3.6 MEDIUM PRESSURE REGULATORS

- A. All regulators shall be located in mechanical rooms, or on roofs as shown on plans.
- B. Each regulator shall have a separate vent to the outside.
- C. Each regulator shall be installed with an approved gas valve upstream of each regulator.
- D. Gas regulators to be installed no closer than 10'-0" to any outside air intake.

3.7 GAS PIPE SLEEVING LOCATIONS

- A. Sleeve all gas piping routed in concrete masonry walls and extend vent up through gooseneck roof termination. Gas piping routed down ICF or tilt wall panels shall not be routed in these walls. Route down along these wall types in chase wall.
- B. Vent all science/biology/chemistry valve enclosures up thru roof and terminate on roof with a gooseneck. Coordinate all valve enclosures with electrical contractor. Furnished by the electrical contractor and installed by the plumbing contractor.
- C. Sleeve all gas pipe roof penetrations from the hooded roof penetration thru the roof decking. Penetration at decking to be cut neatly and shall match the perimeter of pipe to allow fire putty application.
- D. At the main gas line building entry up to roof, sleeve gas piping from the point of entry up to the hooded roof penetration.
- E. All gas lines serving science/biology/chemistry demonstration desk will be sleeved in schedule 40 PVC pipe and fittings. Pipe and fittings to be glued and tested for leaks before backfilling. Sleeve ends to extend no less than 6" above slab.
- F. Sleeve all gas piping routed down in walls that are fire rated or are sound walls that have sheetrock extending up to the bottom side of the roof decking. Sleeve to terminate on room side of entry point and exit point of gas piping.

3.8 PRESSURE-CONNECT FITTINGS FOR STEEL PIPING

- A. Join carbon steel piping and press-connect fittings with tools recommended by fitting manufacturer.
- B. The manufacturer's installation instructions shall be strictly adhered to.
- C. All connections shall bear full insertion marks on the pipe.
- D. Special attention shall be given to the required two step pressure test.
 - 1. Initial test for unpressed fitting detection shall be in accordance with manufacturer's installation manual.
 - 2. Following a successful Smart Connect test, inspection, testing and purging of the fuel gas system shall be in accordance with local codes or, in the absence of local codes, in accordance with the International Fuel Gas Code, NFPA 54/National
 - 3. Fuel Gas Code z223.1, the Uniform Plumbing Code, NFPA 58, or CSA B 149.1 as applicable.
- E. The installers shall be credentialed by Viega.

3.9 SOCKET WELD FITTING LOCATIONS

- A. All interior gas piping in all locations (other than those locations in section 3.7 of this specification) to be installed using socket weld fittings. Install per manufacturer's recommendations.

3.10 UNIONS

- A. Install a union at each gas regulator as noted on detail, at each rooftop unit tie-in per detail, and just downstream of cut-off valve on gas lines that penetrate roof.

3.11 PIPE FLANGED FITTINGS

- A. Install pipe flanged fittings on medium pressure gas piping at locations to allow future relocation for reroofing of building (approximately 50 foot lengths).

3.12 CONNECTIONS TO EQUIPMENT

- A. Connect the gas piping with pipe fittings.
- B. Provide for thermal expansion for straight runs of pipe over 100 feet.
- C. Flexible connectors will not be allowed on any equipment. Connect with black steel pipe and unions.

3.13 CORRUGATED STAINLESS STEEL TUBING (CSST) PIPE

- A. Use only when shown on plans and in concealed areas inside building serving science labs.
- B. Sleeve: All pipe in accordance with Local Codes.

3.14 GAS METER

- A. Coordinate with gas utility.

3.15 SLOPE

- A. Slope all pipe a minimum of 1/4 inch per 15 feet to prevent traps. All horizontal lines shall slope to the risers and slope from the risers to the meter or to a service regulator when a meter is not provided.
- B. If a trap is unavoidable, a drip leg shall be installed. Drip legs shall be installed at the meter and at all appliances. Drip leg to be a minimum of 4" from tee turn down to cap.

3.16 PAINTING

- A. Paint in accordance with architectural specifications and color selected by Architect. Color to be flat black on roof and to match wall color on vertical riser to roof if color not otherwise instructed.

3.17 INSPECTION

- A. Do not enclose or cover any work until it has been inspected, tested, and accepted by local authority having jurisdiction.

3.18 TESTING

- A. Procedure:
 1. Subject gas piping systems to a pneumatic pressure test of 60 pounds per square inch for 30 minutes.
 - a. While the systems are subject to this air pressure, apply a soapy water solution to all welded joints for the purpose of detecting minute, as well as larger leaks.
 - b. If leaks are found in welded lines, repair by chipping and rewelding operations.
 - c. Repeat alternate testing and rewelding operations until the gas piping systems are absolutely tight.
 - d. If leaks occur at threaded joints, eliminate such leaks by replacing the fittings or properly tightening them.
 - e. Finally, subject the entire gas piping system to a pneumatic pressure test of 50 psi for a period of 24 hours and demonstrate that the piping system is absolutely tight.

- B. Perform any other tests as required by the City or other governing bodies.

END OF SECTION

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SECTION 22 33 34

ACCESS DOORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Access doors

1.2 RELATED SECTIONS

- A. Section 22 00 10 - Basic Plumbing Requirements
- B. Section 22 05 24 - Valves - General
- C. Section 22 11 17 - Domestic Water Piping and Appurtenances
- D. Section 22 13 17 - Soil, Waste and Sanitary Drain Piping, Vent Piping and Appurtenances
- E. Section 22 13 18 - Condensate Piping
- F. Section 22 16 01 - Natural Gas Piping and Appurtenances
- G. Section 22 40 01 - Plumbing Fixtures and Fixture Carriers
- H. Section 22 66 54 - Chemical Waste and Vent Piping

1.3 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 22 00 10, General Conditions, and Division 01.

PART - 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acudor
- B. Elmdor
- C. Mifab

2.2 ACCESS DOORS

- A. Locations requiring access doors:
 - 1. Concealed valves
 - 2. Traps
 - 3. Trap primers
 - 4. Controls
 - 5. Cleanouts
 - 6. Equipment above hard ceilings.
 - 7. Other equipment requiring accessibility for operation and maintenance.
- B. Type:
 - 1. Hinged flush-type steel framed door with straps and exposed narrow border.
- C. Minimum size:
 - 1. 18" x 18" unless otherwise indicated.

2. 24" x 24" for equipment above hard ceilings.
 3. Conform to architectural panel pattern for acoustical ceilings.
 4. Confirm size with Building Inspector and Engineer.
- D. Construction:
1. Hinges:
 - a. Concealed continuous type.
 2. Locking Device:
 - a. Flush cam type, screwdriver operated.
- E. Fire Rating:
1. Same or better fire rating than the surrounding area.
- F. Access doors located in kitchens, restrooms, or areas where water is present shall be stainless steel.
- 2.3 FACTORY PAINTING
- A. Apply prime coat of rust inhibiting paint, unless located in wet area.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer`s instructions and recommendations.
- B. In suspended acoustical ceilings, provide a beaded pin or other approved means for identification and easy removal where necessary.
- C. Access doors shall only be installed in areas/locations that are readily accessible.
- D. Doors shall be installed in such a manner that door will open 180 degrees.
- E. Access doors in walls, serving cut-off valves, trap primers, and cleanouts shall be coordinated with the architect/engineer. Top of access doors to be below bottom of wall mount lavatory apron. Access doors will not be allowed in walls above this height unless coordinated with the architect/engineer.

END OF SECTION

SECTION 22 40 01

PLUMBING FIXTURES AND FIXTURE CARRIERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Water Heaters
- B. Thermometers
- C. Pressure Gages
- D. Pete's Plugs
- E. Expansion Tanks
- F. Circulating Pumps
- G. ADA Accessories
- H. Water Closets
- I. Urinals
- J. Mop sinks
- K. Lavatories
- L. Wash Fountains
- M. Electric Drinking Fountains
- N. Sinks
- O. Fixture carriers
- P. Thermostatic Mixing Valves
- Q. Back Flow Preventers
- R. Emergency Fixtures
- S. Utility and Washer Boxes
- T. Floor Drains and Floor Sinks
- U. Floor Drains and Floor Sinks for ALTRO Floor
- V. Whirlpools
- W. Commercial Washers and Dryers
- X. Ice Makers
- Y. Interceptors (Refer to Section 22 13 19)

1.2 RELATED SECTIONS

- A. Section 22 00 10 - Basic Plumbing Requirements

- B. Section 22 05 30 - Pipe and Pipe Fittings - General
- C. Section 22 11 17 - Domestic Water Piping and Appurtenances
- D. Section 22 13 17 - Soil, Waste, and Sanitary Drain Piping, Vent Piping, and Appurtenances
- E. Section 22 33 34 - Access Doors
- F. Section 22 66 54 - Chemical Waste and Vent Piping
- G. Section 26 09 18 - Laboratory Utility Shut-Off System

1.3 REFERENCES

- A. ASHRAE 90-75 - American Society of Heating, Refrigerating & Air Conditioning Engineers, Inc. (Energy Conservation Standard in New Buildings)
- B. PDI-WH 201 - Plumbing & Drainage Institute (Water Hammer Arresters)
- C. ANSI Z21.22 - American National Standards Institute (Relief Valves & Automatic Gas Shutoff Devices)
- D. ANSI Z358.1 - American National Standards Institute (Emergency Eyewashes and Shower Equipment)
- E. AGA - American Gas Association
- F. ADA - Americans With Disabilities Act
- G. TAS - Texas Accessibility Standards
- H. ASSE 1069 - Performance Requirements for Automatic Temperature Control Mixing Valves
- I. ASSE 1070 - Water Temperature Limiting Devices
- J. ASSE 1071 - Performance Requirements for Mixing Valves for Emergency Showers

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 22 00 10, General Conditions, and Division 01.
- B. Indicate on submittal construction materials, finishes, sizes, quantities, and related hardware.
- C. Product Data:
 - 1. Plumbing fixtures
 - 2. Carriers
 - 3. Fixture trim
- D. Certification:
 - 1. Submit certification that complete system complies with test requirements of municipality, State, and other public authorities having jurisdiction over system.
- E. Provide closeout documents as required in Division 01, Section 22 00 10.

1.5 QUALITY ASSURANCE

- A. Provide faucets, fittings, supply stops, and similar devices of one manufacturer.
- B. Verify that the voltage is the same as scheduled on the electrical drawings. If not, change at no cost to the Owner.
- C. Regulatory Requirements:
 - 1. Comply with requirements in the following order of precedence:

- a. Codes, laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction over installation, inspection, and testing, including local codes.
- b. Provisions specified in this section.
- c. Local Plumbing Code.

1.6 HANDLING

- A. Deliver fixtures crated and in undamaged condition.
- B. Replace damaged fixtures with new fixtures.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All plumbing fixtures shall be new and as shown on the plans.
- B. Furnish plumbing fixtures with carriers shown and all necessary trimming.
- C. All porcelain enameled cast iron to be acid resistant.
- D. All supplies shall be IPS brass with stops.
- E. All exposed finished metal parts shall be chromium plated.
- F. Rough bodied parts shall be heavily nickel plated.
- G. Galvanized nipples will not be permitted.
- H. Traps for lavatories, sinks, etc. shall be 17 gauge three-piece chrome plated cast brass with cleanout and IPS tailpiece and chrome plated sleeve.
- I. All escutcheons on supplies and waste shall be heavy cast brass set-screw type.
- J. Furnish faucets and supply stops with renewable seats.
- K. All storage tanks and/or tank type water heaters to be installed with heat traps either in the vertical piping at the water heater connection or in the water heater inlet/outlet connection port.

2.2 WATER HEATERS

- A. Type:
 - 1. Commercial Grade Electric:
 - a. ASME Code Section IV (more than 58 KW)
 - b. Minimum Working Pressure:
 - 1) 160 psi
 - 2. Commercial Grade Gas:
 - a. ASME Code Section IV (more than 200,000 BTU input)
 - b. AGA Seal of Certification
 - c. Minimum Working Pressure:
 - 1) 150 psi
- B. Tank Construction:
 - 1. Insulation:
 - a. Heavy density fiberglass insulation trimmed with a baked enamel steel jacket.
 - 2. Cleanout:
 - a. Boiler type hand-hole
 - 3. Temperature and Relief Valve:
 - a. Comply with ANSI Z21.22
 - b. Discharge line from valve to be same size as valve outlet

4. Coatings:
 - a. 316 stainless steel tank construction.
- C. Low NOx Requirements:
 1. All water heaters/boilers shall meet the TNRCC and TCEQ standards for low NOx as follows:
 - a. ≤ 75 MBTU 55 PPM
 - b. $> 75 \leq 400$ MBTU 55 PPM
 - c. > 400 MBTU 30 PPM
 2. Boilers/water heaters not meeting these standards will be rejected.
- D. Approved Manufacturers:
 1. A.O. Smith
 2. Bradford White
 3. Heat Transfer Products
 4. Larrs
 5. Lochinvar
 6. Rheem
 7. State
- E. Warranties:
 1. Commercial Grade Electric:
 - a. 3-year warranty on storage tank
 - b. 1-year warranty on parts
 2. Commercial Grade Gas:
 - a. 5-year warranty on heat exchanger
 - b. 1-year warranty on parts
- F. Provide a 4-inch thick concrete housekeeping pad and drain pan for all floor mount water heaters.
- G. Neutralization kits on condensate drain line for all high efficient (90% AFUE or greater) water heaters, equal to JJM Boiler Works, Inc.
- H. Each room containing a boiler (greater than 200,000 BTUH or 120 gallons of storage) from which carbon monoxide can be produced shall be provided with a carbon monoxide detector.

2.3 CARBON MONOXIDE DETECTOR

- A. Approved Manufacturers:
 1. Marcurco - CM-6 / CM-12
 2. Equivalent
- B. Provide and install carbon monoxide detector with a manual reset in each boiler (greater than 200,000 BTUH or 120 gallons of storage) room.
- C. The carbon monoxide detector and all heater(s)/boiler(s) in common room shall be interlocked to disable the burners when the measured level of CO rises above 50 ppm.
- D. The carbon monoxide detector shall disable the burners upon loss of power to the detector.
- E. The carbon monoxide detector shall be calibrated in accordance with the manufacturer's recommendations or every eighteen months after installation of the detector. A record of calibration shall be posted at or near the boiler and be readily accessible to an inspector.
- F. Mount, install, and wire per manufacturers recommendations.

2.4 EXPANSION TANK

- A. Approved Manufacturers:
 1. Thrush-Amtrol Model Therm-X-Trol
 2. Watts - DETA Series
 3. Bell & Gossett PTA Series

4. Watts-PLT

- B. Provide and install expansion tank at each water heater installation per manufacturer's requirements. All expansion tanks shall bear ASME seal that serves boilers (greater than 200,000 BTUH or 120 gallons of storage).

2.5 CIRCULATING PUMPS

- A. Approved Manufacturers:
1. Armstrong
 2. Bell & Gossett PL Series
 3. Grundfos
 4. Astro
- B. Pumps are to be 100% bronze construction (Lead-Free).

2.6 THERMOMETERS

- A. Type:
1. 9" adjustable angle thermometer
- B. Construction:
1. Temperature range:
 - a. Fahrenheit degrees as approved by the Engineer.
 2. Window:
 - a. Unbreakable Plexiglas.
 - b. Furnish with separable socket.
 3. Manufacturer/Model:
 - a. Trerice BX91403 ½
 - b. MILJOCO SX935

2.7 VACUUM RELIEF VALVES

- A. Type:
1. Male NPT, low profile, and lead-free.
- B. Manufacturer/Model:
1. Watts LFN36
 2. Mifab
 3. Cash Acme
- C. Construction:
1. Low profile
 2. All lead-free brass body
 3. Protective cap
 4. Testes and rated to ANSI Z21.22
 5. CSA certified
 6. Maximum temperature 250 degrees F.

2.8 PRESSURE GAUGES

- A. Type:
1. 4" dial type pressure gauge
- B. Manufacturer/Model:
1. Trerice 500X
 2. MILJOCO P4509LX
 3. Range is minimum 1 ½ times working pressure of T & P Valve.
- C. Construction:
1. Pressure range:
 - a. As approved by the Engineer.

2. Cast aluminum case
3. Double strength clear glass window
4. Stainless steel movement
5. Phosphor bronze tube
6. Brass socket
7. Furnish with a Trerice No. 880 lever handle gauge cock.

D. Accuracy: 1/2 of 1% of scale range.

2.9 PETE'S PLUGS

- A. Provide two sets of suitable pressure and temperature gauges for use with the plugs.

2.10 ADA ACCESSORIES

- A. P-Trap and water supplies with stop guards
1. Usage: Each ADA lavatory
 2. Size: Verify with fixture
 3. Manufacturer/Model:
 - a. Truebro Lav-Guard 102 or 105 (verify usage)
 - b. Plumberex Pro Extreme #X4333 and X4114 (verify usage)
- B. Truebro Lav-Shields (Verify with fixture)

2.11 SCIENCE LAB AND PREP. ROOM (WATER AND GAS) SOLENOID VALVES

- A. Refer to Section 26 09 18 for laboratory utility shut off.

2.12 WATER CLOSETS, URINALS, AND LAVATORIES

- A. Approved Manufacturers:
1. American Standard
 2. Kohler
 3. Sloan
 4. Zurn

2.13 CARRIERS FOR WATER CLOSETS, URINALS, LAVATORIES, AND ELECTRIC WATER COOLERS

- A. Water Closets:
1. Wade 300 Series
 2. Watts
 3. Mifab
 4. Zurn
 5. Josam
- B. Urinals:
1. Wade 400 Series
 2. Watts
 3. JR Smith
 4. Mifab
 5. Zurn
 6. Josam
- C. Lavatories:
1. Wade 520 Series
 2. Watts
 3. JR Smith
 4. Mifab
 5. Zurn
 6. Josam
- D. Electric Water Coolers:

1. Wade 400
2. Watts
3. J.R. Smith
4. Mifab
5. Zurn
6. Josam

2.14 WATER HYDRANTS

- A. Approved Manufacturers:
1. Woodford
 2. Wade
 3. MAPA
 4. Mifab
 5. Josam
 6. JR Smith
 7. Zurn
 8. Prier Products
- B. All frost proof water hydrants mounted in building or roof shall be designed to not require an independent drain line unless specifically stated on construction drawings.

2.15 FAUCETS

- A. Approved Manufacturers:
1. American Standard
 2. Sloan
 3. Chicago
 4. Delta
 5. Symmons
 6. Moen
 7. T & S Brass
 8. Zurn AquaSpec
 9. Speakman
 10. Elkay
 11. Just

2.16 SINKS

- A. Approved Manufacturers:
1. Elkay
 2. Just

2.17 ELECTRIC WATER COOLERS

- A. Approved Manufacturers:
1. Elkay
 2. Halsey-Taylor
 3. Oasis
 4. Acorn
 5. Murdock
- B. All electric water coolers shall have vandal resistant bubbler and pushbutton activation mechanism.
- C. All electric water coolers shall have mechanical control valves to provide operation and water flow in the event of loss of electrical power.

2.18 MOP SINKS

- A. Approved Manufacturers:
1. Fiat
 2. Stern Williams

3. Acorn
4. Creative Industries Terrazzo Products, Inc.

2.19 SHOWERS

- A. Approved Manufacturers:
1. Acorn
 2. Bradley

2.20 WASH FOUNTAINS

- A. Approved Manufacturers:
1. Acorn
 2. Bradley
 3. Willoughby
 4. Sloan

2.21 FLOOR DRAINS/FLOOR SINKS

- A. Approved Manufacturers:
1. J.R. Smith
 2. Josam
 3. Mifab
 4. Sioux Chief
 5. Wade
 6. Watts
 7. Zurn

2.22 KITCHEN FLOOR DRAINS AND FLOOR SINKS

- A. Kitchen floor drains to be 10"x10" constructed of AISI 304 stainless steel with a vertical outlet. Floor drains to be furnished with a floor drain top, ACO adjustable feet, light duty heel safe grates, silt basket, and stainless steel ACO p-trap.
- B. Kitchen floor sinks to be 10"x10" constructed of AISI 304 stainless steel with a vertical outlet. Floor sinks to be furnished with a floor sink top, ACO adjustable feet, light duty heel safe half grate. Silt basket, and stainless steel ACO p-trap.

2.23 FLUSH VALVES

- A. Approved Manufacturers:
1. Manual:
 - a. Sloan #111 Series Water Closets, #186 Series Urinals
 - 1) Zurn #Z6000, WSI Water Closets, #Z-6003-WSI Urinals
 - b. Provide offset vacuum breaker tube for conflicts with grab bars, as needed, in ADA/TAS water closet stalls.

2.24 THERMOSTATIC MIXING VALVES

- A. Approved Manufacturers:
1. Acorn Controls
 2. Apollo
 3. Bradley
 4. Conbraco
 5. Leonard
 6. Powers
 7. Symmons
 8. Watts
 9. Lawler
- B. Thermostatic mixing valves for showers shall comply with ASSE 1069.

- C. Thermostatic mixing valves for lavatories and sinks shall comply with ASSE 1070. Provide inlet check stops and inlet y-strainers.
- D. Thermostatic mixing valves for emergency fixtures shall comply with ASSE 1071.

2.25 BACKFLOW PREVENTERS

- A. Reduced Pressure Zone
 1. Bronze or FDA approved epoxy coated cast iron body.
 2. Maximum Working Pressure: 175 psi
 3. Provide full line size strainer before reduced pressure zone assembly.
 4. Provide air gap assembly.
- B. Vacuum Breakers (Atmospheric)
 1. Bronze bodied
 2. Non-spilling type
 3. Rated for 150psi maximum operating pressure
 4. Elastomers - Nitrile
 5. Poppet - Acetal/Polypropylene
- C. Vacuum Breakers (Pressure)
 1. Bronze bodied
 2. Elastomers - Nitrile
 3. Union End Ball Valves
 4. Rated for 150 psi maximum operating pressure
- D. Approved Manufacturers:
 1. Apollo
 2. Conbraco
 3. Watts
 4. Zurn
 5. Ames

2.26 EMERGENCY FIXTURES

- A. Comply with ANSI Z358.1
- B. Approved Manufacturers:
 1. Acorn Safety
 2. Bradley
 3. Guardian Equipment
 4. Haws
 5. Encon Safety Products
 6. Water Saver

2.27 SCIENCE/BIOLOGY/CHEMISTRY LABS

- A. Plumbing Contractor to provide acid p-trap, supplies with stops, thermostatic mixing valve (equal to Leonard 270LF), and all final connections. All sinks and faucets furnished by others, installed by Plumbing Contractor.

2.28 INTERCEPTORS

- A. Refer to Section 22 13 19.

2.29 STORM SHELTER WATER SUPPLY TANKS

- A. Lochinvar FVG - glass-lined storage tank (non-ASME)
- B. A.O. Smith TJV - NSF-approved glass lining (non-ASME)

- C. Lochinvar FVG - glass-lined storage tank (ASME)
- D. A. O. Smith TJV - NSF-approved glass lining (ASME)

2.30 UTILITY AND WASHER BOXES

- A. Oatey
- B. Guy Gray

PART 3 - EXECUTION

3.1 PREPARATION

- A. All equipment surfaces coming in contact with walls, floors, or surfaces of other fixtures shall be ground truly flat and shall be bedded with fine dental plaster.
- B. Install an approved vacuum breaker or backflow preventer on each water supply line serving a plumbing fixture which has a water supply below the rim of the fixture. Vacuum breakers shall be designed to prevent any possible backflow through them. Where these are installed in chrome plated lines, they shall be chrome plated to match.
- C. Provide and install a check valve on the cold water supply serving each and every water heater on project.
- D. Temperature and pressure relief line to be piped full-sized and in copper to exterior of building, or as noted on plans.
- E. Set water heater storage temperature to 140°F.

3.2 INSTALLATION

- A. Plumbing contractor is required to provide a mock up for coordination purposes of flush valve and grab bar rough-in locations for water closets in the ADA/TAS stall at each age level in the facility.
- B. Furnish and completely install all fixtures shown on plans and as specified.
- C. Properly anchor all fixtures, lines, or equipment to construction.
- D. Clean all plumbing fixtures before final inspection and acceptance by the Architect.
- E. Install all fixtures to proper heights as shown on the plans and in the codes. Refer to Texas Accessibility Standards. Coordinate height with plans. If different from engineering plans, contact the Architect for the correct height. Do not install until written approval is issued by the Architect. If fixture cannot be installed to proper height given, contact Architect for direction. No cost changes will be allowed for changes to piping to correct the problem.
- F. Install Handi Lav-Guard Kits per manufacturer on ADA lavatories.
- G. Provide and install thermostatic mixing valves at all ADA lavatories, sinks, wash stations, and lavatory systems. Set tempered water supply to 90 to 95 degrees F(tempered), unless noted otherwise by owner.
- H. Provide and install thermostatic mixing valves at all emergency showers/eyewashes to 85 degrees F (tepid), unless noted otherwise by owner.
- I. Electrical Contractor to provide 120V to Science Lab/Prep. Room solenoid valves. Electrical Contractor to make final 120V tie-in to solenoid valves.
- J. Install water heater expansion tank on cold water entering the water heater or storage tank.

- K. All tankless water heaters to be installed per manufacturer's recommendations. All multiple tankless water heater arrangements must be provided with manufacturer's shop drawings showing all components, piping arrangement, and controllers.
- L. Horizontal Y-Strainers shall be located:
 - 1. On domestic water main entry into the building provide a horizontal Y-strainer downstream of the building isolation valve and upstream of the backflow preventer.
 - 2. Where infrared controlled lavatories or hand sinks are provided downstream of the supply stops exposed under the fixture.
 - 3. In gang or private (individual) restrooms directly downstream of the isolation valves behind the access panel.
- M. Provide backflow preventer (reduced pressure zone) at all ice makers/machines, coffee/drink dispensers, and soap dispensers at mop sinks, and where shown on architectural and plumbing drawings. Discharge from R.P.Z. to be drained to nearest floor sink/drain/mop sink.
- N. Provide framing support attached to building structure for all roof hose bibs. Install per manufacturer's recommendations.
- O. Install vacuum relief valves on the cold water supply line at an elevation no less than 12" above top of storage tank/water heater.
- P. Plumbing contractor to provide strainers, spools (for future pressure reduction valve), associated cut-off valves, reduced pressure zone, and flood control valve at all building main water entry backflow preventer assemblies. Also, route drain from the backflow preventer (RPZ) to the exterior of the building.

3.3 FIELD QUALITY CONTROL

- A. Inspect all faucets, flush valves, stop valves, and other equipment for proper amount of water discharged. Adjust as required to meet low water consumption and ADA/Texas Accessibility Standards.
- B. Correct any faucet or other equipment as directed by the Architect/Engineer.
- C. Protect all drains during construction. Install covers on all floor drains and floor sinks until substantial completion.
- D. Do not install mop sinks until substantial completion.

END OF SECTION

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SECTION 22 66 54

CHEMICAL WASTE AND VENT PIPING SYSTEM

PART 1 - GENERAL

1.1 SCOPE

- A. Chemical waste piping, vents for drains and sinks upstream of the dilution basin, p-traps, dilution basin, crushed limestone, and inspector's port for a complete and workmanlike system.

1.2 RELATED SECTIONS

- A. Section 22 00 10 - Basic Mechanical Requirements
- B. Section 22 05 30 - Pipe and Pipe Fittings - General
- C. Section 22 13 17 - Soil, Waste and Sanitary Drain Piping, Vent Piping and Appurtenances
- D. Section 22 33 34 - Access Doors
- E. Section 22 40 01 - Plumbing Fixtures and Fixture Carriers

1.3 REFERENCES

- A. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
- B. ASTM D101-02b - Standard Specification for Polypropylene Injection and Extrusion Materials
- C. ASTM D1784 - Standard Specification for Rigid PVC and CPVC Compounds
- D. ASTM F1412 - Standard Specification for Polyolefin Pipe & Fittings for Corrosive Waste Drainage Systems
- E. ASTM F1673 - Standard Specification for Polyvinylidene Fluoride (PVDF) Corrosive Waste Drainage Systems
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- G. ASTM F441/F441M - Standard Specification for CPVC Plastic Pipe, Schedules 40 and 80
- H. ASTM D3311 - Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fitting Patterns
- I. ASTM F2618 - Standard Specification for CPVC Pipe and Fittings for Chemical Waste Drainage Systems
- J. ASTM F493 - Specification for Solvent Cements for CPVC Plastic Pipe and Fittings

1.4 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 22 00 10, General Conditions, and Division 01.
- B. Submit product data sheets with methods of making joints.
- C. Submit qualifications of installer of particular product.

PART 2 - PRODUCTS

2.1 GENERAL

- A. System to include pipe, fittings, traps inspector's port downstream of the dilution basin, and recommended adapters to connect other piping material where applicable.
- B. Mechanical systems utilizing the space above the ceiling (plenum) for air return shall be PVDF pipe and pipe fittings. Coordinate with this specification and the mechanical contractor.

2.2 PIPING AND FITTINGS

- A. Type: Acid Resistant
- B. Material:
 - 1. Flame retardant polypropylene (PP) meets requirements of ASTM F1412.
- C. Maximum Average Burn Time:
 - 1. Pipe: 0 seconds
 - 2. Fittings: 80 seconds
- D. Maximum Extent of Burning:
 - 1. Pipe: 13 mm
 - 2. Fittings: 20 mm
- E. Wall Thickness:
 - 1. Schedule 40 wall thickness
- F. Manufacturers:
 - 1. Enfield Industrial Corp.
 - 2. Fuseal
 - 3. George Fischer
 - 4. Orion
 - 5. Zurn

2.3 JOINTS

- A. Connections Above Slab (That Are Accessible):
 - 1. Manufacturer/Model:
 - a. Enfield Mechanical Joint
 - b. Fuseal Mechanical Joint
 - c. Orion Mechanical Joint
 - d. Zurn Mechanical Joint
 - 2. Connections containing metal components are prohibited.
- B. Connections Below Slab (Or Connections Above Slab That Are Not Accessible):
 - 1. Manufacturer/Model:
 - a. Enfield Enfusion Joint
 - b. Fuseal II Fusion
 - c. Orion Rionfuse
 - d. Zurn Fusion Lock
- C. Connections Between PVDF and Other Types of Piping Material:
 - 1. Manufacturer/Model:
 - a. Pipe Manufacturer Adapters

2.4 SYSTEMS COMPATIBILITY

- A. All pipe, fittings, and electrofusion equipment shall be from the same manufacturer.

2.5 NEUTRALIZATION BASINS

- A. Material:

1. Polypropylene
 2. Manufacturers:
 - a. Enfield Industrial Corp IPEX
 - b. Fuseal
 - c. George Fischer
 - d. Orion
 - e. Zurn
- B. Provide as shown on drawings.
- C. Fill with limestone chips per manufacturer's recommendation.
- D. Install per construction document details.
- E. Provide and install cleanouts on both side of tank.
- 2.6 PIPING VOID SYSTEM FOR PIPING BELOW BUILDING
- A. Piping Void System: Plumbing contractor to provide PlumbingVoid System for all sanitary sewer piping under building. Plumbing contractor to coordinate with Geotech Company and PlumbingVoid System manufacturer for required system for soil expansion requirement.
- B. Comply with Geotech Report Soil Expansion Requirements to properly protect all piping below slab from damage due to heaving.
- C. Manufacturer:
 1. Void Form Products, LLC
- 2.7 3/8 INCH PEA CLEAN PEA GRAVEL FOR SCHEDULE 40 PVC PIPING BELOW SLAB
- A. Provide 3/8" clean pea gravel aggregate as backfill for all schedule 40 PVC piping below slab. Provide a minimum of 6 inches of pea gravel cover over pipe and under pipe. Compact to 85% to 95%.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with contract drawings, manufacturer's recommendations, and the local plumbing code.
- B. Install entire system free of stress and in proper alignment without strain.
- C. Supply necessary extension to install dilution basin at final grade level.
- D. Install vents in accordance with these specifications.
- E. Install hangers a minimum of 4 feet on center.
- F. Provide PVDF piping in all return air plenums.
- G. The manufacturer's certified installation trainer shall be on site for initial job start-up and must train and certify all installers per the manufacturer's installation procedures. Each installer must pass a written exam, make a test joint, and be issued a certification card that must be available for review at all times. Installers shall follow all manufacturers' recommendations regarding installation of their systems.
- H. Provide an inspector's port per the authority having jurisdiction and as noted on the construction documents.

3.2 TESTING

- A. Test the system in the same manner as the sanitary drain piping (see Section 22 13 17).

- B. Perform any further tests required by the local plumbing inspector.

END OF SECTION

SECTION 23 00 00

BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Basic mechanical requirements necessary to provide complete installation of all Division 23 work.

1.2 WORK INCLUDED

- A. This section of work comprises furnishing of all materials, equipment, tools, scaffolding, rigging, hoisting, labor, and transportation necessary for the complete installation of the mechanical systems as shown on the plans and as specified herein.
- B. Bidders shall determine the contents of a complete set of drawings and specifications and be aware that they may be bidding from a partial set of drawings, applicable only to the various separate contracts, subcontracts, or trades as may be issued for bidding purposes only. The contract documents and the complete scope of work for the project are illustrated on the combined Architectural, Structural, Plumbing, Heating, Ventilating, Air Conditioning, and Electrical, and each Bidder shall thoroughly acquaint himself with all the details of the complete set of drawings and specifications before submitting his bid. All drawings and specifications form a part of the contract documents for each separate contract and shall be considered as bound therewith in the event partial sets of plans and specifications are issued for bidding only. The submission of bids shall be deemed evidence of the review and examination of all drawings, specifications, and addenda issued for this project as no allowances will be made because of unfamiliarity with any portion of the complete set of documents.

1.3 CODES AND REFERENCE STANDARDS

- A. General:
 - 1. Perform all Division 23 work in strict accordance with the requirements and recommendations stated in all the latest editions of the applicable state codes, national building codes and local ordinances.
 - 2. Nothing in the Contract Documents shall be construed to permit work not conforming to these codes.
 - 3. When two or more codes or standards are applicable to the same work, then the stricter code or standard shall govern.
 - 4. The date of the code or standard that is in effect on the date of issue of the contract documents except when a particular publication date is specified.
 - 5. The Contractor shall be held responsible for verifying all local codes and ordinances that may alter any part of the plans or specifications. The Contractor shall bear all costs for correcting the deficiencies.
 - 6. Where local codes and ordinances are not in writing or on record, but a local precedence has been set, the Owner shall pay for any additional cost incurred.
- B. Applicable Codes and Standards for All Division 23 Work:
 - 1. International Building Code
 - 2. International Gas Code
 - 3. International Plumbing Code
 - 4. International Mechanical Code
 - 5. International Energy Conservation Code
 - 6. National Electrical Code
 - 7. American Society of Heating, Refrigerating and Air Conditioning Engineers Standards.
 - 8. Occupational Safety and Health Administration Standards:
 - a. OSHA Standard 2207 - Construction Industry Standards
 - b. OSHA 29 CFR 1926 - Regulation of Excavation
 - c. All other applicable standards

9. National Fire Protection Association:
 - a. NFPA 90A - Installation of Air Conditioning and Ventilating Systems
10. Clean Air Act and Clean Air Act Amendments
11. State Codes:
 - a. All other applicable codes
12. Local Municipal Codes and Ordinances

1.4 SCHEDULE OF ABBREVIATIONS

- A. Reference Standards are listed in Section 23 using abbreviations listed below:
1. AABC (NSTSB) - Associated Air Balance Council
 2. AASHTO - American Association of State Highway and Transportation Officials
 3. ADA - Americans with Disabilities Act
 4. ADC - Air Diffusion Council
 5. A/E - Architect/ Engineer
 6. AGA - American Gas Association
 7. AMCA (DIR) - Air Moving and Conditioning Association
 8. ANSI - American National Standards Institute
 9. AHRI - Air-Conditioning and Refrigeration Institute
 10. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
 11. ASME - American Society of Mechanical Engineers
 12. ASPE - American Society of Plumbing Engineers
 13. ASTM- American Society for Testing and Materials
 14. AWE - American Welding Society
 15. AWWA - American Water Works Association
 16. CGA - Compressed Gas Association
 17. CISPI - Cast Iron Soil Pipe Institute
 18. CS - Commercial Standard
 19. CSA - Canadian Standards Association
 20. DIPRA - Ductile Iron Pipe Research Association
 21. DOT - Department of Transportation
 22. DOC - Department of Commerce
 23. FCC - Federal Communications Commission
 24. FM - Factory Mutual
 25. FS - Federal Specification
 26. GSHPA - Ground Source Heat Pump Association
 27. IBC - International Building Code
 28. ITL - Independent Testing Laboratories
 29. NEC - National Electric Code
 30. NFPA - National Fire Protection Association
 31. NSF - National Sanitation Foundation
 32. OSHA - Occupational Safety and Health Administration
 33. PDI - Plumbing and Drainage Institute
 34. SMACNA - Sheet Metal and Air Conditioning National Association
 35. UBC - Uniform Building Code
 36. UL - Underwriters Laboratories

1.5 QUALITY ASSURANCE

- A. Provide complete installations of all systems.
- B. Furnish all items of equipment, material, and labor to complete the Contract even though each and every item necessary is not specifically mentioned or shown.
- C. In case of any conflict between the specifications, plans, and ordinances, the ordinances shall govern.
- D. All materials furnished under this Contract shall be new, free from defects of any kind, of the quality and design hereinafter specified, and shall conform to the standards of Underwriter's Laboratories Inc., except for equipment which U.L. does not list or provide label service.
- E. All mechanical equipment and fixtures shall be the same brand unless scheduled differently on plans.

- F. Contractor's Responsibility:
1. Contractor assumes all responsibility regarding the safety of his personnel on the project during construction.
 2. Erect barricades, protective fencing, and signs to prevent injury to personnel on site.
 3. Make permanent connection to utilities or existing lines. Determine depth and location, and bid accordingly.
 4. Relocate and repair any existing lines cut by general construction work.
 5. Pay all costs in connection with metering devices.
 6. Plans do not show exact location and elevations of lines, nor do they show all offsets required.
 7. Deviate from plans as required to conform to the general construction and provide proper grading.
 8. Maintain all utility services during construction to existing portions of job that remain.
 9. Procure and pay for all necessary permits or licenses to carry out the work.
 10. Obtain and pay for all the necessary certificates of approval which must be delivered to the Architect/Engineer before final acceptance of the work.
 11. Periodically remove rubbish, clean or repair all surfaces marred by the work required under this contract.
 12. Protect work from damage by other trades.
 13. Make all tests required by law; pay all costs in connection with the testing.
 14. Where job conditions require changes in indicated locations and arrangement, make such changes without extra cost to Owner.
 15. Provide motor starters, controls, relays, all low-voltage wiring, conduit and wiring related to HVAC and other equipment and devices to form a complete working system.

1.6 DEFINITIONS

- A. Approval:
1. It is understood that approval must be obtained from the Architect/Engineer in writing before proceeding with the proposed work.
 2. Approval by the Architect/Engineer of any changes, submitted by the Contractor will be considered as general only to aid the Contractor in expediting his work.
- B. Contractor:
1. The Contractor engaged to execute the work included in a particular section only, even though he may be technically described as a Subcontractor to the General Contractor.
 2. If the Contractor engaged to execute said work employs Sub-Contractors to perform various portions of the work included under this Section, he shall be held responsible for the execution of same, in full conformity with Contract Document requirements.
 3. The Contractor shall cooperate at all times and shall be responsible for the satisfactory cooperation of his Subcontractors with the other Contractors on the job so that all of the various phases of the work may be properly coordinated without unnecessary delays or damage to any parts of the work of any Contractor.
- C. Provide:
1. Defined as requiring the furnishing and installing of the item or facility indicated, complete in all respects, and ready for operation unless otherwise specifically noted.
- D. As Required:
1. Indicates that the Contractor shall perform the work or provide the material as indicated in accordance with manufacturer's installation instructions; and in accordance with applicable codes or regulations; and in a workmanlike manner as defined by good local practice.
- E. Or Equal:
1. Indicates that the Contractor may substitute equipment by another manufacturer if the salient features of the equipment indicated by manufacturer's name and/or described are, in the judgment of the Architect/Engineer, adequate. Submittals for approval are required where indicated.
- F. Intent of Contract Documents:
1. The specific intent of these documents is to provide to the Owner, in a thoroughly functional condition, all the various systems, equipment, etc., indicated herein. Final authority over interpretation of the "intent" shall rest with the Architect/Engineer.

1.7 WARRANTY

- A. The Contractor shall warranty his work against defective materials and workmanship for a period of one year from the date of acceptance of the job.
- B. Neither the final payment nor any provisions in Contract Documents shall relieve the Contractor of the responsibility for faulty materials or workmanship.
- C. He shall remedy any defects due thereto, and pay for any damage to other work resulting therefrom, which shall appear within a period of one year from date of substantial completion.
- D. The Owner shall give notice of observed defects with reasonable promptness.
- E. This Guarantee shall not be construed to include the normal maintenance of the various components of the system covered by these specifications.

1.8 SITE VISIT

- A. Before submitting his proposal, each bidder shall examine all plans and specifications relating to the work, shall visit the site of the project and become fully informed of the extent and character of the work required.
- B. No consideration will be granted for any alleged misunderstanding of the materials to be furnished or the amount of work to be done, it being fully understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying plans or required by nature of the site of which may be fairly implied as essential to the execution and completion of any and all parts of the work.

1.9 PROJECT RECORD DOCUMENTS

- A. The Contractor shall keep a set of plans on the job, noting daily all changes made in connection with the final installation including exact dimensioned locations of all new and uncovered existing utility piping outside the building.
- B. Upon submitting his request for final payment, he shall turn over to the Architect/Engi, for subsequent transmittal to the Owner, a clean, neatly marked set of reproducible plans showing "as installed" work and an electronic file with changes of materials.
- C. In addition to the above, the Contractor shall accumulate during the job's progress the following data, in duplication (2 each), prepared in 3 ring binders of sufficient size, black in color, neat in appearance, and turned over to the Architect/Engineer for checking and subsequent delivery to the Owner. Electronic copies of the following are also acceptable, but they must be saved to a single flash drive or external hard drive:
 - 1. All warranties, guarantees, and manufacturer's directions on equipment and material covered by the Contract.
 - 2. Approved fixture brochures.
 - 3. Copies of approved shop drawings.
 - 4. Set of operating instructions. Operating instructions shall also include recommended maintenance and seasonal changeover procedures.
 - 5. Any and all other data and/or plans required during construction.
 - 6. Repair parts lists of all major items and equipment including name, address, and telephone number of local supplier or agent.
- D. The first page, or pages, shall have the names, addresses, and telephone numbers of the following:
 - 1. General Contractor and all sub-contractors.
 - 2. Major Equipment Suppliers.

1.10 TRAINING

- A. Upon completion of the work and at a time designated by the Owner's representative, provide a formal training session for the Owner's operating personnel to include location, operation, and maintenance of

all mechanical equipment and systems, some sections have further instructions.

- B. Before proceeding with instruction, prepare a typed outline in triplicate listing the subjects that will be covered. Submit the outline for review by the Owner's representative.
- C. At the conclusion of the instruction, obtain the signatures of the attendees on each copy of the outline to signify that they have a proper understanding of the operation and maintenance of the system. Submit the signed outlines to the Owner's representative and Engineer as a condition of final acceptance.

1.11 PLANS AND SPECIFICATIONS

- A. The plans show diagrammatically the locations of the various lines, ducts, conduits, fixtures, and equipment and the method of connecting and controlling them.
- B. It is not intended to show every connection in detail and all fittings required for a complete system.
- C. The systems shall include but are not limited to the items shown on the plans.
- D. Exact locations of these items shall be determined by reference to the general plans and measurements of the building and in cooperation with other contractors, and in all cases, shall be subject to the approval of the Architect/Engineer.
- E. The Architect/Engineer reserves the right to make any reasonable change in the location of any part of this work without additional cost to the Owner.
- F. Contractor, subcontractor, vendors, and suppliers are required to waive subrogation against Owner and Engineer.

1.12 UTILITIES, LOCATIONS, AND ELEVATIONS

- A. Locations and elevations of the various utilities within the scope of this work have been obtained from the City and/or other substantially reliable sources and are offered separately from the Contract documents, as a general guide only, without guarantees as to accuracy.
- B. The Contractor shall examine the site, shall verify to his own satisfaction the locations, elevations and availability of all utilities and services required, and shall adequately inform himself as to their relation to the work; the submission of bids shall be deemed evidence thereof.
- C. The Contractor shall coordinate all services with the Utility Companies during construction, coordinate changes made by Utility Companies to the design of project, and coordinate with the Owner, Architect/E, and Utility the scheduling of any shutdowns or delays that may occur in providing service.
- D. The Contractor shall verify location, conduct all necessary tests, inspections, coordinate with Owner's representatives and utilities, and check for existing underground utilities and lines before ditching.
- E. The Contractor shall be responsible for repair of any cut or damaged lines or utilities he uncovers. There are lines and utilities not shown on any plans.

1.13 SUBSTITUTION OF PRODUCTS

- A. Substitution of products specified herein will be considered only when a complete list of proposed alternative equipment is submitted to the Engineer in writing, supported by adequate technical and cost data. This includes a complete description of the proposed substitution, drawings, catalog cuts, performance data, test data, or any other data or information necessary for evaluation.
- B. All proposed substitutions and data must be received by the Engineer no less than seven working days prior to the scheduled date for opening of bids.
- C. The Engineer will consider all such submittals and the Architect/Engineer will issue an addendum listing items which the Engineer considers acceptable. Only such items as specified or approved as acceptable will be installed on this project.

- D. Manufacturers` names are listed herein and on the plans to establish a standard of quality and design. Where a manufacturer`s name is mentioned, products of other manufacturers will be acceptable, if, in the opinion of the Engineer, the substitute material is of equivalent quality or better than that of the material specified.
- E. The Contractor`s Bid represents that the bid price is based solely upon the materials and equipment described in the Bid Documents (including addenda, if any) and that he contemplates no substitutions or extras.
- F. Requests for substitution are understood to mean that the Contractor:
 - 1. Has personally investigated the proposed substitution and determined that it is equal or superior in all respects to that specified.
 - 2. Will provide the same guarantee for the substitution that he would for that specified.
 - 3. Will, at no cost to the Owner, replace the substitute item with the specified product if the substitute item fails to perform satisfactorily.
 - 4. After Award of the Contract, substitutions will be considered only under one or more of the following circumstances:
 - a. The substitution is required for compliance with subsequent interpretations of code or insurance requirements.
 - b. The specified product is unavailable through no fault of the Contractor.
 - c. The manufacturer refuses to warranty the specified products as required.
 - d. Subsequent information that the specified product is unable to perform properly or to fit in the designated space.
 - e. In the Engineer`s sole judgment, the substitution would be in the Owner`s best interest.
 - 5. Revisions to the mechanical system shall be under the supervision of the Engineer at a standard hourly rate charged by the Engineer and shall be paid by the Contractor originating the changes.

1.14 PROTECTION OF EQUIPMENT AND MATERIALS

- A. Contractor shall continuously maintain adequate protection of both stored and installed materials and equipment. Fixtures and equipment, whether located inside or outside, shall be tightly covered with sheet polyethylene or waterproof tarpaulin as protection against dirt, rust, moisture and abuse from other trades. Adequate air circulation shall be provided under any protective sheet to prevent condensate build up. Materials and equipment shall not be stored directly on the ground, floor or roof deck. Ductwork, piping and equipment shall not be used by other trades as supports for scaffolds or personnel. At the completion of the work, equipment, fixtures, exposed supports and piping shall be cleaned of dirt, construction debris, overspray, etc., to the satisfaction of the Architect/Engineer. Repairs made necessary by damage shall be paid for by the Contractor.
- B. Contractor in performing his work shall take particular care not to damage the structure. All finished floors and step treads shall be covered to prevent any damage by workmen or their tools and equipment during the construction of the building. In addition, each Contractor shall protect any materials on the job site whether a part of this contract or the property of another Contractor.
- C. Contractor shall be responsible for damage to project caused by this Contractor's failure to recognize hazards associated with items such as leaks, scheduling of work, inexperienced workmen, excessive cutting, etc.
- D. Contractor shall familiarize himself with working conditions to the extent that he shall be responsible for damage to concealed piping, wiring and other equipment to remain and shall repair any damage caused by his negligence at no cost to the Owner.
- E. The Contractor shall take such precautions as may be necessary to properly protect his apparatus from damage.
- F. This shall include the creation of all required temporary shelters to adequately protect any apparatus above the floor of the construction and the covering of apparatus in the completed building with tarpaulins or other protective covering.

- G. Failure to comply with the above to the satisfaction of the Owner's inspector will be sufficient cause for the rejection of the equipment in question and its complete replacement by this Contractor.
- H. All apparatus shall be cribbed up from the floor or ground by the Contractor and covered with tarpaulins or other protective covering where necessary or directed.
- I. Each contractor shall provide space for storage of materials, equipment or tools at ground level. Any storage contemplated within the building will be allowed only upon specific approval of the Architect/Engineer.

1.15 FINAL INSPECTION

- A. It shall be the duty of this Contractor to make a careful inspection trip of the entire project, assuring himself that the work on the project is ready for final acceptance before calling upon the Architect/Engineer to make a final inspection.
- B. To avoid delay of final acceptance of the work, the Contractor shall have all necessary bonds, warranties, receipts, affidavits, etc., called for in the various articles of these specifications, prepared and signed in advance, together with a letter of transmittal, listing each paper included, and shall deliver the same to the Architect/Engineer at or before the time of said final inspection. The Contractor is cautioned to check over each bond, receipt, etc., before preparing for submission to verify that the terms check with the requirements of the specifications.

1.16 ASBESTOS

- A. No asbestos or asbestos containing materials shall be permitted in this project.

1.17 CUTTING AND PATCHING

- A. All Subcontractors shall notify the General Contractor sufficiently ahead of construction of any floors, walls, ceiling, roof, etc., of any openings that will be required for his work.
- B. He shall see that all sleeves required for his work are set at proper times so as to avoid delay of the job.
- C. All necessary cutting of walls, floors, partitions, ceilings, etc., as required for the proper installation of the work under this Contract shall be done at the Subcontractor's expense in a neat and workmanlike manner, and as approved by the Architect/Engineer.
- D. No joists, beams, girders, or columns shall be cut by any Contractor without first obtaining written permission of the Architect/Engineer.
- E. Patching of openings and/or alterations shall be provided by the General Contractor.
- F. All openings in firewalls and floors shall be completely sealed after installation for a completely airtight installation. Sealing material shall be non-combustible and UL approved. The installed sealing assembly shall not cause the fire rating of the penetrated structure to be decreased.
- G. All openings in exterior walls shall be sealed watertight.

1.18 MANUFACTURER'S INSTRUCTIONS

- A. All equipment and devices shall be stored, protected and installed in accordance with these plans and specifications, manufacturer's instructions, and applicable codes.
- B. Where specifications call for installation of a product to be in accordance with manufacturer's instructions and/or where manufacturer's instructions are required for installation of a product, it shall be the contractor's responsibility to obtain the necessary applicable manufacturer's instructions and install the product in accordance with the manufacturer's instructions.
- C. It shall be the Contractor's responsibility to install all equipment, materials, and devices shown on the plans and as called out in these specifications even if manufacturer's instructions are absolutely

unattainable.

- D. Any such work performed that does not comply with the manufacturers' directions shall have deficiencies corrected at no cost to the Owner.

1.19 RELATED WORK

- A. Whether specifically identified or not, it is the responsibility of the Mechanical Contractor to coordinate all mechanical work with all related trades.

1.20 ELECTRICAL WIRING AND EQUIPMENT FOR MECHANICAL SYSTEMS

- A. All wiring, conduit, boxes, equipment (controls, thermostats, relays, contactors, motor starters, heaters, switches), and any other control devices or equipment required to form a complete and properly operating system, shall be the responsibility of the Mechanical Contractor.
- B. The Electrical Contractor shall only provide line voltage (including hook-up) to all mechanical equipment.
- C. All mechanical controls and devices shall be low voltage unless otherwise noted or shown on the plans. Where line voltage controls or devices are noted, the Contractor shall provide complete wiring diagrams (approved by the Engineer) to the Electrical Contractor prior to final hook-up.
- D. All electrical resistance heating elements which are scheduled to be served by three-phase electrical power shall impose an equal electrical load on all phases. Electrical resistance elements which are not balanced over all three phases are not acceptable.
- E. The Mechanical and Electrical plans are based on the equipment and devices scheduled as shown on the plans or as called for in the specifications. Should any mechanical equipment or device be changed or approved from those which are shown or noted, all electrical and/or mechanical changes shall be made at the expense of the trade or contractor initiating the change with no expense to the Owner, Architect, Engineer or their representatives.
- F. All wiring provided by this Contractor shall be installed in a workmanlike manner using tie wraps, labels, anchors and etc. Loose wiring is not acceptable.
- G. All conduit and boxes required in all walls for control purposes (thermostats, etc.) shall be provided by electrical contractor. All conduit required in attic, clear spaces, or on roof shall be by mechanical contractor.

1.21 DEMOLITION AND REMODEL

- A. It shall be the responsibility of this Contractor to see that all demolition and remodeling work involving his trade (including but not limited to chilled and hot water piping used for space cooling and heating, condensate lines, air handlers, mechanical equipment, etc.) is accomplished in a manner and completeness to provide the appearance of new construction work.
- B. Abandoned air conditioning units shall be removed and disposed of off-site in a legal manner.
- C. Any usable equipment and/or structure damaged during demolition and remodel work shall be replaced.
- D. All abandoned and/or otherwise unused piping shall be securely capped using materials of the same composition as the original piping.
- E. No exposed piping and/or other materials will be permitted in the finished job.
- F. Any abandoned piping which penetrates the slab in an exposed area shall be securely capped below the slab.

1.22 OPERATION PRIOR TO COMPLETION

- A. When any piece of mechanical or electrical equipment is operable and the Contractor needs to operate the equipment, he may do so providing that he properly supervises the operation.

- B. The warranty period shall, however, not commence until such time as the equipment is operated for the beneficial use of the Owner.
- C. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, install clean filter media, properly adjust and complete all punch list items before final acceptance by the Owner.
- D. The date of acceptance and the start of the warranty may not be the same date.

1.23 SAFETY GUARDS

- A. Contractor shall furnish and install all safety guards required. All belt driven equipment, projecting shafts, and other rotating parts shall be enclosed or adequately guarded.

1.24 FLAME SPREAD PROPERTIES OF MATERIALS

- A. All materials and adhesives used for air conditioning filters, acoustical lining, and insulation shall conform to NFPA and UL life and flame spread properties of materials.
- B. The composite classifications shall not exceed the flame spread rating and the smoke development rating as outlined by NFPA 255/ ASTM E-84 for the basic material, the finishes, adhesives, etc., specified for each system, and shall be such when completely assembled.

1.25 FILTER ASSEMBLIES

- A. All filter housings and assemblies shall be factory built and supplied with the unit. A separate filter rack may be required and is the responsibility of the mechanical contractor to provide.
- B. Access doors (panels) must be opened to change the air filters shall be labeled "Filter Access" and the number and size of required filters shall be identified.
- C. No piping conduit etc. shall be installed in front of this access door.
- D. Install clean filters prior to substantial completion.
- E. All air handlers shall have filters installed upstream of all coils.

1.26 LEAD MATERIALS

- A. No lead or lead containing materials shall be allowed in any domestic or potable water supply piping, valves, fixtures, components, equipment, or any other item.

1.27 REFRIGERANTS

- A. Chlorofluorocarbons (CFCs) and Hydrochlorofluorocarbons (HCFCs) shall not be allowed in any equipment on this project.
- B. Comply with ASHRAE Standards 15 and 34.

1.28 REFRIGERANT RECOVERY AND RECYCLE

- A. Refrigerants shall not be released to the environment.
- B. Contractor shall provide recovery and recycle equipment that has been certified by the Electrical Testing Laboratories or Underwriters Laboratories.
- C. Contractor shall also provide properly trained and certified (in accordance with EPA) personnel for refrigerant work during installation, demolition, start-up, servicing, etc.

1.29 ACCESS CLEARANCE

- A. Proper access to all installed equipment shall be provided. The Mechanical Contractor shall label all points of access immediately upon installation with a marker pen.
- B. A minimum of 3 feet shall be maintained in front of all access points.
- C. If another trade violates this space, the Mechanical Contractor shall immediately notify the General Contractor to correct this condition.
- D. When equipment is installed above lay-in ceiling the Mechanical Contractor shall coordinate with the Ceiling Contractor to provide access without removing part of T-bar ceiling.
- E. No speakers, lights, fire alarm equipment, etc. shall be installed in lay-in ceiling tiles where access is to be gained.

PART 2 PRODUCTS

2.1 MATERIALS

- A. All materials shall be new and free from defects at the time of installation. Materials or equipment damaged in shipment or otherwise damaged prior to installation shall not be repaired at the job site, but shall be replaced with new.

2.2 MANUFACTURERS REQUIREMENTS

- A. When a manufacturer's name appears in these specifications, it is not to be construed that the manufacturer does not have to meet the full requirements of the specifications or that his standard cataloged item will be acceptable.

PART 3 - EXECUTION

3.1 CONFLICTS, INTERFERENCES AND COORDINATION BETWEEN TRADES

- A. Drawings are not to be construed as shop drawings, but indicate the extent, general location, arrangement, etc., of piping systems and equipment. This Contractor shall refer to other sections of the specifications and other drawings such as electrical, structural, architectural, etc., in order to eliminate conflicts and undue delays in the progress of the work. Where other Contractors furnish items requiring piping connections by this Contractor, they will be held responsible for providing roughing-in drawings and assistance upon request.
- B. Each trade shall so harmonize its work with that of the other trades so that the work may be done in the most direct and workmanlike manner without hindering the other trades. Piping interference shall be handled by giving precedence to pipelines which require a stated grade for proper operation.

3.2 TESTING

- A. After all mechanical systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequence and operation throughout the range of operation regardless of the season the contractor shall test all HVAC equipment in both heating and cooling modes.
- B. Each and every phase of the new air conditioning, heating, and ventilating systems shall be operated separately, or in conjunction with the other, for a period of time, to demonstrate to the satisfaction of the Architect/Engineer the ability of the equipment to meet the capacity and performance requirements while maintaining design conditions in accordance with the true intent and purpose of these specifications.
- C. Previous to such performance tests, the Contractor shall have set all valves, dampers, motors, controllers, thermostats, etc., and shall have the system operating and maintaining design temperatures, humidity, and air circulation throughout all areas of the building.
- D. Make adjustments as required to ensure proper functioning of all systems.

- E. Special tests on individual systems are specified under individual sections.
- F. See Section 23 05 93 for Testing, Adjusting, and Balancing for HVAC.

END OF SECTION

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SECTION 23 00 90

HVAC SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section supplements Division 01 Submittal Procedures and contains additional requirements applicable to Division 23 submittals.

1.2 SECTION INCLUDES

- A. This section includes, but is not limited to:
 - 1. HVAC submittal procedures
 - 2. This section applies only to the Division 23 specifications. Submittals required by other specification divisions are not included here, even though the same subcontractor may be providing work under other divisions.

1.3 RELATED SECTION

- A. Division 01 - Submittal Procedures

1.4 DEFINITIONS

- A. Product Data: Illustrations, standard schedules, performance charts, instructions, and brochures furnished by the contractor, subcontractor, manufacturer, or supplier to illustrate materials or equipment or to illustrate some portion of the work. Provide a summary of scheduled items with all data in schedules.
- B. Shop Drawings: Drawings, diagrams, schedules, and other data specifically prepared for the work by the contractor, subcontractor, manufacturer, or supplier to illustrate some portion of the work.
- C. Equipment/Material Submittal Package: A compilation of the product data, shop drawings, and other items as required by the specifications, submitted near the start of the work. Typically, the specifications require the initial submittal package to be submitted within a certain number of days after the work starts.
- D. Quality Assurance Submittal: Items submitted before and during the execution of a particular portion of the work for the purpose of guarding against defects and deficiencies.
- E. Quality Control Submittal: Items submitted at the completion of a particular portion of the work for the purpose of evaluating completed activities and elements of the work for conformance with contract requirements (e.g. start-up reports).
- F. Closeout Submittals: Items submitted at or near the completion of the contract.

1.5 SUBMITTALS

- A. The materials, workmanship, design, and arrangement of all work installed under this contract shall be subject to the review of the architect, engineer, and owner. Review of shop drawings and/or submittal data shall not relieve the Contractor of responsibility for deviations from the contract drawings or specifications.
- B. Manufacturers: Manufacturers submitted shall be as per the acceptable manufacturers listed in each specification section or referenced schedule.
- C. Required Submittals: All material, components and equipment that fall under Division 23 shall be submitted.

- D. Contractor's Coordination Submittals: The contractor may require his subcontractors to provide drawings, setting diagrams, and similar information to help coordinate the project, but such data shall remain between the contractor and his subcontractors and will not be reviewed by the engineer.
- E. Electronic Submittals: E-mail or other electronic forms of submittals from the contractor are required. The procedures described in this section shall be as follows:
 - 1. The contractor shall supply one electronic copy of the submittal.
 - 2. The electronic files will either be e-mailed to the architect or posted to a project management and information exchange website, depending on the architect's requirements. The architect and contractor can distribute copies of the files as desired.
 - 3. The engineer will retain an electronic copy of the submittal and all responses.
- F. Coordination Correspondence: The contractor may desire to verify the acceptability of a particular item prior to assembling the initial submittal package. The contractor may send material directly to the engineer for comments and feedback. This communication will be treated as normal coordination correspondence and will not be tracked or documented as a formal submittal. The engineer may or may not respond to such correspondence. If the engineer agrees, in writing, to the use of a particular item, then that same material shall be included in the initial submittal package along with a copy of the correspondence.
- G. Unapproved Products: If materials or equipment are installed before being reviewed by the engineer, the contractor shall be liable for the removal and replacement of such unapproved materials and equipment, at no additional expense to the owner. Additionally, if the removal and replacement of rejected materials or equipment necessitates the removal and replacement of other related materials or equipment, then the contractor shall be liable for the removal and replacement of the related materials and equipment at no additional expense to the owner.
- H. Product Data: Where the content of manufacturer submittal literature includes data not pertinent to the submittal, clearly indicate which portions of the contents are being submitted for review. Catalogs, pamphlets, or other documents submitted to describe items on which review is being requested shall be specific and identifications in catalogs, pamphlets, etc., of items submitted shall be clearly made in a contrasting ink or highlighting. Data of a general nature shall not be acceptable.
- I. Shop Drawings:
 - 1. Contractor shall submit shop drawings showing all piping, ductwork and equipment shown by drawings and specification. Submit drawings on all mechanical rooms and congested areas. The drawings shall be coordinated with structural, electrical and fire sprinkler drawings. Submit prior to construction of work.
 - 2. Scale and measurements: Make shop drawings accurately to a scale sufficiently large to show all pertinent aspects of the item.
 - 3. Electronic shop drawing submittals are required.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 SUBMITTALS

- A. Make submittals of product data, shop drawings, samples, quality assurance submittals, quality control submittals, and other items in accordance with the requirements of this section, applicable sections in Division 23, and additional requirements of each individual Division 23 specification section.
- B. Grouping of Submittals:
 - 1. The submittal package shall be coordinated and included in a single submission. Multiple submissions are not acceptable except where prior written approval has been obtained from the engineer. Partial submittals may be rejected, without being reviewed, as not complying with the provisions of the contract.

2. In the case that multiple submissions are approved, it is the responsibility of the contractor to maintain and update a submittal checklist. The contractor shall ensure that all applicable submittal sections are submitted to the Engineer. If a submittal section is not submitted, it will be considered rejected until reviewed by the Engineer.
 3. If submittal sections are submitted as individual submittal files, the submittal sections will be grouped and returned as one file with one set of submittal responses.
- C. Electronic Submittal Organization:
1. Electronic submittals are to be submitted as a single PDF file. Within the PDF file, each section shall be bookmarked.
 2. Provide an electronic submittal cover sheet that lists at least the following:
 - a. Project name
 - b. Date
 - c. Name and address of architect
 - d. Name and address of engineer
 - e. Name, address, and telephone number of prime contractor
 - f. Name, address, and telephone number of HVAC contractor
 - g. Name, address, and telephone number of HVAC supplier
 3. Provide an electronic index sheet listing all items submitted.
 4. The contractor shall call to the attention of the engineer, clouded in the submittal and noted after the index sheet, any instance in which the submittals are known to differ from the requirements of the contract documents.
 5. Organize all required items by specification section. The material for each specification section shall be organized as follows:
 - a. Provide an electronic section cover sheet that lists the same information as the submittal cover sheet, plus the specification number and title and the name, address, and telephone number of the vendor or vendor's representative, if applicable.
 - b. Refer to the individual Division 23 specification sections for any required organization of the submittal material within each submittal section.
 - c. Bookmarked sections shall be arranged by specification section number in numerical order.
 - d. Submit in accordance with these procedures and procedures described in Division 01 Submittal Procedures.
 - e. Submittals not organized as described here may be rejected, without being reviewed, as not complying with the provisions of the contract.
- D. Response to engineer's review:
1. Review comments: Review comments of the engineer will either be shown on the returned sets to the contractor or shown on a document attached to the sets. If the comments are on an attached document, then the engineer will place a note on the submittal referring to the attached comments. In such cases, the engineer's signature will appear only on the attached document. If the attached, signed document becomes physically separated from the submittal, then the submittal will no longer be considered as being a reviewed submittal.
 2. Complete rejection: If the submittal is not complete or does not meet the requirements of this specification section, then the engineer may reject the entire submittal and return the submittal without further review or comment. In such cases, the entire submittal shall be completely revised and resubmitted. The resubmittal shall be given a new submittal number and shall be documented and processed as a separate submittal from the original.
 3. Held for completion: If the submittal is not complete, but is only missing some minor item, the engineer may, at the engineer's sole discretion, hold the submittal rather than rejecting and returning the submittal. In such cases, the engineer will notify the architect and contractor that the submittal is being held for completion. The contractor will be given a predetermined amount of time to provide the missing item. Upon receipt of the missing item, the engineer will insert the missing item into the submittal package and proceed with the review process.
 4. Partial rejection: The engineer may reject only certain portions of the submittal. In such cases, only those rejected portions or items need to be revised and resubmitted.
 5. Provide as noted and corrected: The engineer may note a required change to a submitted item, but may not consider the change serious enough to require a resubmittal. In such cases, the engineer will note that the item is to be provided as noted or corrected. In such cases, the contractor may proceed to provide the item. However, if subsequent observations reveal that the noted change was not made, then the contractor shall be liable for removal and replacement of the item at no

- additional cost to the owner.
6. Reviewed without comment: The contractor may proceed to provide all materials and equipment as submitted.
- E. Close-out Submittals:
1. Provide close-out submittals and O&M's at or near completion of the contract.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Isolation pads
- B. Concrete bases
- C. Expansion joints
- D. Refrigerant Piping supports
- E. Other supports

1.2 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 31 13 - Metal Ductwork
- C. Section 23 34 16 - HVAC Fans

1.3 SUBMITTALS

- A. Product Data:
 - 1. Provide submittal data on all items specified in this section in accordance with Section 23 00 90, General Conditions, and Division 1.
 - 2. Submit shop drawings and catalog data with locations of use.

1.4 REFERENCES

- A. Refer to Section 23 00 00 for complete names of references identified in this section.
- B. SMACNA Standards
- C. ASHRAE - American Society of Heating, Refrigeration and Air Conditioning Engineers

1.5 QUALITY ASSURANCE

- A. Isolation devices must be provided by a company whose sole business is to provide isolation equipment.
- B. All equipment and materials to be installed in workmanlike manner by experienced mechanics and as recommended by the manufacturers.
- C. Design Data: Complete design of isolation equipment including confirmation that no noise will be transmitted to structure of building.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide isolation and support devices as required for all mechanical equipment.

2.2 MANUFACTURERS

- A. Amber/Booth
- B. Anvil
- C. Kenetics
- D. Korfund Vibration Mountings
- E. Mason
- F. Peabody
- G. Vibro Acoustics

2.3 FLEXIBLE DUCT CONNECTIONS

- A. Use "Ventglas" fabric, fireproof, waterproof, and mildew resistant, approximately 30 ounces per square yard.
- B. Comply with SMACNA standards.

2.4 HVAC PIPE SUPPORTS

- A. Hangers:
 - 1. All Copper Piping
 - a. Copper plated ferrous hangers.
 - 2. 2" and smaller piping in walls:
 - a. May be split cast ring type with fastening device in walls and chases.
 - 3. Trapeze Hangers for Multiple Pipes
 - a. Steel channels with welded spacers and hanging rods
 - 4. All Other Above Ceiling Locations:
 - a. Adjustable clevis type. Hangers to accommodate circumference of pipe and saddles.
- B. Vertical Supports:
 - 1. Wall support for 3" or smaller diameter pipe:
 - a. Cast iron hooks
 - 2. Wall support for 4" or larger diameter pipe:
 - a. Welded steel bracket and wrought steel clamp
- C. Floor Supports:
 - 1. Cast iron adjustable pipe saddle, lock, nut, nipple, floor flange, concrete pier or steel support
- D. Hanger Rods:
 - 1. Type:
 - a. Minimum 3/8 inch diameter with machine threads.
- E. Minimum Steel Hanger Rod Diameter for Individually Suspended Horizontal Pipes:
 - 1. 2" and smaller diameter pipe:
 - a. 3/8"
 - 2. 2-1/2" to 3-1/2" diameter pipe:
 - a. 1/2"
 - 3. 4" diameter pipe:
 - a. 5/8"
 - 4. 5" to 6" diameter pipe:
 - a. 3/4"
 - 5. 8" to 12" diameter pipe or larger:
 - a. 7/8"

2.5 SLEEVES

- A. Application:
 - 1. Provide sleeves for all pipes and conduits which pass through a concrete slab, masonry wall/concrete wall, roof, or other portion of the building structure. Each pipe and duct, regardless of material, which passes through a concrete slab, masonry wall, roof or other portion of the building structure shall be free from the structure and shall pass through a sleeve.
 - 2. After installation of pipe and duct through sleeves, all sleeves shall be sealed with materials suitable for maintaining thermal resistance, acoustic properties, and weatherproofing of walls, roofs, etc.
- B. Above Grade and/or dry locations:
 - 1. Material:
 - a. 18 gauge galvanized steel.
 - 2. Size:
 - a. As necessary to allow free passage of the insulated pipe.
- C. Passing through fire-rated enclosures:
 - 1. Material:
 - a. Fire stopped using approved materials to maintain the fire rating of the structure
 - b. Galvanized or black steel pipe.
 - c. Non-combustible.
 - d. PVC will not be allowed.

PART 3 - EXECUTION

3.1 ISOLATION DEVICES AND PAD INSTALLATION

- A. Install isolation pads between floor and equipment pads according to manufacturer's recommendations and approved shop drawings.
- B. Install flexible duct connections where ducts connect to fans or air handling units.
- C. All joints to be airtight.
- D. Provide a minimum of 1/2" slack in connections, and a minimum of 2 1/2" distance between the edges of ducts.
- E. Comply with recommendations of ASHRAE for the selection and application of vibration materials and units.

3.2 SECURING AND SUPPORTING OF HVAC PIPING

- A. Support all pipe from the building structure by means of approved hangers and supports while maintaining required grade and pitch, preventing vibration and providing for expansion and contraction.
- B. Secure all hangers to approved inserts wherever possible.
- C. Set hanger inserts in place when the concrete is poured.
- D. If Joists Are Used for Attachment:
 - 1. 2" diameter or smaller:
 - a. May be attached to the bottom of joists.
 - 2. Greater than 2" diameter:
 - a. Must be attached to the top cord of the joists.
 - 3. Do not support any piping and trapeze hangers from joist bridging on roof and floor deck.
- E. If Structural Steel Framing Is Used for Attachment:
 - 1. Use approved beam clamps.
 - 2. Where required, install channels to span between framing members.
 - 3. Do not attach hangers to the roof deck or cross bracing.

- F. Hanger Spacing:
1. Schedule 40 Black Steel Piping (Chilled water/ Hot water piping):
 - a. 1/2" diameter pipe → 5'-0" or less
 - b. 3/4" diameter pipe → 6'-0" or less
 - c. 1-1/4" diameter pipe → 8'-0" or less
 - d. Vertical:
 - 1) Every Floor Level Minimum
 - 2) Adequately support at their bases, either by a suitable hanger placed in the horizontal line near the riser, or by a base fitting set on a pedestal or foundation.
 - 3) Support from each floor slab by means of an approved clamp-type support which bears on the slab or beam.
 2. Copper Piping (Refrigerant Piping):
 - a. Smaller Than 1 1/4" → 6'-0" or less
 - b. 1 1/2" and Larger → 8'-0" or less
 - c. Vertical → 10'-0" or less
- G. Change of Direction:
1. Install supports within two feet of change of direction.
 2. Brackets of approved type may be used along the walls.
 3. Install hangers within 2 feet of each change in vertical or horizontal direction, pipe tees and on each side of valves, strainers, etc.
 4. Multiple horizontal pipes, smaller than 12" diameter pipe, may be supported on trapeze hangers. Space trapeze hangers in accordance with the schedule for pipe spacing based upon the smallest size pipe.
 5. Properly size the trapeze members for the piping load they are to support. The number of pipes on the trapeze must be approved by the Engineer to prevent overloading of the building structure.
 6. Where pipes are insulated, oversize the hanger accordingly to accommodate the outside diameter of the insulation. Provide half-round 16 gauge galvanized steel shields, not less than 12" long and rolled to fit the insulation diameter, between the insulation and the hanger.
 7. When pipe is guided at top and bottom, cover the entire pipe circumference with metal shields.
 8. Adhere metal shield to the insulation so that the metal will not slide with respect to the insulation.
 9. Wood struts shall not be used to support piping in walls.

3.3 SLEEVES

- A. Above Grade and/or Dry Locations:
1. Walls:
 - a. Mount flush on both sides.
 2. Floors:
 - a. Mount 2 inches above finished floor in pipe chases.
- B. Passing Through Fire-Rated Enclosure:
1. Fill the void space around the pipe in accordance with NFPA requirements.
 2. Do not allow the sleeve installation to lower the fire rating of the assembly.

END OF SECTION

SECTION 23 05 32

ROOF CURBS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Roof curbs for rooftop packaged HVAC units, exhaust fans, and supply fans.
- B. Steel Housing for storm shelter duct penetrations

1.2 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 34 16 - HVAC Fans
- C. Section 23 81 19 - Packaged HVAC Units

1.3 REFERENCES

- A. ASTM D4586 - Fibrated Asphalt Roof Cement

1.4 SUBMITTALS

- A. Product Data:
 - 1. Submit manufacturer's product data sheets, including installation instructions, in accordance with Section 23 00 90, General Conditions, and Division 01.
 - 2. Submit with equipment that curb is used with.
- B. Shop Drawings:
 - 1. Submit for prefabricated equipment supports in accordance with Section 23 00 90, General Conditions, and Division 01.

PART 2 - PRODUCTS

2.1 ROOF CURB MANUFACTURERS FOR ALL HVAC UNITS:

- A. HVAC unit manufacturer (OEM)
- B. TECO Metal Products
- C. ThyCurb
- D. Rooftop Systems
- E. RPS Curbs
- F. Curbs Plus
- G. Acme Manufacturing
- H. Kinetics
- I. Vibro-Acoustics
- J. Bimobject - Storm Shelter Vault

2.2 ROOF CURBS FOR ROOFTOP PACKAGED HVAC UNITS, EXHAUST AND SUPPLY FANS

- A. Insulated and Non-insulated Roof Decks:
1. Type - Prefabricated insulated curb.
 2. Material - Minimum 18 gauge prime galvanized steel.
 3. Construction:
 - a. Designed to meet local wind zone load/rating
 - b. Designed to support full weight of equipmen.
 - c. Internal liner or double shell
 - d. Seal between bottom of unit and curb with gasket.
 - e. Factory welded or hinged corners.
 - f. Internally reinforced
 - g. Factory installed 1" x 4" treated wood nailers fastened from the underside with TEK screws.
 - h. Top of all curbs to be level with pitch built into the curb when deck slopes $\frac{1}{4}$ " per foot or greater.
 - i. Full perimeter curbs only.
 - j. Curbs higher than 18" and curbs for sloped roofs shall have factory welded corners.
 4. Height - 18 inches above the roof deck or as shown on plans.
 5. Fiberglass Insulation:
 - a. Thickness - 1 $\frac{1}{2}$ inches
 - b. Density - 3 lbs.
 - c. Factory installed
- B. Roof Curbs For Single-Ply Roofing:
1. Type - Prefabricated insulated curb.
 2. Material - Minimum 18 gauge prime galvanized steel.
 3. Construction:
 - a. Designed to meet local wind zone load/rating
 - b. Designed to support weight of equipment.
 - c. Internal liner or double shell
 - d. Welded corners and seams joined by continuous welds.
 - e. Internally reinforced.
 - f. Factory-installed 2" x 4" treated wood nailers fastened from the underside with TEK screws.
 - g. Top of all curbs to be level with pitch built into the curb when deck slopes $\frac{1}{4}$ inch per foot or greater.
 4. Fiberglass Insulation:
 - a. Thickness - 1 $\frac{1}{2}$ inches
 - b. Density - 3 lbs.
 - c. Factory installed.
 5. Height - 18 inches above roof deck or as shown on plans.

2.3 ISOLATION DEVICES

- A. Where units are noted and/or scheduled, prefabricated vibration isolation curb to be manufactured of prime galvanized steel construction, minimum 18 gauge as required, meeting ASTM A653/653M, with welded corners and with seams joined by continuous water and air tight welds. Vibration isolation curb shall be internally reinforced with bulkheads 48" on center and factory installed wood nailer. Curb to be provided with acoustically non-conductive material to minimize sound transitions. Top of all vibration isolation curb shall be level, with pitch built into curb when deck slopes. Vibration isolation curb shall be designed to provide a minimum of 90% isolation efficiency with 1" deflection. continuous rubber cover around perimeter of vibration isolation curb over spring isolators.

2.4 KITCHEN EXHAUST FAN CURB

- A. All kitchen exhaust fans to have extended vented curb extension.

2.5 STORM SHELTER DUCT PENETRATION PROTECTION

- A. Equal to CYCLONE Steel Housing (CSH) / RPH. Coordinate all requirements with TFG Founders Group, Greg Kichan, 817-484-5696, greg@tfgsales.com
- B. Third party tested to meet ICC-500 2014 and FEMA P-361
- C. Coordinate all roofing attachments, curbs, etc. with all parties involved with shelter construction.

2.6 RELATED MATERIALS

- A. Nails:
 - 1. Type:
 - a. Stainless steel, flathead, wire, barbed, slating type.
 - 2. Washers:
 - a. Neoprene.
- B. Flashing Cement:
 - 1. ASTM D4586 - Type 1
 - 2. Asbestos free

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrates are smooth and clean to extent needed for work.

3.2 INSTALLATION

- A. General:
 - 1. Install prefabricated roof curbs beneath new exhaust fans, supply fans, and all other mechanical equipment on the roof.
 - 2. Install work watertight, without waves, warps, buckles, fastening stresses or distortion.
 - 3. Allow for expansion and contraction.
 - 4. Coat contact surfaces of dissimilar metals with zinc chromate paint.
 - 5. Set LEVEL and square on structural framing beneath roof deck.
 - 6. Securely fasten curb flanges with bolts through flanges.
 - 7. Seal bolt heads with flashing cement.
- B. Roof Curbs for Rooftop Packaged HVAC Units:
 - 1. Roofing contractor to install 1½ inch, 3 lb. density fiberglass insulation between unit and roof deck.
 - 2. Roofing material is not to be placed over top of curb.
- C. Roof Curb Heights:
 - 1. Verify roofing insulation thickness where curbs are to be installed. Coordinate height above roof to meet roofing manufacturer's specifications.
 - 2. Minimum Height:
 - a. 12-inches above finished roof.

END OF SECTION

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SECTION 23 05 33
ROOF CURB ADAPTERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Roof curb adapters for packaged rooftop HVAC units and roof mounted fans.

1.2 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 34 16 - HVAC Fans
- C. Section 23 81 19 - Packaged HVAC Units

1.3 REFERENCES

- A. ASTM A-446, 525, and 527

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data sheets, including installation instructions, in accordance with Section 23 00 90, General Conditions, and Division 1.
- B. Shop Drawings: Submit for prefabricated equipment supports in accordance with Section 23 00 90.

PART 2 - PRODUCTS

2.1 ROOF CURB ADAPTERS FOR PACKAGED ROOFTOP HVAC UNITS AND ROOF MOUNTED FANS

- A. Type: Prefabricated insulated, self-contained curb adapters.
- B. Material: Minimum 18 gauge prime galvanized steel.
- C. Construction:
 - 1. Designed to support weight of the equipment.
 - 2. Internal liner or double shell
 - 3. Welded corners.
 - 4. Seams joined by continuous water and airtight welds.
 - 5. Include necessary block-offs to allow use of existing ductwork.
 - 6. Insulated and internally reinforced with T-bars 36" on center.
- D. Manufacturer/Model:
 - 1. HVAC Manufacturer (OEM)
 - 2. ThyCurb
 - 3. TECO Metal Products
 - 4. Rooftop Systems
 - 5. RPS Curbs
 - 6. Curbs Plus
 - 7. Acme Manufacturing
- E. Contractor and manufacturer to verify all existing rooftop units and roof mounted fans. Contractor and manufacturer shall ensure proper fit between existing rooftop equipment base and new rooftop unit and fabricate curb adapter so that any slope in the existing roof curb is accounted for, and all equipment is installed level.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrates are smooth and clean to extent needed for work.

3.2 INSTALLATION

- A. General:
 - 1. Install prefabricated roof curb adapters securely between new equipment and old roof curbs.
 - 2. Install work watertight, without waves, warps, buckles, fastening stresses or distortion.
 - 3. Allow for expansion and contraction.
 - 4. Coat contact surfaces of dissimilar metals with zinc chromate paint.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 01 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. Identification required for mechanical systems.
- B. Code required identification not shown on plans nor specified herein shall be provided.

1.3 RELATED SECTION

- A. Section 23 00 00 - Basic Mechanical Requirements

1.4 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 23 00 90, General Conditions, and Division 01.
- B. Submit wording of nameplates with submittals.
- C. Submit a list of all products incorporated in this section.

1.5 REFERENCES

- A. Comply with ANSI A13.1
- B. USAS Code B31.8
- C. NTSB-PSS-73-1
- D. AGA

1.6 DESCRIPTION OF WORK

- A. Nameplates and tags are to be provided for all mechanical equipment and piping in the project. Identification is also required for the following, but is not limited to:
 - 1. Air Handlers
 - 2. Boilers/Water Heaters
 - 3. Condensing Units
 - 4. Duct Dampers
 - 5. Filter Sizes for Air Handlers
 - 6. Fire Dampers
 - 7. Heat Exchangers
 - 8. Outside Air Units
 - 9. HPiping
 - 10. Pumps
 - 11. Starters
 - 12. Supply/Exhaust Fans
 - 13. Valves
 - 14. Refrigerant Lines

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Seton
- B. Brady
- C. MSI

2.2 EQUIPMENT LABELS

- A. Type: Engraving-Stock, melamine plastic laminate, 3 layer.
 - 1. Thickness:
 - a. Less than 25 square inches: 1/16 inch
 - b. 25 square inches or more: 1/8 inch
- B. Color:
 - 1. Black
- C. Conform to FS L-P-387A

2.3 LETTERING

- A. Style:
 - 1. Engraved standard print.
- B. Size:
 - 1. 3/16 inch to 1/4 inch
- C. Color:
 - 1. White letters, black background

2.4 NAMEPLATE/TAG INFORMATION

- A. HVAC Equipment:
 - 1. Unit mark from Drawings/Owner
 - 2. Voltage - Phase
 - 3. Manufacturer and Model Number
 - 4. Filter size

2.5 NAMEPLATE FASTENERS

- A. Securely attach nameplates to equipment with non-corroding stainless steel screws.
- B. In addition to name plate tags on HVAC equipment, provide and install 1/2" diameter nameplate marker (color to be approved by A/E), and apply to T-bar ceiling below any mechanical equipment and fire dampers above lay-in ceiling.
- C. Non-corroding pop rivets are acceptable.
- D. Stick-ons or adhesives will not be allowed.

2.6 PIPING AND CONTROL DIAGRAM SIGNS

- A. Material: 1/4 inch acrylic cover and backing screwed together with brass screw/bolts.
 - 1. Size:
 - a. Minimum: 12" x 17"
 - b. Maximum: 24" x 36"

- B. Provide a diagram in each mechanical room similar to the diagrams shown on the plans, and/or as required for the area served. This diagram to reflect as-built conditions.

2.7 IDENTIFICATION OF PRODUCTS

- A. Provide pipe markers with the following features.
1. Letters from 1/2" to 3-1/2"; size letters to afford readability from the appropriate viewing position.
 2. Repeated and reversed words for viewing from 360 degrees around pipe.
 3. Self-clinging, coiled markers that snap into place around pipe and do not require any other securement.
 4. Integral directional arrows.
- B. Letters on Field:
1. Identify the specific material conveyed. (i.e. "Domestic Cold Water", "Sprinkler", etc.)
- C. Model:
1. Less than 3/4":
 - a. Tags: Piping System Devices, color codes for hazard.
 2. 3/4" up to 6"; snap-on.
 3. Over 6"; strap-on, with stainless steel spring straps.
 4. Use tags and/or nameplates that are scratch resistant and UV resistant for outdoor equipment and piping.
- D. Piping System Devices (Valves, Thermometers, Pressure Gages, etc., and Pipe Less Than 3/4"):
1. Identify with the following:
 - a. Tags:
 - 1) Not less than 1-1/2 inch brass or aluminum tags, round, square, or octagonal.
 - b. Stamp tags with minimum 1/2" high descriptive characters, 1/2" high numbers with black enamel-filled indentations.
- E. Attachment:
1. Stainless steel or solid brass jack chain, or stainless steel or brass "S" hooks
- F. Refrigerant Lines (R454B and/or R32)
1. Refrigerant pipe located in areas other than the room or space where the refrigerating equipment is located shall be identified. The pipe identification shall be located at intervals not exceeding 20 feet on the refrigerant piping or pipe insulation. The minimum height of lettering of the identification label shall be 1/2". The identification shall indicate the refrigerant designation and safety group classification of refrigerant used in the piping system. The identification shall also include the following statement: "WARNING—Risk of Fire. Flammable Refrigerant."
- G. Ductwork:
1. Stenciled letters or self-adhesive labels, minimum 1" high characters.
 2. Red ribbon at each balancing damper.

PART 3 - EXECUTION

3.1 GENERAL

- A. Contractor shall verify room numbers with Owner/Engineer before nameplates are fabricated.
- B. The following shall be permanently and clearly identified:
1. Each air handler, condensing unit, compressor, exhaust fan, and pump.
 2. Each zone duct, outside air duct, and return air duct whose duty is not immediately apparent.
 3. Each valve whose service and/or duty is not immediately apparent.
 4. Every piping system

3.2 INSTALLATION

- A. Install signs on non-removable panels. Attach to equipment with pop rivets or stainless steel screws.

- B. Mount in an easily visible location.
- C. All labeling identification shall conform to final room numbers. Coordinate with General Contractor, A/E, and Owner to secure construction room numbers.
- D. In addition to name plate tags on HVAC equipment, provide and install 1/2" diameter nameplate marker (color to be approved by A/E), and apply to T-bar ceiling below any mechanical equipment and fire dampers above lay-in ceiling.
- E. Provide all additional signage required by local authority at no cost to the Owner.
- F. Provide filter sizes and quantity on all air handlers.
- G. Complete installation in accordance with ANSI A13.1 and manufacturer's installation instructions and with the Drawings. Fasten each unit securely in place with stainless steel screws.
- H. Equipment Labeling:
 - 1. Install on scheduled items of equipment, including the following:
 - a. Air conditioning equipment
 - b. Pumps
 - c. Control panels and major control components
 - d. Include Mark Number and descriptive name from Drawing and Specification schedules
 - e. Attach with corrosion resistant, stainless steel screws or pop rivets
- I. Piping System Color Coding:
 - 1. Designate for painter the following:
 - a. Types of piping services
 - b. Direction of flow
 - c. Other information required for proper identification.
- J. Surfaces to be Painted:
 - 1. Bare piping
 - 2. Insulation covering of insulated piping
- K. Paint according to the following schedule:

System	Pastel Color
Gas Piping on Roof	Black or as required by local authority having jurisdiction
- L. Piping System Devices (Valves, Thermometers, Pressure Gages, etc.):
 - 1. Identify with the following information:
 - a. System
 - b. Device number
 - c. Device Function
- M. Device Chart:
 - 1. Key devices to device chart
 - 2. Give complete description of device function and system.
- N. Key devices to drawings as follows:
 - 1. Floor plans
 - 2. Schematic drawings of piping systems

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Testing and balancing services for the heating, ventilating, and air conditioning (HVAC) systems of this project.
- B. The testing and balancing agency will be responsible for the satisfactory execution of testing and balancing of the HVAC systems.
- C. The following are acceptable agencies:
 - 1. Complete System Balance
 - 2. Delta-T, Inc.
 - 3. Engineered Air Balance
 - 4. PHI Service Agency, Inc.
 - 5. Air Balancing Company, Inc.
 - 6. Elite Test and Balance, LLC
 - 7. ATCO EnviroAir Testing Engineers

1.2 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements

1.3 STANDARDS

- A. The balancing agency shall perform the services specified herein in accordance with the Associated Air Balance Council's National Standards, including revisions, to the date of the contract.
- B. All terms in this specification shall have their meaning defined as stated in the National Standards.
- C. If these specifications set forth more stringent requirements than the AABC National Standards, these specifications shall prevail.

1.4 QUALIFICATIONS OF THE BALANCING AGENCY

- A. The balancing agency shall be a member of the Associated Air Balance Council (AABC) and/or certified by the National Environmental Balancing Bureau (NEBB).
- B. To perform required professional services, the balancing agency shall have a minimum of one "Test and Balance Engineer" certified by the Associated Air Balance Council and/or the National Environmental Balancing Bureau (NEBB).
- C. This certified "Test and Balance Engineer" shall be responsible for supervision and certification for the total work herein specified.
- D. The balancing agency shall submit records of experience in the field of air and hydronic system balancing or any other data as requested by the Owner/Engineer. The supervisory personnel for the firm shall have at least five (5) years' experience, and be a full-time employee for a minimum of six (6) months prior to the project. All employees used in this project shall be qualified technicians in this specific field.
- E. The balancing agency shall furnish all necessary calibrated instrumentation to adequately perform the specified services. An inventory of all instruments and devices in possession of the balancing agency may be required by the Owner to determine the balancing agency's performance capability.

- F. The balancing agency shall have operated for a minimum of five (5) years under its current name.

1.5 DOCUMENTS

- A. The General Contractor will provide the balancing agency one copy of the following documents:
 1. Project drawings (mechanical sepias if requested) and specifications.
 2. Reviewed construction revisions pertaining to the HVAC systems.
 3. Reviewed submittal data on HVAC equipment and systems to be installed by the Mechanical Subcontractor.
 4. Reviewed HVAC shop drawings.
 5. Reviewed HVAC wiring diagrams, control diagrams, and equipment brochures, as appropriate.

1.6 COORDINATION

- A. It will be necessary for the balancing agency to perform its services in close coordination with the Mechanical Subcontractor.
- B. The plans and specifications indicate meters, valves, dampers, and other devices for the purpose of adjusting the system to obtain optimum operating conditions. It will be the responsibility of the Mechanical Subcontractor to install these devices in a manner that will leave them accessible, readily adjustable, and complete. The balancing agency shall provide guidance if there is a questionable arrangement of a control or balancing device.
- C. The General Contractor, Mechanical Contractor, Temperature Controls Subcontractor, and the suppliers of the HVAC equipment shall all cooperate with the balancing agency to provide all necessary data on the design and proper application of the system components. In addition, they shall furnish all labor and materials required to eliminate any system deficiencies.

1.7 RESPONSIBILITIES OF THE MECHANICAL CONTRACTOR

- A. The Mechanical Contractor shall complete the installation and start all HVAC systems to ensure they are working properly and shall perform all other items as described hereinafter to assist the balancing agency in performing the testing and balancing of the HVAC systems.
- B. Air Distribution Systems:
 1. Verify installation for conformity to design.
 2. Terminate all supply, return, and exhaust ducts, and pressure test them, for leakage, as required by specification.
 3. Ensure that all splitters, extractors, and volume and fire dampers are properly located and functional. Dampers serving requirements of minimum and maximum outside, return, relief, and exhaust air shall provide tight closure and full opening, with a smooth and free operation.
 4. Verify that all supply, return, exhaust, and transfer grilles; registers; diffusers; and high-pressure terminal units are installed and operational.
 5. Ensure that air-handling systems, units, and associated apparatus, such as heating and cooling coils, filter sections, access doors, etc., are blanked and/or sealed to eliminate excessive bypass or leakage of air.
 6. Ensure that all fans (supply, return, relief, and exhaust) are operating and free of vibration. All fans and drives shall be checked for proper fan rotation and belt tension. Overload protection shall be of proper size and rating. A record of motor current and voltage shall be made to verify that the motors do not exceed nameplate rating.
 7. Make any necessary changes to the sheaves, belts, and dampers, as required by the balancing agency, at no additional cost to the Owner.
 8. Install clean filters.

1.8 RESPONSIBILITIES OF THE TEMPERATURE CONTROLS CONTRACTOR

- A. The Temperature-Controls Contractor shall allow sufficient time in the project to provide assistance and instruction to the balancing agency in the proper use and setting of control components such as, but not limited to, computers, static pressure controllers, or any other device that may need set points changed so that the testing and balancing work can be performed.

- B. Furnish to the balancing agency any software and cables required to make adjustments to controls. Any unique micro-processor required to set controls shall be furnished by Temperature Controls Contractor.
- C. The Temperature Controls Contractor shall complete the installation of the temperature control system, and operate and test all control systems to ensure they are functioning properly as designed. The Temperature Controls Contractor shall assist the balancing agency in testing and balancing the HVAC systems, as described hereinafter.
 - 1. Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, damper sequences, air, and water reset, and fire and freeze stats.
 - 2. Verify that all controlling instruments are calibrated and set for design operating conditions.
 - 3. Calibrate room thermostats/sensors after installation, and before the thermostat control verification tests are performed. The balancing agency shall prove the accuracy of final settings by taking temperature readings. The readings shall be in a typical conditioned space for each separately controlled zone.

1.9 PRE-BALANCING CONFERENCE

- A. Prior to beginning of the testing, adjusting, and balancing procedures, schedule and conduct a conference with the Architect/Engineer, General Contractor, Mechanical Contractor, Electrical Contractor, and Temperature Controls Contractor. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting, and balancing.

1.10 NOTIFICATION FOR TESTING AND BALANCING WORK TO BEGIN

- A. The general contractor shall notify the balancing agency in writing when all heating, ventilating, and air conditioning systems are complete and ready for testing and balancing. The Mechanical Contractor shall attest that he has completed all items as described in "RESPONSIBILITIES OF THE MECHANICAL CONTRACTOR" Section of these specifications.
- B. If upon commencing the work, the balancing agency finds that the systems are not ready, or if a dispute occurs as to the readiness of the systems, the balancing agency shall request an inspection to be made by the Mechanical Engineer. This inspection shall establish to the satisfaction of the represented parties whether or not the systems meet the basic requirements for testing and balancing. Should the inspection reveal the notification to have been premature, the balancing agency shall be reimbursed for all costs for the inspection and work previously accomplished. Furthermore, such items that are not ready for testing and balancing shall be completed and placed in operational readiness before testing and balancing services shall again be requested.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 SCOPE

- A. In accordance with Project Drawings and Specifications and as specified herein, the balancing agency shall provide all supervision, personnel, instruments, calibration equipment, and all other materials and services necessary to perform all testing and balancing of the heating, ventilating, and air conditioning systems. All test data including all pertinent calculations shall be reported on appropriate forms.

3.2 GENERAL

- A. The testing and balancing of the heating, ventilating, and air conditioning systems shall be performed by an independent balancing agency approved by the Engineer. The balancing agency shall have a minimum of five years specialized experience in air and hydronic system balancing, possess calibrated instruments, certified "Test and Balance Engineers", and skilled technicians to perform all required tests. The balancing agency shall be a certified member of the Associated Air Balance Council and/or the

National Environmental Balancing Bureau (NEBB).

- B. The tests shall demonstrate the specified capacities and operation of all equipment and materials comprising the systems. The balancing agency shall then make available to the Owner's representative such instruments and technicians as are required for spot checks of the system.
- C. The balancing agency shall not instruct or direct the Mechanical Contractor in any of the work. Any proposed changes or revisions in the work shall be submitted to the Architect and General Contractor in writing.
- D. Document Review:
 - 1. The Test and Balance Firm shall be responsible for reviewing the HVAC plans and specifications relating to the test and balance services for proper arrangement and adequate provisions of devices for testing, adjusting, and balancing.
 - 2. Test and Balance Firm shall review HVAC manufacturers' submittals data relative to balanceability.
 - 3. Test and Balance Firm shall review submitted HVAC automatic temperature control sequences for conformity to the specifications.

3.3 SERVICES

- A. During construction, the balancing agency shall inspect the installation of pipe systems, sheet metal work, temperature controls, and other component parts of the heating, ventilating, and air conditioning systems.
- B. The inspections shall be performed periodically as the work progresses. A minimum of two inspections are required as follows: (1) when 60 percent of the ductwork is installed; (2) when 90 percent of the equipment is installed. The balancing agency shall submit a brief written report of each inspection to the General Contractor and Engineer.
- C. Upon completion of the installation and start-up of the mechanical equipment by the Mechanical Contractor, the balancing agency shall test and balance the system components to obtain optimum conditions in each conditioned space in the building.

3.4 DEFICIENCIES

- A. If in the process of performing the TAB work, any deficiencies encountered shall be brought to the attention of the contractor responsible through defined procedures and entered in the punch list of deficiencies on the next daily Status Report. If correction of the deficiency is urgent, the matter shall be brought to the attention of all involved parties for quick resolution. The General Contractor shall provide and coordinate services of qualified responsible subcontractors, suppliers, and personnel as required to correct, repair, or replace any and all deficient items or conditions during the testing, adjusting, and balancing period.
- B. The notification may be for single or multiple deficiencies. The work necessary to correct items on the listing shall be performed and verified in writing by the affected trade.
- C. All deficiencies that prevent proper TAB work from being completed shall be corrected prior to submittal of the Final TAB Report, unless the correction of such deficiencies cannot be accomplished in a reasonable period of time, in which case the Mechanical Engineer may grant permission to submit the Final TAB Report with the deficiencies detailed in the report.

3.5 AIR SYSTEM PROCEDURES

- A. The balancing agency shall perform the following testing and balancing functions in accordance with the Associated Air Balance Council's National Standards:
 - 1. Fan Speeds:
 - a. For all two stage units, low and high fan speeds must be individually set. For all multistage units, every fan speed step must be individually set. When controls contractor are directly controlling fan speed, the balancing agency shall provide the fan speeds needed to control units at every stage.
 - b. Test and adjust fan RPM to achieve design CFM requirements.
 - 2. Current and Voltage:

- a. Measure and record motor current and voltage.
3. Pitot-tube Traverse:
 - a. Perform a Pitot-tube traverse of main supply and return ducts to obtain total CFM. If a Pitot-tube traverse is not practical, the summation of the outlets or inlets may be used. An explanation of why a traverse was not made must appear on the appropriate datasheet.
4. Outside Air:
 - a. Test and adjust system minimum outside air by Pitot-tube traverse. If a Pitot-tube traverse is not practical, the percentage of outside air may be determined by calculations from the return air, outside air, and mixed air temperatures. Make allowances for heat of compression and motor heat where applicable.
5. Static Pressure:
 - a. Test and record system static pressures, including suction and discharge static pressure of each fan.
6. Air Temperature:
 - a. Take wet-bulb and dry-bulb air temperatures on the entering and leaving side of each cooling coil. Dry-bulb temperature shall be taken on the entering and leaving side of each heating coil.
7. Zone Ducts:
 - a. Adjust zone ducts to within design CFM requirements. At least one zone balancing damper shall be completely open.
8. Main Ducts:
 - a. Adjust main ducts to within design CFM requirements and traverse for total CFM quantities.
9. Branch Ducts:
 - a. Adjust branch ducts to within design CFM requirements. Multi-diffuser branch ducts shall have at least one outlet or inlet volume damper completely open.
10. Tolerances:
 - a. Test and balance each diffuser, grille, and register to within 10 percent of design requirements.
11. Identification:
 - a. Identify the location and area of each grille, diffuser, register, and terminal box. This information shall be recorded on air outlet data sheets.
12. Description:
 - a. Record the size, type, and manufacturer of each diffuser, grille, and register on air outlet data sheets.
13. Terminal Boxes:
 - a. Set volume regulators on all terminal boxes to meet design maximum and minimum CFM requirements. All associated temperature controls shall be checked for proper operation and calibration. If the terminal boxes have separate settings for heating and cooling CFM, the CFM quantities for each shall be recorded on air outlet data sheets. All diffusers connected to the terminal box shall be read in the heating and cooling modes and their readings recorded on air outlet data sheets.
14. Minimizing Drafts:
 - a. Adjust all diffusers, grilles, and registers to minimize drafts in all areas.

3.6 VERIFICATION OF TEMPERATURE CONTROL

- A. The balancing agency shall be assisted by the Temperature Controls Contractor in verifying the operation and calibration of all temperature control systems. The following tests shall be conducted:
 1. Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, damper sequences, air and water reset, and fire and freeze stats.
 2. Verify that all controlling instruments are calibrated and set for design operating conditions.
 3. Verify the accuracy of the final settings by taking temperature readings. The readings shall be in a typical conditioned space for each separately controlled zone.
- B. In the process of performing the TAB work, the balancing agency firm shall:
 1. Verify that all dampers, valves, and other controlled devices are operated by the intended controller.
 2. Verify that all dampers and valves are in the position indicated by the controller (open, closed, or modulating).

3. Verify the integrity of valves and dampers in terms of tightness of close-off and of full-open position. This includes dampers in VAV terminals.
 4. Check that all valves are properly installed in the piping system in relation to direction of flow and location.
 5. Verify the proper application of all normally open and normally closed valves.
 6. Check the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts, or cold/hot walls.
 7. Check the locations of all sensors to determine whether their position will allow them to sense only the intended temperatures or pressures of the media.
 8. Check the sequence of operation for any control mode to ensure that it is in accordance with the Contract Documents.
- C. Verify that all controller set points meet the design intent. Record observations of systems under DDC control. Record all default set points if different from operating set points.
- D. Check all dampers for free and full operation, and record any obstructions.
- E. Verify the operation of all interlock systems.
- F. Perform all system verifications to assure the safety of the system and its components.
- G. Verify that the changeover from heating to cooling mode occurs as specified.

3.7 TEST AND BALANCE REPORT

- A. The test and balance report shall be complete with logs, data, and records as required herein. All logs, data, and records shall be typed on white bond paper and bound and submitted in a single PDF file. The report shall be certified, accurate and complete by the balancing agency's certified Test and Balance Engineer.
- B. The report shall contain the following general data in a format selected by the balancing agency:
1. Project number
 2. Contract number
 3. Project title
 4. Project location
 5. Project Architect
 6. Project Mechanical Engineer
 7. Test & Balance agency
 8. Test & Balance Engineer
 9. General Contractor
 10. Mechanical Subcontractor
 11. Dates tests were performed
 12. Certification
- C. The test and balance report shall be recorded on report forms conforming to the recommended forms in the AABC National Standards. At a minimum, the report shall include:
1. Preface:
 - a. A general discussion of the system, any abnormalities, and problems encountered.
 - b. A deficiency log detailing system abnormalities that do not meet these specifications.
 - c. The list of instruments including type, model, manufacturer, serial number, and calibration dates.
 2. Air System Data:
 - a. All test and balance data indicating design conditions, and actual conditions of operation for each device and/or piece of HVAC equipment.
 - b. Outside Air Temperatures, dry bulb, and wet bulb.
 - c. Entering Air Temperatures, dry bulb, and wet bulb.
 - d. Discharge Air Temperatures, dry bulb, and wet bulb.
 - e. Suction and discharge static pressures across each fan.
 3. System Identification:
 - a. In each report, the zones, supply, return, exhaust openings, and traverse points shall be numbered and/or lettered on mechanical drawings corresponding to the numbers and letters

- used on the report data sheets.
4. Controls:
 - a. Document verification of controls.
 5. Occupancy Inspection:
 - a. Make a total of three (3) inspections within ninety (90) days after occupancy of the building, and make adjustments if required, to ensure that satisfactory conditions are being maintained throughout. Inspections to be coordinated with Architect/Engineer and Owner and shall be documented with a supplemental report containing data and information as required.
 6. Instructions to Operating Personnel:
 - a. Test and Balance Firm shall instruct the operating personnel regarding the following:
 - 1) Systems Operation
 - 2) Unusual Operating Conditions.
 - 3) System Troubleshooting Procedures.

3.8 REPORT SUBMITTAL

- A. The test and balance report are required and shall be submitted to the General Contractor for distribution to the Owner, Architect, and Mechanical Engineer. The test and balance report shall be submitted in a single, fully bound PDF file.

3.9 FINAL ACCEPTANCE

- A. At the time of final inspection, the balancing agency shall recheck, in the presence of the Owner's representative, specific and random selections of data recorded in the certified test and balance report.
- B. Points and areas for recheck shall be selected by the Owner's representative.
- C. Measurements and test procedures shall be the same as the original test and balance.
- D. Selections for recheck, specific plus random, shall not normally exceed 15 percent of the total number tabulated in the report, except where special air systems require a complete recheck for safety reasons.
- E. If random tests demonstrate a measured flow deviation of 10 percent or more from that recorded in the certified test and balance report, the report shall automatically be rejected. In the event the report is rejected, all systems shall be readjusted and tested, new data recorded, a new certified test and balance report submitted, and a new inspection test made, all at no additional cost to the Owner.

3.10 OPPOSITE SEASON TEST

- A. Opposite season test and balance work shall be required for systems that cannot be tested and balanced due to climate or seasonal conditions. An example would be Chiller operation in the winter season, or Boiler operation in the summer season. In such case, the balancing agency shall perform an inspection of the buildings HVAC system during the opposite season from that in which the initial adjustments were made. The balancing agency shall make any necessary modifications to the initial adjustments to produce optimum system operation in compliance with the contract documents. The TAB agency shall contact the Owner's Commissioning Agent, to coordinate such work, no less than 14 calendar days prior to any Opposite Season Testing.
- B. Opposite Season Testing is not required if the Owner's Commissioning Agent can simulate off season conditions via the building automated controls system.

END OF SECTION

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SECTION 23 07 13

DUCT AND GRILLE INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. External duct insulation
- B. Internal duct liner
- C. Exterior ductwork
- D. Kitchen exhaust duct

1.2 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 31 13 - Metal Ductwork
- C. Section 23 37 13 - Diffusers, Registers, and Grilles

1.3 SUBMITTALS

- A. Product Data:
 - 1. Provide submittal data on all equipment specified in this section in accordance with Section 23 00 90, General Conditions, and Division 01.
 - 2. Submit product data indicating typical catalog of information.
 - 3. Submit product data sheets indicating dimensions, general assembly, and ratings.
 - 4. Submit manufacturer's installation instructions.
 - 5. Submit kitchen exhaust duct wrap to City for approval prior to submitting to Engineer.

1.4 REFERENCES

- A. Refer to Section 23 00 00 for complete names of references identified in this section.
 - 1. ASTM E84 - Standard test for surface burning characteristics of building materials.
 - 2. NFPA 221 - Fire walls and fire barrier walls.
 - 3. NFPA 255 - Surface burning characteristics of building materials.
 - 4. NFPA 96 - Ventilation control and fire protection of commercial cooking operations.
 - 5. UL 723 - Test for surface burning characteristics of building materials.
 - 6. UL 1978 - First Edition Standard for Grease Ducts
 - 7. ASTM C553 - Standard specification for mineral fiber blanket thermal insulation for commercial and industrial applications.
 - 8. ASTM C1071 - Fibrous glass duct lining insulation (thermal and sound).
 - 9. IECC - International Energy Conservation Code
 - 10. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials
 - 11. ASTM C916-85(2001)e1 - Standard Specification for Adhesives for Duct Thermal Insulation
 - 12. ASTM C1136-02 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
 - 13. ASTM A635/A635M-02 - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Commercial Steel, Drawing Steel, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, Hot-Rolled, General Requirements
 - 14. ASTM A924 - Hot Dip Galvanized Coils & Sheets - Tolerances

1.5 QUALITY ASSURANCE

- A. Fire Hazard Rating:

1. All insulation used on the project must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50 as determined by test procedures ASTM E84, NFPA 255 and UL 723. Bear UL label.
 2. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive.
 3. Components such as adhesives, mastics and cements must meet the same individual ratings as minimum requirements.
 4. Install in accordance with SMACNA standards.
- B. Kitchen Exhaust Insulation Performance Requirements:
1. Two-hour rated resistive enclosure assembly, ASTM E119: Large scale Wall Panel Test and Total Engulfment Test.
 2. Zero inch clearance to combustible, maximum allowable surface temperature on unexposed side, UL 1978.
 3. Class I interior finish materials, ASTM E84.
 4. Through-penetration protection systems for grease and air ducts, ASTM E814 and UL 1479.
 5. Non-combustibility, ASTM E136.
 6. ISO-6944-1985, Fire Resistance Tests - Ventilation Ducts.
- C. Insulations shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or poly-brominated diphenyl ether fire retardants.
- D. Fiberglass insulations shall have a minimum of 50 percent recycled glass content; certified and UL Validated.
- E. Fiberglass insulations shall have a bio-based, formaldehyde-free binder and be UL GREENGUARD Gold certified.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Deliver materials in original sealed containers or unopened packages, and clearly labeled with manufacturer's name, product identification, and lot numbers.
 - B. Store materials out of weather and in an enclosed shelter.

PART 2 - PRODUCTS

2.1 APPLICATIONS

- A. Supply ducts
- B. Return ducts
- C. Outside air ducts
- D. Supply and return diffusers
- E. Grilles
- F. Registers with exposed surfaces in unconditioned areas
- G. Kitchen exhaust ducts
- H. General exhaust ducts do not receive insulation

2.2 MANUFACTURERS

- A. Owens Corning
- B. Knauf Insulation
- C. Manson Insulation

D. Johns Manville

2.3 EXTERNAL DUCT WRAP AND GRILLE INSULATION

A. Minimum Thickness and Density:

1. Minimum 2" thick at 1 pound per cubic foot, Minimum Value of R-6.0

B. Material:

1. Fiberglass insulation with factory-applied FSK vapor retarding facing complying with ASTM C 1136. Fiberglass bonded with a bio-based thermosetting binder.
2. Flexible Blanket Duct Wrap insulation, complying with ASTM C 553, Type I, II, and III; ASTM C 1136 Type II; and ASTM C 1290, Type III. UL/ULC Classified per UL 723 for FSK; NFPA 90A and 90B.
3. Thermal conductivity (k-value) at 75 degrees F mean temperature is 0.27 Btu x in. /h x sq. ft. x degrees F, or less. Maximum service temperature of 250 degrees F with FSK facing, 350 degrees F for un-faced material.
4. Flame spread/Smoke-developed rating (ASTM E84) of 25/50.
5. Must be UL Environment GREENGUARD Gold certified and UL Validated Formaldehyde-free.

2.4 INTERNAL DUCT LINER

A. Use only where specifically noted, or with written approval of Engineer.

B. Install internal duct liner that extends no more than 2'-0" below roof deck at each rooftop unit.

C. Thickness:

1. Minimum 1½ inch thick, Minimum Value R-6.0

D. Material:

1. Rigid Plenum and Duct Liner
 - a. Fiberglass complying with ASTM C 1071 Type II, ASTM 1338, ASTM G21/G22, NFPA 90A and 90B, ASTM C 1104, and NAIMA AH124, "Fibrous Glass Duct Liner Standard". Fiberglass bonded with a bio-based thermosetting binder, having a bonded, black mat-faced airstream surface and factory-applied edge coating.
 - b. Thermal conductivity (k-value) at 75 degrees F mean temperature is 0.23 Btu x in. /h x sq. ft. x deg. F., or less. Maximum service temperature of 250 degrees F. UL/ULC Classified per UL 723.
 - c. Flame spread/Smoke-developed rating (ASTM E84) of 25/50.
 - d. Must be UL Environment GREENGUARD Gold certified and UL Validated Formaldehyde-free.
2. Flexible Duct Liner
 - a. Fiberglass complying with ASTM C1071 Type I, ASTM C 1338, NFPA 90A and 90B, and NAIMA AH124, "Fibrous Glass Duct Liner Standard". Rotary glass fibers bonded with bio-based thermosetting binder, having a bonded, black mat-faced airstream surface and factory-applied edge coating.
 - b. Must be UL Environment certified GREENGUARD Gold and UL Validated Formaldehyde-free.
 - c. Surface Burning Characteristics: ASTM E84, UL 723 – Flame spread less than 25 and Smoke developed less than 50.
 - d. Maximum Rated Air Velocity: ASTM C 1071 – 6,000 ft. /min. (30.5 m/sec.).
 - e. Maximum Thermal Conductivity: ASTM C 177, C518, C1114 - 0.24 Btu / (ft² x hr. x °F) @ 75°F mean temperature.
 - f. Water Vapor Sorption: ASTM C 1104 – Not exceeding 3 percent by weight.
 - g. Antimicrobial Agent: Compound shall be tested for efficacy by an NRTL, and registered by the EPA for use in HVAC systems. Mold & Mildew Growth/Fungi Resistance: ASTM C 1338, ASTM G21/G22 – Pass.
 - h. Corrosiveness/Corrosion: ASTM C 665 / C 1617 - Does Not Accelerate / Pass.
 - i. Required Markings: EI rating, UL label, duct liner thickness, and other markings required by UL 181 on each full roll of duct liner.

- j. Duct liner adhesive shall be applied to the sheet metal with a minimum coverage of 90%. Adhesive shall meet the requirements of ASTM C916.
- k. Noise Reduction Coefficient (NRC): ASTM C 423, Type "A" Mounting
 - 1) 1.5 PCF Density: 1"=.70, 1-1/2"=.80, 2"=.95
 - 2) 2.0 PCF Density: 1/2"=.50, 1"=.70, 1-1/2"=.85

2.5 EXTERIOR DUCTWORK

- A. Thickness:
 - 1. Minimum 2-inch thick with a minimum R-value of R-8.
- B. Material:
 - 1. Rigid Board fiberglass insulation with factory-applied white ASJ facing complying with ASTM C 1136 and ASTM C 612, Type IA or Type IB. Fiberglass bonded with a bio-based thermosetting binder.
 - 2. UL/ULC Classified per UL 723 for unfaced; ASJ. Thermal conductivity (k-value) at 75 degrees F mean temperature shall be 0.24 Btu x in. /h x sq. ft. x deg. F., or less. Maximum service temperature of 450 degrees F.
 - 3. Flame spread/Smoke-developed rating (ASTM E84) of 25/50.
 - 4. Must be UL Environment GREENGUARD Gold certified and UL Validated Formaldehyde-free.
- C. All exterior ductwork to be protected and sealed with a weather-proofing, protective finishing system such as Alumaguard All Weather, Venture Clad System, or equivalent. Both insulation and protective finish cover system shall be pitched in order to shed water. Level or flat covers will not be accepted.

2.6 FIREPROOFING KITCHEN HOOD EXHAUST DUCTS

- A. Manufacturers:
 - 1. Thermal Ceramics - Firemaster Duct Wrap
 - 2. 3M Fire Barrier Duct Wrap
 - 3. Unifrax Fyre Wrap Elite
- B. Materials:
 - 1. Fire Resistive duct wrap: Duct Wrap, 1.5" thick, 24" or 48" wide x 25' long rolls, foil encapsulated with logo identification. Duct Wrap Collar, 8" wide for air duct butt alternate wrap method (see Part 3).
 - 2. Tapes:
 - a. High performance filament: Tape No. 898, 1" wide, manufactured by 3M, or equal and approved.
 - b. Aluminum foil tape: Minimum 3" wide to seal cut blanket edges.
 - 3. Banding Material:
 - a. 304 Stainless Steel banding: 3/4" wide x 0.015" thick minimum.
 - 4. Insulation Pins/Washers:
 - a. Cup Head Pins: 10 gage, 5 inches long, copper coated steel; washers: 1.5" x 1.5" square or 1.5" diameter galvanized steel speed clip.
 - 5. Through-Penetration Fire Stop Materials:
 - a. Packing Material: Scrap pieces, Duct wrap, 1.5" thick or 3 pcf mineral wool as packing material.
 - b. 3M FB-2000+Silicone, FireMaster Putty, or ceramic fiber based sealant.
 - 6. Grease Duct Access Door:
 - a. Steel angle opening frame
 - b. Access over, minimum 16 gage
 - c. Insulation Pins
 - d. Speed Clips, minimum 1.5" x 1.5" or 1.5" diameter galvanized steel
 - 7. Hardware:
 - a. Threaded rods: 4" to 5" long, 1/4" diameter galvanized steel with 1/4" wing nuts and 1/4" metal washers.
 - b. Four inch long steel hollow tubing to fit threaded rods.
 - c. 1/4" wing nuts.

2.7 FIREPROOFING HAZARDOUS EXHAUST DUCTS (SCIENCE FUME HOODS)

- A. Hazardous exhaust ductwork shall only be wrapped with fireproof insulation if the hazardous exhaust ductwork must pass through a fire rated wall.
- B. Manufacturers:
 - 1. Thermal Ceramics - Firemaster Duct Wrap
 - 2. 3M Fire Barrier Duct Wrap
 - 3. Unifrax Fyre Wrap Elite
- C. Materials:
 - 1. Fire Resistive duct wrap: Duct Wrap, 1.5" thick or 2" thick, 24" or 48" wide x 300" long rolls, foil encapsulated with logo identification. Duct Wrap Collar, 8" wide for air duct butt alternate wrap method (see Part 3).
 - 2. Tapes:
 - a. High performance filament: Tape No. 898, 1" wide, manufactured by 3M Company, St. Paul, MN, or equal and approved.
 - b. Aluminum foil tape: Minimum 3" wide to seal cut blanket edges.
 - 3. Banding Material:
 - a. 304 Stainless Steel banding: 3/4" wide x 0.015" thick minimum.
 - 4. Insulation Pins/Washers:
 - a. Pins: 10 gage, 5 inches long, copper coated steel; washers: 1.5" x 1.5" square or 1.5" diameter galvanized steel speed clip.
 - 5. Through-Penetration Fire Stop Materials:
 - a. Packing Material: Scrap pieces, Duct wrap, 1.5" thick or 3 pcf mineral wool as packing material.
 - b. 3M FB-2000+Silicone or FireMaster Putty, ceramic fiber based sealant.
 - 6. Hardware:
 - a. Threaded rods: 4" to 5" long, 1/4" diameter galvanized steel with 1/4" wing nuts and 1/4" metal washers.
 - b. Four inch long steel hollow tubing to fit threaded rods.
 - c. 1/4" wing nuts.

PART 3 - EXECUTION

3.1 DUCT WRAP INSTALLATION

- A. To ensure that it will achieve its highest possible performance and serve its intended purpose, install all insulation materials and accessories in accordance with manufacturer's published instructions (latest edition) and industry practices detailed by the North American Commercial and Industrial Insulation Standards (latest edition).
- B. Wrap insulation on the ductwork with all circumferential joints butted and longitudinal joints overlapped a minimum of 3 inches. Do not over stretch, or compress more than 25%, during installation process.
- C. On circumferential joints, secure the 2-inch flange of the facing and tape with a minimum of 3 inch wide foil-scrim-Kraft tape (FSK).
- D. On longitudinal joints, secure the overlap using 1/2 inch outward clinch staples applied 6 inches on centers and taped with minimum 3 inch wide foil-scrim-Kraft tape (FSK).
- E. Tape all pin penetrations or punctures in facing.
- F. The duct wrap insulation on all rectangular/square ducts 24-inch or wider shall be additionally secured to the bottom of the duct with mechanical fasteners such as pins and speed clip washers. Spacing at 18-inch on center each direction to prevent sagging.
- G. Duct wrap should be attached and sealed to grilles, registers and diffusers in the same manner as used for duct.

- H. Extend insulation 1 inch beyond each outer surface of diffuser, grille, and register.

3.2 INTERNAL DUCT LINER

- A. Provide internal duct liner as indicated on the plans.
- B. Install internal duct liner on rooftop unit supply and return ducts no more than 2'-0" below roof deck.
- C. To ensure that it will achieve its highest possible performance and serve its intended purpose, install Duct Liner insulation and all accessories in accordance with manufacturer's published instructions (latest edition) and industry practices detailed by the NAIMA FGDLS (North American Insulation Manufacturers Association, Publication AH-124 Fibrous Glass Duct Liner Standard) or SMACNA HVAC DCS (Sheet Metal and Air Conditioning Contractors' National Association, Publication HVAC Duct Construction Standards – Metal & Flexible).
- D. Apply the liner to the inside of the duct with heavy density side to the air stream and secure to the duct with adhesive Insul-Coustic No. 225 or equal meeting ASTM C916, providing a minimum of 90% coverage of clean sheet metal.
- E. Do not use duct liner in kitchen or other areas that may have excess moisture present.
- F. Mechanical fasteners shall be used to secure the duct liner to the sheet metal, spaced in accordance with NAIMA FGDLS or SMACNA HVAC DCS. Fasteners may be either impact-driven, weld-secured, or adhesively secured.
- G. Accurately cut the liner and thoroughly coat the ends with adhesive to make a firmly butted and tightly sealed joint.
- H. Where ducts are lined, exterior insulation will not be needed except as otherwise specified.

3.3 KITCHEN HOOD EXHAUST DUCTS

- A. Install Duct wrap system in accordance with manufacturer's instructions and referenced standards.
- B. Install Duct wrap in direct contact with the duct it enclosed. Protect every portion of duct with manufacturer specified layers for grease duct applications. Overlap both perimeter and longitudinal joints minimum 3" per layer of material.
- C. Air Duct Enclosure Alternate Wrap:
 - 1. Follow same traditional wrap method with exception of utilizing a 3" perimeter overlap in conjunction with longitudinal butt joint wrap plus Duct wrap Collar over exterior layer joints. Filament tape is used as temporary hold on both layers until banding hardware is in place. Band exterior layer spaced minimum 10½" on center. For duct widths greater than 24", weld insulation pins to bottom horizontal and outer vertical duct runs. Impale Duct wrap over pins and secure with galvanized steel speed clips until banding is applied.
- D. Locate grease duct access doors at horizontal cleanouts as required by local codes. Protect with minimum of 2 layers of Duct wrap, each layer overlapping previous by 1" on all sides and in accordance with manufacturer's instructions.
- E. Sections of grease ducts that are inaccessible from the hood or discharge openings shall be provided with cleanout openings spaced not more than 20 feet apart and not more than 10 feet from changes in direction greater than 45 degrees.
- F. Cleanouts and openings shall be equipped with tight-fitting doors constructed of steel having a thickness not less than that required for the duct.
- G. Cleanout doors shall be installed liquid tight.
- H. Door assemblies including any frames and gaskets shall be approved for the application and shall not have fasteners that penetrate the duct.

- I. Gasket and sealing materials shall be rated for not less than 1500°F (816°C).
- J. Protect floor and wall penetrations with an approved through-penetration system having an F and T hourly rating not less than that of assembly penetrated and installed in accordance with manufacturer's instructions and as follows:
 - 1. Grease Ducts - 2 hour Enclosure: Alternate A: 2 layers Duct wrap per manufacturer's installation instructions, maintaining 3" transverse and longitudinal overlaps continuous through the penetration. Alternate B: Tightly butt Duct wrap to the floor or wall on both sides of the assembly. Fill remaining annular space (3" maximum) between the wrapped duct (Alternate A) or bare steel duct (Alternate B) and periphery of the opening with 4¼" thickness of scrap Duct wrap, or 4¼" 3 pcf mineral wool batt, firmly packed into opening. Apply 1/4" minimum 2000+ Silicone over packing material, within the annulus, flush with top surface of floor or both surfaces of wall.

3.4 HAZARDOUS EXHAUST DUCTWORK

- A. All hazardous exhaust ductwork that penetrates a fire rated wall shall be wrapped with fireproof insulation for a minimum of 10'-0" from the point of penetration.

END OF SECTION

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SECTION 23 07 21
REFRIGERANT PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Elastomeric closed-cell structure insulation
- B. Applications - All refrigerant line sets serving units

1.2 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 23 00 - Refrigerant Piping

1.3 SUBMITTALS

- A. Product Data:
 - 1. Provide submittal data on all equipment specified in this section in accordance with Section 23 00 90, General Conditions, and Division 1.
 - 2. Submit product data indicating typical catalog of information.
 - 3. Submit product data sheets indicating dimensions, general assembly, and ratings.
 - 4. Submit manufacturer's installation instructions.

1.4 SHOP DRAWINGS

- A. Submit 1/4" per foot shop drawing(s) showing all piping and equipment shown by plans and specifications. The drawings shall be coordinated with structural, electrical, and fire sprinkler drawings.

1.5 REFERENCES

- A. Refer to Section 23 00 00 for complete names of references identified in this section.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
- C. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials

1.6 QUALITY ASSURANCE

- A. Fire Endurance Rating: The composite classifications shall be listed and labeled to not exceed 25 flame spread rating and 50 smoke development rating as outlined by NFPA 255/ ASTM E84/ UL 723 for the basic material, the finishes, adhesives, etc., specified for each system, and shall be such when completely assembled.
- B. Components such as adhesives, mastics, and cement must meet the same requirement.

PART 2 - PRODUCTS

2.1 PIPE INSULATION

- A. Type: Closed-Cell Flexible Elastomeric Foam Pipe Insulation w/dual-tape overlap self seal lip closure.
- B. Performance Criteria: Resistant to ultra-violet and biological degradation.
- C. Temperature Range: -297°F to 220°F

- D. Water Vapor Permeability (Dry Cup): Less than 0.03 per inch when measured by ASTM E96.
- E. Thermal Conductivity: 0.24 - 0.27 BTU-IN/HR-FT²-°F.
- F. All Refrigerant Line Set Insulation thickness - 1" on Interior Pipe, 1½" on Exterior Pipe
- G. Manufacturer/Model:
 - 1. Armacell
 - 2. Aeroflex

2.2 SEALANT & ADHESIVE

- A. Manufacturer/Model:
 - 1. Therma-Cel
 - 2. Armacell
 - 3. Aeroflex

2.3 ALUMINUM METAL JACKETING/CLADDING

- A. All exterior refrigerant line sets
 - 1. Manufacturers:
 - a. Polyguard
 - b. Johns Manville
 - c. VentureClad
 - d. RPR Products

PART 3 - EXECUTION

3.1 PIPE

- A. To ensure that it will achieve its highest possible performance and serve its intended purpose, install all insulation materials and accessories in accordance with manufacturer's published instructions (latest edition) and industry practices detailed by the North American Commercial and Industrial Insulation Standards Manual (latest edition).
- B. Where straps or hangers are used, provide insulating pipe support insert and insulation shield.
- C. Apply insulation to clean, dry pipes.
- D. Butt insulation joints firmly together.
- E. Seal butt seams with sealant. Duct tape or electrical tape will not be permitted.
- F. Insulation without proper sealing of butt ends and longitudinal seams and/or not neat in appearance will be rejected by the Engineer.
- G. Do not stretch insulation around elbows. All fittings must be factory-fabricated or site-fabricated from same materials as straight pipe insulation.
- H. When possible, install insulation on piping prior to final connection.
- I. Longitudinal joints installed after pipe is assembled are not acceptable.
- J. Do not allow liquid lines to come in contact with any structural members or steel stubs. Use plastic ties to secure liquid lines to insulation on vapor line. Do not crush insulation.

3.2 FINISH

- A. All exterior insulation to be protected with aluminum metal jacketing/cladding. Apply as recommended by the manufacturer, to protect the insulation on exterior of building.

3.3 VALVES, FLANGES & FITTINGS

- A. Insulate all valves, flanges, and fittings in a neat manner.

3.4 REPAIRS AND REPLACEMENT

- A. Replace any insulation that has ever been wet.
- B. Repair any damage caused by condensation due to improper insulating.
- C. Replace any insulation which is cut or torn during construction.

END OF SECTION

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SECTION 23 08 00

COMMISSIONING OF HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes commissioning process requirements for Mechanical systems, assemblies, and equipment.
- B. Related Sections:
 - 1. Division 01 Section "Building Systems Commissioning" for general commissioning process requirements.

1.2 DESCRIPTION

- A. Refer to Division 01 Section "Building Systems Commissioning" for the description of commissioning.

1.3 SUBMITTALS

- A. Refer to Division 01 Section "Building Systems Commissioning" for CxA's role.
- B. Refer to Division 01 Section "Submittals" for specific requirements. In addition, provide the following:
 - 1. Certificates of readiness
 - 2. Certificates of completion of installation, prestart, and startup activities.
 - 3. O&M manuals
 - 4. Test reports

1.4 QUALITY ASSURANCE

- A. Test Equipment Calibration Requirements: Contractors will comply with test manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to CxA upon request.

1.5 COORDINATION

- A. Refer to Division 01 Section "Building Systems Commissioning" for requirements pertaining to coordination during the commissioning process.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. All standard testing equipment required to perform startup, initial checkout, and functional performance testing shall be provided by the Contractor for the equipment being tested. For example, the mechanical contractor of Division 23 shall ultimately be responsible for all standard testing equipment for the mechanical systems and controls systems in Division 23. A sufficient quantity of two-way radios shall be provided by each contractor.
- B. Special equipment, tools, and instruments (specific to a piece of equipment and only available from vendor) required for testing shall be included in the base bid price to the Owner and left on site, except for stand-alone data logging equipment that may be used by the CxA.
- C. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the Owner

upon completion of the commissioning process.

- D. Data logging equipment and software required to test equipment will be provided by the CxA, but shall not become the property of the Owner.
- E. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.

PART 3 - EXECUTION

3.1 GENERAL DOCUMENTATION REQUIREMENTS

- A. With assistance from the installing contractors, the CxA will prepare Functional Testing Forms for all commissioned components, equipment, and systems.
- B. Red-lined Drawings:
 - 1. The contractor will verify all equipment, systems, instrumentation, wiring and components are shown correctly on red-lined drawings.
 - 2. Preliminary red-lined drawings must be made available to the Commissioning Team for use prior to the start of Functional Performance Testing.
 - 3. Changes, as a result of Functional Testing, must be incorporated into the final as-built drawings, which will be created from the red-lined drawings.
 - 4. The contracted party, as defined in the Contract Documents will create the as-built drawings.
- C. Operation and Maintenance Data:
 - 1. Contractor will provide a copy of O&M literature within 45 days of each submittal acceptance for use during the commissioning process for all commissioned equipment and systems.
 - 2. The CxA will review the O&M literature once for conformance to project requirements.
 - 3. The CxA will receive a copy of the final approved O&M literature once corrections have been made by the Contractor.
- D. Systems manual requirements:
 - 1. The Systems Manual is intended to be a usable information resource containing all of the information related to the systems, assemblies, and Commissioning Process in one place with indexes and cross-references.
 - 2. The GC shall include final approved versions of the following information for the Systems Manual:
 - a. As-Built System Schematics
 - b. Verified Record Drawings
 - c. Test Results (not otherwise included in Cx Record)
 - d. Periodic Maintenance Information for computer maintenance management system
 - e. Recommendations for recalibration frequency of sensors and actuators
 - f. A list of contractors, subcontractors, suppliers, architects, and engineers involved in the project along with their contact information
 - g. Training Records, Information on training provided, attendees list, and any ongoing training
 - 3. This information shall be organized and arranged by building system, such as fire alarm, chilled water, heating hot water, etc.
 - 4. Information should be provided in an electronic version to the extent possible. Legible, scanned images are acceptable for non-electronic documentation to facilitate this deliverable.

3.2 CONTRACTOR'S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend construction phase controls coordination meetings.

- C. Participate in Mechanical systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- D. Provide information requested by the CxA for final commissioning documentation.
- E. Include requirements for submittal data, operation and maintenance data, and training in each purchase order or sub-contract written.
- F. Prepare preliminary schedule for Mechanical system orientations and inspections, operation and maintenance manual submissions, training sessions, equipment start-up, and task completion for owner.
- G. Update schedule as required throughout the construction period.
- H. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CxA.
- I. Assist the CxA in all verification and functional performance tests.
- J. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.
- K. Gather operation and maintenance literature on all equipment, and assemble in binders as required by the specifications. Submit to CxA 45 days after submittal acceptance.
- L. Participate in, and schedule vendors and contractors to participate in the training sessions.
- M. Provide written notification to the CM/GC and CxA that the following work has been completed in accordance with the contract documents, and that the equipment, systems, and sub-system are operating as required.

Cx Systems	Require Fx Testing	Items Tested
HVAC		
___ Chilled Water Plants	Yes	Controls, Sequence of Operations, Alarms
___ Hot Water Plants	Yes	Controls, Sequence of Operations, Alarms
___ Air Handling Units	Yes	Controls, Sequence of Operations, Alarms, Economizer
___ Packaged Units (RTU and HP)	Yes	Controls, Sequence of Operations, Alarms, Economizer
___ Terminal Units/VAV's	Yes	Controls, Sequence of Operations, Alarms, Economizer
___ Exhaust and Relief fans	Yes	Controls, Sequence of Operations, Alarms
___ DDC Control System (<i>Component installation and System Operation</i>)	Yes	System calibration and function

- N. The equipment supplier shall document the performance of his equipment.
- O. Provide a complete set of red-lined drawings to the CxA prior to the start of Functional Performance Testing.
- P. Provide training of the Owner's operating staff using expert qualified personnel, as specified.
- Q. Equipment Suppliers
 1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner, to keep warranties in force.
 2. Assist in equipment testing per agreements with contractors.

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3. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.

R. Refer to Division 01 Section "Building Systems Commissioning" for additional Contractor responsibilities.

3.3 OWNER'S RESPONSIBILITIES

A. Refer to Division 01 Section "Building Systems Commissioning" for Owner's Responsibilities.

3.4 DESIGN PROFESSIONAL'S RESPONSIBILITIES

A. Refer to Division 01 Section "Building Systems Commissioning" for Design Professional's Responsibilities.

3.5 CxA'S RESPONSIBILITIES

A. Refer to Division 01 Section "Building Systems Commissioning" for CxA's Responsibilities.

3.6 TESTING PREPARATION

- A. Certify in writing to the CxA that Mechanical systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify in writing to the CxA that Mechanical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify in writing that testing procedures have been completed and that testing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Place systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- F. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.7 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of Mechanical testing shall include sequence of operations for HVAC equipment, HVAC building automation control system, economizers; etc.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. Tests will be performed using design conditions whenever possible.
- E. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- F. The CxA may direct that set points be altered when simulating conditions is not practical.
- G. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

- H. If tests cannot be completed because of a deficiency outside the scope of the Mechanical system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- I. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.8 MECHANICAL SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

- A. Functional Performance Tests: These procedures are representative of those that will be implemented in the Cx process. The CxA may modify these procedures during the Construction Phase once all systems are known and all required documentation has been provided.
- B. Mechanical Instrumentation and Control System Testing: Assist the CxA with preparation of testing plans.

3.9 DEFICIENCIES/NON-CONFORMANCE, COST OF RETESTING, FAILURE DUE TO MANUFACTURER DEFECT

- A. Refer to Division 01 Section "Building Systems Commissioning" for requirements pertaining to deficiencies/non-conformance, cost of retesting, or failure due to manufacturer defect.

3.10 APPROVAL

- A. Refer to Division 01 Section "Building Systems Commissioning" for approval procedures.

3.11 DEFERRED TESTING

- A. Refer to Division 01 Section "Building Systems Commissioning" for requirements pertaining to deferred testing.

3.12 OPERATION AND MAINTENANCE MANUALS

- A. The Operation and Maintenance Manuals shall conform to Contract Documents requirements as stated in Division 01.
- B. Refer to Division 01 Section "Building Systems Commissioning" for the AE and CxA roles in the Operation and Maintenance Manual contribution, review, and approval process.

3.13 SAMPLE FUNCTIONAL PERFORMANCE TESTING PROCEDURES

- A. These testing procedures are representative of those that will be implemented in the Cx process. The CxA may modify these procedures during the Construction Phase once all systems are known and all required documentation has been provided.

Example Systems

Electronic File Name

AHU

AHU-FT

Functional Test Record: _____		
Project Owner: _____		
Project Type: _____		
Project Address:		
List Building Systems to Test:		
CH-1 & CH-2	Cooling Only VAV Terminal	Generator Run Status
BL-1 & BL-2	Electrical Room Exhaust Fans	Lighting
AHU-A1, A2, B1, B2, C1, C2, D1, D2	Boiler Room Supply Fan	Fire Alarm Monitoring
AHU-B3, E1, E2	Packaged Computer Room Units (MDF/IDF)	Utility Monitoring
AHU-E3	Freezer/ Cooler	Relief Dampers
OAHU-A1, B1, E1	Kitchen Exhaust/ Supply Fans	Power Monitoring
FCU-1	Dishwasher Exhaust	Outside Air Conditions
Constant Volume Terminal Unit with Hot Water Reheat	Building Emergency Shutdown	
Constant Volume Terminal Unit with Electric Reheat	General Exhaust Fans	
Beginning O. A. Temp: _____ (F)	Ending O.A. Temp: _____ (F)	% RH: (HI)_____ (LO)_____

List Weather conditions at the project site: Mostly dry conditions with a short shower.			
List Controls and HVAC Testing Spec Sections:	_____, _____, _____, _____, _____		
Building Environmental Conditions:			
<input type="checkbox"/> Clean <input type="checkbox"/> Dirty <input type="checkbox"/> Dry <input type="checkbox"/> Wet <input type="checkbox"/> Other In Construction			
Verify the following conditions prior to testing	Yes	No	If <u>No</u> is checked, list reason
AHU/O.A/CV Boxes have clean filters installed	<input type="checkbox"/>	<input type="checkbox"/>	
Final Filters are as specified	<input type="checkbox"/>	<input type="checkbox"/>	
Ductwork protective covers have been removed	<input type="checkbox"/>	<input type="checkbox"/>	
TAB is Complete for systems being tested	<input type="checkbox"/>	<input type="checkbox"/>	
Controls are complete and system is controlled from DDC control panel/laptop	<input type="checkbox"/>	<input type="checkbox"/>	

Verify the following documentation requirements have been met prior to testing	Yes	No
Checklists have been sampled for review by the CxA to determine the operational readiness for systems being tested	<input type="checkbox"/>	<input type="checkbox"/>
TAB <u>Draft Field Report</u> has been reviewed and all know TAB deficiencies are corrected or noted by the Cx Agent	<input type="checkbox"/>	<input type="checkbox"/>
Controls Contractor completed Pre-Commissioning Checklist has been reviewed by the CxA	<input type="checkbox"/>	<input type="checkbox"/>
General Contractor has been notified of the CxA scheduled testing dates and times. This is related to coordination with Life Safety Systems testing by the AHJ or Fire Marshal.	<input type="checkbox"/>	<input type="checkbox"/>
All issues identified and recorded on the Cx Issues Log or reported to the GC have been resolved	<input type="checkbox"/>	<input type="checkbox"/>
COMMISSIONING CHECKLISTS:		
<input type="checkbox"/> REVIEWED by CxA <input type="checkbox"/> COMPLETE <input type="checkbox"/> INCOMPLETE		
TAB FIELD REPORT:		
<input type="checkbox"/> SUBMITTED <input type="checkbox"/> NOT SUBMITTED <input type="checkbox"/> REVIEWED <input type="checkbox"/> NOT REVIEWED		
CEILING SYSTEMS/GRID INSTALLED IN ALL AREAS UNDER TEST		
<input type="checkbox"/> YES <input type="checkbox"/> NO		

LIGHTING SYSTEMS:					
<input type="checkbox"/> INDOOR		<input type="checkbox"/> EXTERIOR		<input type="checkbox"/> SITE	
<input type="checkbox"/> INSTALLED		<input type="checkbox"/> FULLY OPERATIONAL		<input type="checkbox"/> PRE-TESTED BY CONTROLS SUB	
<input type="checkbox"/> NOT INSTALLED		<input type="checkbox"/> NOT FULLY OPERATIONAL		<input type="checkbox"/> NOT PRE-TESTED	
COMMENTS:					
<p>CxA Note: Items found noncompliant, incomplete, in variance to the contract documents, or fail to perform as intended per the contract documents and engineer approved control sequences, will be documented in writing, and the GC, Owner's PM, and Engineer of record will be notified of the discrepancy. The GC will be responsible for ensuring his sub-contractors resolve issues reported, in a timely manner and notify the CxA that the system is made ready for Functional Retest.</p>					
Building Occupied/Unoccupied Schedule:					
Day of Week	Area	System Enabled	Occ	Syst. Disabled	Un-Occ
Monday - Friday	Admin	6:00 AM	7:00 AM	3:30 PM	4:00 PM
	Classrooms				
	Gym				
	Cafeteria				
	General Spaces				

Weekend	Scheduled as requested per facility request		
Holidays	Scheduled as requested per facility request		
Note:			
Optimum Start Program:	Yes	No	Comments
YES No			
Required	<input type="checkbox"/>	<input type="checkbox"/>	
Programmed	<input type="checkbox"/>	<input type="checkbox"/>	
Designated Temperature Setpoints:			
Occupied:			
Cooling Setpoint °F	<u>74 +/- 1°</u>		
Heating Setpoint °F	<u>69 +/- 1°</u>		
Unoccupied:			
Cooling Setpoint °F	95		
Heating Setpoint °F	55		
Night Setback			
Setpoint °F	95/55		
CxA Note: Testing sequences may be conducted simultaneously where systems are connected or operate in conjunction with one another. This includes Chillers, Boilers, AHU's, TU`s, and Exhaust fans.			

Testing Sequence			
Variable Volume Air Handling Unit Sequence of Operation	Pass	Fail	Note
Unit: VAV AHU #			
Fan Control			
When the air handling unit is requested to run, the BAS shall start the fan. A current switch shall prove status to the BAS and shall alarm at the central site if the switch is not made within 40 seconds (adjustable).			
Cold Deck Temperature Control			
When the air handling unit is in occupied mode and cooling is required, the BAS shall send a request for cooling to the chiller plant and shall modulate the chilled water control valve to maintain leaving air temperature set point (55 °F, adjustable).			
Air Volume Control			
While the air handling unit is active, the BAS shall maintain the duct static pressure setpoint at 1.5" w.g. (adjustable) by modulating the speed of the supply fan through a variable speed drive (VSD). A static pressure sensor mounted two-thirds down the longest duct run, shall monitor the duct static pressure. A manual-reset static pressure high limit switch shall monitor the static pressure of the supply ducts. If the duct static pressure rises above 3.0" w.g. (locally adjustable) the air handling unit shall be de-energized via hard-wire interlock to the VFD safety circuit. The BAS shall monitor the high static limit switch and shall display an alarm at the central site. The static pressure high limit switch must be manually reset.			
Demand Control Ventilation			
When the air handler is running in the occupied mode, the OA damper control shall be enabled. CO2 sensors mounted as indicated on drawings, shall monitor the CO2 levels. Where multiple sensors are provided for a particular AHU, the BAS shall select the highest level for control. The BAS shall modulate the outdoor air damper from its minimum position to its maximum position as required to maintain the CO2 level between 850			

ppm and 1000 ppm (all adjustable). The OA dampers minimum and maximum positions shall be determined by the T.A.B. contractor to be the positions that allow the scheduled minimum and maximum OA CFM. The system shall have the ability to perform a "Purge Mode" at a scheduled time for a scheduled duration. The BAS will monitor Outside Airflow via the Airflow Monitoring Station.			
Humidity Control			
The BAS shall monitor humidity in 2 representative zones for each AHU. If either humidity transmitter senses humidity above 55% (adjustable), the BAS shall command 40% of the associated terminal units to 100% cooling (adjustable), and the terminal unit controller shall utilize the terminal unit reheat to maintain space setpoint.			
Auxiliary DX Cooling Coil (If Available)			
The air handling unit serving the administration area shall be provided with an auxiliary DX cooling coil in addition to the hydronic coil. When the system is operating after hours, the BAS shall utilize the DX cooling for supply air temperature control and shall not send a request to the chiller plant.			
Reversed valve, DX coil not started up			
Associated Equipment			
During the occupied time period, any associated exhaust fans shall be energized.			
End of Testing			

END OF SECTION

SECTION 23 09 23

ENERGY MANAGEMENT CONTROL SYSTEM (BACNET)

PART 1 - GENERAL

1.1 SUMMARY

- A. It is the intent of this specification to describe the basic architecture and performance requirements of the Energy Management Control System (EMCS). The turn-key EMCS shall include Control Units, Distributed Controllers, Unitary Controllers, Local Area Networks (LANs), sensors, modems, wiring, connectors, control devices, actuators, installation and calibration, supervision, adjustments, and fine tuning necessary for a complete and fully operational system.
- B. The entire campus shall receive a complete and new EMCS. All wiring/sensors/controllers, etc. to be removed and replaced. EMCS contractor to field verify all existing conditions and existing components to be controlled for a complete and turnkey system.
- C. A distributed logic control system complete with all software and hardware functions shall be provided and installed. System shall be completely based on ANSI/ASHRAE Standard 135-2001, BACnet. This system is to control all mechanical equipment, including all unitary equipment such as VAV boxes, heat pumps, fan-coils, AC units, etc. and all air handlers, boilers, chillers, and any other listed equipment using Native BACnet-compliant components.
- D. All systems shall be complete true stand-alone systems.
- E. **All communication wiring shall communicate using BACnet. LonWorks or Proprietary communication networks are not allowed. This includes ARCNET network cabling.**
- F. Everything shall be reprogrammed through software without change of any hardware. The owner shall have all the tools necessary to reprogram without any additional costs.
- G. EMCS shall have backward and forward compatibility.
- H. Systems shall be furnished and installed complete in all respects, including any and all equipment, controls, wiring, instrumentation, enclosures, labor, engineering, training, commissioning, programming, supervision, calibration, coordination with other trades, etc. No information given in (or omitted from) these specifications shall relieve the contractor of this absolute requirement. Include all associated electrical work except as noted. Work includes furnishing of all labor, superintendence, materials, tools, equipment and sources necessary for the complete installation or modification of the following systems as herein specified. It is the intent of these specifications that the Contractor shall furnish and install the systems complete in every respect and ready to operate. All equipment, miscellaneous items and accessories required for such installation and for the correct and convenient operation of the entire installation whether or not each such item or accessory is shown on the plans or mentioned in these specifications shall be furnished and installed.
- I. Bidders shall take into account that projects require verification of existing conditions that are not described in these specifications. Bids shall include, at Bidder's discretion, costs related to site verifications for renovation projects. No additional costs shall be allowed for such items.
- J. Should discrepancies or ambiguities arise within these specifications, the most stringent condition with regard to cost shall govern the bid. Obtain clarification from the Engineer prior to purchasing equipment and proceeding with the work.
- K. Where drawings are provided as part of or supplement to these specifications, such drawings are inherently schematic only and not intended to convey all controls, wiring, installation, details, etc. It shall be the responsibility of the EMCS contractor to verify that control approaches presented are appropriate for the HVAC systems involved, and that bids include all work described, specified, or otherwise necessary for a complete and functioning system.

- L. Schedule: Contractor acknowledges that submission of bid constitutes agreement with and conformance to the completion dates.
- M. Codes, Permits, and Fees: This contractor shall comply with all local, state and national codes, and shall secure and pay all applicable costs, fees, permits, and licenses. No additional costs shall be allowed for these items.
- N. Other Conditions:
 - 1. Safety: Execute all work with the highest regard to safety. Comply with all laws governing safety, including the "Occupational Safety and Health Standards" and the "Safety and Health Regulations for Construction", State and federal. All applicable power tools used during construction shall have current approval under an approved Equipment Grounding Program, and shall bear the tag relating such. Contractor is solely responsible for all means and methods.
 - 2. Coordination and Supervision: Each bid shall include the necessary detail and interconnection work to coordinate his work with the work of other trades. Contractor shall keep competent supervisory personnel on the job whenever work is being performed which affects his trade.
 - 3. Storage of Materials: Each Contractor shall provide temporary storage facilities suitable for equipment stored at the job site. Storage facilities shall be weatherproof and lockable as required.
 - 4. Protection of Building and Materials: Each Contractor shall take necessary precautions to prevent damage to existing buildings and to work of other trades.
 - 5. Observations: Site observation by Owner or Engineer is for express purpose of verifying compliance by Contractor with Contract Documents, and shall not be construed as construction supervision nor indication of approval of manner or location in which work is being performed as being safe practice or place.
 - 6. Contractor is reminded that he shall also comply with all respects to the Invitation to Bid, General Conditions, Supplementary Conditions, Notice of Bidders, Instructions to Bidders, and all other governing parts of these specifications and the contract documents. These sections are included as part of the contract.
 - 7. Where the term "Contractor" is used within these specifications, it shall be understood to mean an approved controls manufacturer/contractor, and facility management systems contractor.
- O. The entire system shall be approved and listed by Underwriters Laboratories, Inc., under UL 916 for energy management systems and FCC-Part 15 Subparagraph J Class A Emissions Requirements.
- P. Equipment and Software Updates/Upgrades:
 - 1. Equipment: All equipment, components, parts, materials, etc. provided throughout the period of Work (as governed in the Agreement) shall be fully compatible with all other equipment, etc. provided at any other time throughout the period of Work. Should updated versions of equipment be provided which are not fully compatible with earlier equipment provided, Contractor shall replace earlier equipment with the later version at no cost to Owner.
 - 2. Software: All software upgrades applicable to system and offered by the manufacturer/contractor for this system shall be provided at no cost to the Owner throughout the period of work. This no cost upgrade shall include installation, programming, modifications to field equipment, data base revisions, training, etc. as appropriate.
- Q. The Engineer shall reserve all authority regarding approval, conditional approval, or rejection of systems not fully complying with these specifications.

1.2 WORK INCLUDED

- A. The EMCS shall be a totally Native BACnet-based system based on a distributed control system in accordance with this specification. The workstation, all building controllers, application controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135-2001, BACnet. In other words, all workstations and controllers, including unitary controllers, shall be Native BACnet devices. No gateways shall be used for communication to controllers installed under this section. Gateways may be used for communication to existing systems or to systems installed under other sections.
- B. The installing contractor shall provide the new web-based software and software updates required for this project. Additionally, the installing contractor shall provide all computer related components (BAS

Web server) for the new software platform to function in a peer-to-peer environment.

- C. The owner will provide reserved DHCP addresses and any other network configuration information necessary to each control contractor for the purpose of configuring each building controller and/or server on the owner's network. The controls contractor shall coordinate the IP address for each building controller and/or server. It shall be the responsibility of each control contractor to coordinate with the owner for network connectivity.
- D. The Energy Management and Control System (EMCS) application program shall be written to communicate specifically utilizing BACnet protocols. Software shall include password protection, alarming, logging of historical data, full graphics including animation, full suite of field engineering tools including graphical programming and applications. Systems using operating systems other than that described above are strictly prohibited.
- E. Building controllers shall include complete energy management software, including scheduling building control strategies and logging routines. All energy management software and firmware shall be resident in field hardware and shall not be dependent on the operator's terminal. Operator's terminal software is to be used for access to field-based energy management functions only. Provide zone-by-zone direct digital logic control of space temperature, scheduling, runtime accumulation, equipment alarm reporting, and override timers for after-hours usage.
- F. All application controllers for every terminal unit (VAV, HP, UV, etc.) air handler, all central plant equipment, and any other piece of controlled equipment shall be fully programmable. Application controllers shall be mounted next to controlled equipment and communicate with building controller via BACnet LAN.
- G. Provide all necessary BACnet-compliant hardware and software to meet the system's functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for Windows-based control software and every controller in system, including unitary controllers.
- H. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.
- I. Implement the detailed design for all analog and binary objects, system databases, graphic displays, logs, and management reports based on control descriptions, logic drawings, configuration data, and bid documents.
- J. Design, provide, and install all equipment cabinets, panels, data communication network cables needed, and all associated hardware.
- K. Provide and install all interconnecting cables between supplied cabinets, application controllers, and input/output devices.
- L. Provide and install all interconnecting cables between all operator's terminals and peripheral devices (such as printers, etc.) supplied under this section.
- M. Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.
- N. Provide supervisory specialists and technicians at the job site to assist in all phases of system installation, startup, and commissioning.
- O. Provide a comprehensive operator and technician training program as described herein.
- P. Provide as-built documentation, operator's terminal software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.
- Q. Provide new sensors, dampers, valves, and install only new electronic actuators. No used components shall be used as any part or piece of installed system.

- R. Unless otherwise specified, all products shall be of single manufacturer where possible with substitutions approved by Engineer/Owner.
- S. Provide all indicating devices, interface equipment, and other apparatus required to operate mechanical system and to perform functions specified and to operate other items specified.
- T. Provide protective devices to prevent damage to the EMCS as a result of lightning.
- U. The Energy Management Control system shall allow full user operation with minimum of training. It shall have an English language display, with both user prompts and a "help" user tutorial. It shall contain management reports for the monitoring of both current and historical energy usage, heating and cooling degree day, building status and after hours occupancy information.
- V. All applications programs shall be pre-engineered and pretested. Program entries shall utilize graphical templates.
- W. Workmanship:
 - 1. Contractor shall use only thoroughly trained and experienced workmen completely familiar with the items required and with the manufacturers recommended methods of installation. In all respects, the workmanship shall be of the highest grade, and all construction shall be done according to the best practice of the trade. Unless otherwise noted, conduit shall be concealed and installed square to the building lines. Any work not meeting these requirements shall be replaced or rebuilt without extra expense to the Owner

1.3 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC

1.4 DEFINITIONS

- A. Energy Management Control System, Facility Management System, and Control System are to be considered the same.

1.5 REFERENCES

- A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections thereof, shall govern design and selection of equipment and material supplied:
 - 1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
 - 2. ANSI/ASHRAE - Standard 135-2001, BACnet.
 - 3. Uniform Building Code (UBC), including local amendments.
 - 4. UL 916 - Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.
 - 5. National Electrical Code (NEC).
 - 6. FCC Part 15, Subpart J, Class A.
 - 7. EMC Directive 89/336/EEC (European CE Mark).
 - 8. City, county, state, and federal regulations and codes in effect as of contract date.
 - 9. Except as otherwise indicated the system supplier shall secure and pay for all permits, inspections, and certifications required for his work and arrange for necessary approvals by the governing authorities.

1.6 SPECIFICATION NOMENCLATURE

EMCS	Energy Management and Control System
WAN	Wide Area Network
RWS	Remote Work Station
HHI	Hand Held Interface
LAN	Local Area Network

1.7 QUALITY ASSURANCE

- A. Responsibility:
 - 1. The supplier of the EMCS shall be responsible for inspection and Quality Assurance (QA) for all materials and workmanship furnished.
- B. Component Testing:
 - 1. Maximum reliability shall be achieved through extensive use of high-quality, pre-tested components. Each and every controller, sensor, and all other DDC components shall be individually tested by the manufacturer prior to shipment.
- C. Tools, Testing and Calibration Equipment:
 - 1. The EMCS supplier shall provide all tools, testing, and calibration equipment necessary to ensure reliability and accuracy of the system.

1.8 SUBMITTALS

- A. Drawings
 - 1. The system supplier shall submit detailed complete, engineered drawings, control sequence, and bill of materials for approval.
 - 2. The contractor shall supply one electronic copy of the submittal.
 - 3. The electronic files will either be e-mailed to the architect or posted to a project management and information exchange website, depending on the architect's requirements. The architect and contractor can distribute copies of the files as desired.
 - 4. The engineer will retain an electronic copy of the submittal and all responses.
- B. System Documentation
 - 1. Include the following in submittal package:
 - a. Data sheets for all pieces of equipment.
 - b. System configuration diagrams in simplified block format.
 - c. All input/output object listings and an alarm point summary listing.
 - d. Electrical drawings that show all system internal and external connection points, terminal block layouts, and terminal identification.
 - e. Complete bill of materials, valve schedule, and damper schedule.
 - f. Manufacturer's instructions and drawings for installation, maintenance, and operation of all purchased items.
 - g. Overall system operation and maintenance instructions including preventive maintenance and troubleshooting instructions.
- C. For all system elements - operator's workstation(s), building controller(s), application controllers, routers, and repeaters, provide BACnet Protocol Implementation Conformance Statements (PICS) as per ANSI/ASHRAE Standard 135-2001.
- D. Provide complete description and documentation of any proprietary (non-BACnet) services and/or objects used in the system.
- E. A list of all functions available and a sample of function block programming that shall be part of delivered system.
 - 1. Scheduling
 - a. The vendor shall provide a detailed project design and installation schedule with time markings and details for hardware items and software development phases. Schedule shall show all the target dates for transmission of project information and documents and shall indicate timing and dates for system installation, debugging, and commissioning.
 - 2. Drawings and Manuals:
 - a. Upon completion of the work, the Contractor shall provide the Owner with "record" layouts for the system. Layouts shall indicate all equipment and the function of each item shall be indicated.
 - 3. Operating instructions and as-built system flow diagrams and drawings shall be prepared, bound, and delivered to the Owner. Each sensor, relay, switch, motor, controller, indicator (when inside panel), and item of equipment, etc., shall be identified with a number or mark identical to one which

shall be tagged on each item. Large items of equipment may be identified by a suitable symbol listed in a legend on the control diagram.

1.9 EMCS CONTRACTOR QUALIFICATION REQUIREMENTS

- A. The Energy Management Control System Manufacturer/Contractor, to be acceptable to this project, must have had an established engineering and service office serving the Owner's area for a minimum of five years prior to bid date of this project and be the authorized installing contractor for the manufacturer of the BACnet components. This office shall have a staff of factory trained technicians fully capable of rendering training, instruction, calibration procedures, and routine and emergency maintenance service on all system components furnished.
- B. Installers shall have not less than five years' experience with electronic and pneumatic controls.
- C. The entire system shall be provided by a qualified and approved Controls Manufacturer/Contractor. It shall be designed by engineers and installed by competent technicians, all of which are regularly employed by the manufacturer of the control equipment. The Manufacturer/Contractor shall maintain permanent local facilities for engineering, installation, and 24-hour maintenance and service. Submit required Qualifications Form as specified. The manufacturer shall provide evidence of the ability to support and service the work in the Owner's facilities.
- D. The Bidder/Contractor shall be certified by the manufacturer of the equipment and have factory trained installers
- E. Equipment and performance are intended as a standard of quality, but not as a means of excluding other approved Manufacturers/Control Contractors.

1.10 WARRANTY

- A. The temperature control contractor shall guarantee all workmanship and material in the installed temperature regulation system for a period of one (1) year, such guarantee dating from the date of final acceptance of the entire air conditioning system by the Architect/Engineer.
- B. This warranty shall cover the repair or replacement without additional costs to the Owner of any defective materials, parts, etc. of facility workmanship.
- C. During the warranty period, the temperature controls contractor shall respond to calls for warranty service within eight (8) working hours. Emergency service shall be obtainable within four (4) hours of notification by the Owner. Emergency service shall be obtainable on a 24-hour basis, seven (7) days per week.
- D. The temperature control contractor's office shall be within a 150-mile radius of the job site.
- E. Warranty Access:
 - 1. The Owner shall grant to the Contractor, reasonable access to the EMCS system during the warranty period. The owner shall provide, at no cost to the contractor, remote software access to an on-site computer or VPN access for the following functions:
 - a. Access to the entire facility control system by the contractor to provide service and diagnostic support.
- F. Service:
 - 1. All service of the system shall be furnished by the Contractor, at no cost to the Owner, for a period of one (1) year, concurrent with the warranty period specified above.

PART 2 - PRODUCTS

2.1 ACCEPTABLE EMCS VENDORS

- A. Reliable Controls - Enviromatic Systems

- B. The Engineer and Owner shall reserve all authority regarding approval, conditional approval, or rejection of systems not fully complying with these specifications

2.2 MATERIALS

- A. General: All materials and equipment used shall be standard components, of regular manufacture for this application. All systems and components shall have been thoroughly tested and proven in actual use.
- B. Exceptions to the specification will qualify bid as unacceptable.

2.3 OPERATOR'S WORKSTATION

- A. This system is an addition to the existing control system and shall be connected to the existing local area network (LAN) and computer. No additional workstation is required.
- B. The new graphics software shall be fully integrated to the owners existing front end software and existing workstation. Floor plan and interactive color graphics shall be provided for the school with each zone providing color indication of the zone comfort level. In addition to the floor plan graphic, each piece of controlled equipment shall be represented by a graphic that is accessible by clicking on the zone or indicated piece of equipment. All points shall be available on the graphic.
- C. Software:
 - 1. EMS software shall be provided as an all-inclusive package. Software package shall allow the owner to have all the software modules/software tools that the controls contractor has for installation. The district shall have the software tools to be 100% self-sufficient when it comes to programming the systems, modifying DDC and graphics, creating reports and trends, etc. Provisions to provide software at each school campus at no additional charge in the future must be included as a part of this bid.
- D. Software shall include the following, but not be limited to:
 - 1. DDC Programming tool
 - 2. All points binding and interoperability software to make the system truly open
 - 3. Graphic editing tools
 - 4. Energy management tools
 - 5. Trending tools
- E. Graphics:
 - 1. Graphics pages shall consist of the following graphics at a minimum:
 - 2. District Map
 - 3. Floor plans (typical of every school for both space temperature and humidity)
 - 4. Animated Unit Summary Pages (one per piece of HVAC equipment)
 - 5. Text Summary Pages (one per piece HVAC equipment)
 - 6. Time Schedule Pages
 - 7. Run times Page
 - 8. Graphics Editing Mode
 - 9. Trendlog Page
- F. General structure of workstation interaction shall be a standard client/server relationship. Server shall be used to archive data and store system database. Clients shall access server for all archived data. Each client shall include flexibility to access graphics from server or local drive. Server shall support a minimum of 50 clients simultaneously. Provide software licenses for server and 20 clients.
- G. BACnet Conformance:
 - 1. Operator's workstation shall as a minimum support Point-to-Point (PTP) and Ethernet BACnet LAN types. It shall communicate directly via these BACnet LANs as a Native BACnet device. Operator's terminal shall comply with the requirements of a BACnet conformance class 3 device and support all BACnet services necessary to provide the following BACnet functional groups:
 - a. Clock Functional Group
 - b. Event Response Functional Group

- c. Time Master Functional Group
 - d. Device Communications
2. Refer to section 22.2, BACnet Functional Groups, in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 3. Standard BACnet object types accessed by the workstation shall include as a minimum: Analog Value, Analog Input, Analog Output, Binary Value, Binary Input, Binary Output, Calendar, Device, Event Enrollment, File, Notification Class, Program and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 4. The Operator Workstation shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs). Workstation shall support Foreign Device Registration to allow temporary workstation connection to IP network.
- H. Displays:
1. Operator's workstation shall display all data associated with project as called out on drawings and/or object type list supplied. Graphic files shall be created using digital, full color photographs of system installation, AutoCAD or Visio drawing files of field installation drawings, and wiring diagrams from as-built drawings. Operator's workstation shall display all data using three-dimensional graphic representations of all mechanical equipment. System shall be capable of displaying graphic file, text, and dynamic object data together on each display and shall include animation. Information shall be labeled with descriptors and shall be shown with the appropriate engineering units. All information on any display shall be dynamically updated without any action by the user. Workstation shall allow user to change all field-resident EMCS functions associated with the project, such as setpoints, weekly schedules, exception schedules, etc. from any screen no matter if that screen shows all text or a complete graphic display. This shall be done without any reference to object addresses or other numeric/mnemonic indications.
 2. All displays and programming shall be generated and customized by the local EMCS supplier and installer. Systems requiring factory programming for graphics or DDC logic are specifically prohibited.
 3. Binary objects shall be displayed as ACTIVE/INACTIVE/NULL or with customized text. Text shall be justified left, right, or center as selected by the user. Also, allow binary objects to be displayed as individual change-of-state graphic objects on the display screen such that they overlay the system graphic. Each binary object displayed in this manner shall be assigned up to three graphic files for display when the point is ON, OFF, or in alarm. For binary outputs, toggle the object's commanded status when the graphic item is selected with the system mouse. Similarly, allow the workstation operator to toggle the binary object's status by selecting with the mouse a graphic of a switch or light, for example, which then displays a different graphic (such as an "ON" switch or lighted lamp). Additionally, allow binary objects to be displayed as an animated graphic. Animated graphic objects shall be displayed as a sequence of multiple graphics to simulate motion. For example, when a pump is in the OFF condition, display a stationary graphic of the pump. When the operator selects the pump graphic with the mouse, the represented object's status is toggled and the graphic of the pump's impeller rotates in a time-based animation. The operator shall be able to click on an animated graphical object or switch it from the OFF position to ON, or ON to OFF. Allow operator to change graphic file assignment and also create new and original graphics online. System shall be supplied with a library of standard graphics, which may be used unaltered or modified by the operator. Systems that do not allow customization or creation of new graphic objects by the operator (or with third-party software) shall not be allowed.
 4. Analog objects shall be displayed with operator modifiable units. Analog input objects may also be displayed as individual graphic items on the display screen as an overlay to the system graphic. Each analog input object may be assigned to a minimum of five graphic files, each with high/low limits for automatic selection and display of these graphics. As an example, a graphic representation of a thermometer would rise and fall in response to either the room temperature or its deviation from the controlling setpoint. Analog output objects, when selected with the mouse, shall be displayed as a prompted dialog (text only) box. Selection for display type shall be individual for each object. Analog object values may be changed by selecting either the "increase" or "decrease" arrow in the analog object spinner box without using the keypad. Pressing the button

- on the right side of the analog object spinner box allows direct entry of an analog value and accesses various menus where the analog value may be used, such as trendlogs.
5. Analog objects may also be assigned to an area of a system graphic, where the color of the defined area changes based on the analog object's value. For example, an area of a floor-plan graphic served by a single control zone would change color with respect to the temperature of the zone or its deviation from setpoint. All editing and area assignment shall be created or modified online using simple icon tools.
 6. A customized menu label (push-button) shall be used for display selection. Menu items on a display shall allow penetration to lower level displays or additional menus. Dynamic point information and menu label push buttons may be mixed on the same display to allow sub-displays to exist for each item. Each display may be protected from viewing unless operator has appropriate security level. A security level may be assigned to each display and system object. The menu label shall not appear on the graphic if the operator does not have the appropriate security level.
 7. A mouse shall be used to move the pointer arrow to the desired item for selection of new display or to allow the operator to make changes to object data.
- I. Password Protection:
1. Provide security system that prevents unauthorized use unless operator is logged on. Access shall be limited to operator's assigned functions when user is logged on. This includes displays as outlined above.
 2. Each operator's terminal shall provide security for 200 users minimum. Each user shall have an individual User ID, User Name and Password. Entries are alphanumeric characters only and are case sensitive (except for User ID). User ID shall be 0-8 characters, User Name shall be 0-29 characters, and Password shall be 4-8 characters long. Each system user shall be allowed individual assignment of only those control functions and menu items to which that user requires access. All passwords, user names, and access assignments shall be adjustable online at the operator's terminal. Each user shall also have a set security level, which defines access to displays and individual objects the user may control. System shall include 10 separate and distinct security levels for assignment to users.
- J. Operator Activity Log:
1. Operator Activity Log shall be included with system that tracks all operator changes and activities. System shall track what is changed in the system, who performed this change, date and time of system activity and value of the change before and after operator activity. Operator shall be able to display all activity, sort the changes by user and also by operation.
 2. Log shall be gathered and archived to hard drive on operator workstation as needed. Operator shall be able to export data for display and sorting in a spreadsheet.
 3. Any displayed data, that is changeable by the operator, may be selected using the right mouse button and the operator activity log shall then be selectable on the screen. Selection of the operator activity log using this method shall show all operator changes of just that displayed data.
- K. Scheduling:
1. Operator's workstation shall show all information in easy-to-read daily format including calendar of this month and next. All schedules shall show actual ON/OFF times for day based on scheduling priority. Priority for scheduling shall be events, holidays, and daily with events being the highest.
 2. Scheduling tool shall allow scheduling of events up to 2 calendar years in advance.
 3. Holiday and special event schedules shall display data in calendar format. Operator shall be able to schedule holidays and special events directly from these calendars.
 4. Operator shall be able to change all information for a given weekly or exception schedule if logged on with the appropriate security access.
 5. System shall include a Schedule Wizard for set up of schedules. Wizard shall walk user through all steps necessary for schedule generation. Wizard shall have its own pull-down selection for startup or may be started by right clicking on value displayed on graphic and then selecting Schedule.
- L. Alarm Indication and Handling:
1. Operator's workstation shall provide audible, visual, and printed means of alarm indication. The alarm dialog box shall always become the top dialog box regardless of the application(s), currently running. Printout of alarms shall be sent to the assigned terminal and port.
 2. System shall provide log of alarm messages. Alarm log shall be archived to the hard disk of the system operator's terminal. Each entry shall include a description of the event-initiating object generating the alarm. Description shall be an alarm message of at least 256 characters in length.

- Entry shall include time and date of alarm occurrence, time and date of object state return to normal, time and date of alarm acknowledgment, and identification of operator acknowledging alarm.
3. Alarm messages shall be in user-definable text (English or other specified language) and shall be entered either at the operator's terminal or via remote communication.
 4. System shall include an Alarm Wizard for set up of alarms. Wizard shall walk user through all steps necessary for alarm generation. Wizard shall have its own pull-down selection for startup or may be started by right clicking on value displayed on graphic and then selecting alarm setup.
- M. Trendlog Information:
1. System server shall periodically gather historically recorded data stored in the building controllers and field controllers and archive the information. Archived files shall be appended with new sample data, allowing samples to be accumulated. Systems that write over archived data shall not be allowed, unless limited file size is specified. Samples may be viewed at the operator's workstation. Operator shall be able to scroll through all trended data. All trendlog information shall be displayed in standard engineering units.
 2. Software shall be included that is capable of graphing the trend logged object data. Software shall be capable of creating two-axis (x, y) graphs that display up to ten object types at the same time in different colors. Graphs shall show object values relative to time.
 3. Operator shall be able to change trend log setup information. This includes the information to be logged as well as the interval at which it is to be logged. All input, output, and value object types in the system may be logged. All operations shall be password protected. Setup and viewing may be accessed directly from any and all graphics on which object is displayed.
 4. System shall include a trend Wizard for setup of logs. Wizard shall walk user through all necessary steps. Wizard shall have its own pull-down selection for startup, or may be started by right clicking on value displayed on graphic, and then selecting Trendlogs from the displayed menu.
- N. Energy Log Information:
1. System server shall be capable of periodically gathering energy log data stored in the field equipment and archive the information. Archive files shall be appended with new data, allowing data to be accumulated. Systems that write over archived data shall not be allowed unless limited file size is specified. Display all energy log information in standard engineering units.
 2. All data shall be stored in data base file format for direct use by third-party programs. Operation of system shall stay completely online during all graphing operations.
 3. Operator shall be able to change the energy log setup information as well. This includes the meters to be logged, meter pulse value, and the type of energy units to be logged. All meters monitored by the system may be logged. System shall support using flow and temperature sensors for BTU monitoring.
 4. System shall display archived data in tabular format form for both consumption and peak values. Data shall be shown in hourly, daily, weekly, monthly and yearly formats. In each format the user shall be able to select a specific period of data to view.
- O. Configuration/Setup:
1. Provide means for operator to display and change system configuration. This shall include, but not be limited to, system time, day of the week, date of daylight savings set forward/set back, printer termination, port addresses, modem port and speed, etc. Items shall be modified using understandable terminology with simple mouse/cursor key movements.
- P. Field Engineering Tools:
1. Operator's workstation software shall include field-engineering tools for programming all controllers supplied. All controllers shall be programmed using graphical tools that allow the user to connect function blocks on screen that provide sequencing of all control logic. Function blocks shall be represented by graphical displays that are easily identified and distinct from other types of blocks. Graphical programming that uses simple rectangles and squares is not acceptable.
 2. User shall be able to pick graphical function block from menu and place on screen. Provide zoom in and zoom out capabilities. Function blocks shall be downloaded to controller without any reentry of data.
 3. Programming tools shall include a real time operation mode. Function blocks shall display real time data and be animated to show status of data inputs and outputs when in real time operation. Animation shall show change of status on logic devices and countdown of timer devices in graphical format.

4. Field engineering tools shall also include a database manager of applications that include logic files for controllers and associated graphics. Operator shall be able to select unit type, input/output configuration and other items that define unit to be controlled. Supply minimum of 250 applications as part of workstation software.
5. Field engineering tool shall include Device Manager for automatic detection of devices connected anywhere on the BACnet network by scanning of the entire network. This function shall display device instance, network identification, model number and description of connected devices. It shall record and display software file loaded into each controller. A copy of each file shall be stored on the computer's hard drive. If needed, this file shall be downloaded to the appropriate controller by selection using the mouse.

Q. Software:

1. At the conclusion of project, contractor shall leave with owner a CD ROM or flash drive that includes the complete software operation system and project graphics, setpoints, system parameters, etc. This backup shall allow the owner to completely restore the system in the case of a computer malfunction.

2.4 BUILDING CONTROLLER

- A. This system is an addition to the existing control system and shall be connected to the existing building controller if feasible. Field verify if existing building controller can be expanded or if additional building controller(s) is necessary.

B. General:

1. All communication with operator workstation and all application controllers shall be via BACnet. Building controller shall incorporate as a minimum, the functions of a 3-way BACnet router. Controller shall route BACnet messages between the high-speed LAN (Ethernet 10/100MHz), at least 4 master slave token passing (MS/TP) LANs, a point-to-point (PTP - RS-232) connection and an on-board modem.
 - a. Each MS/TP LAN must be software configurable from 9.6 to 76.8Kbps.
 - b. The RJ-45 Ethernet connection must accept either 10Base-T or 100Base-TX BACnet over twisted pair cable (UTP).
 - c. The direct access port must be a female DB-9 connector supporting BACnet temporary PTP connection of a portable BACnet operator terminal at 9.6 to 115.2 Kbps over RS-232 null modem cable.
2. Building controller shall be capable of providing global control strategies for the system based on information from any objects in the system regardless if the object is directly monitored by the controller or by another controller. The program that implements these strategies shall be completely flexible and user definable. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site or downloaded via remote communications are not acceptable. Changing global strategies via firmware changes is also unacceptable.
3. Programming shall be object-oriented using control function blocks, supporting DDC functions, 1000 Analog Values and 1000 Binary Values. All flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be resident on workstation and the same tool used for all controllers.
4. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed via the operator's workstation or field computer.
5. Building controller shall provide battery-backed real-time (hardware) clock functions.
6. Controller shall have a memory needed to ensure high performance and data reliability. Battery shall retain static RAM memory and real-time clock functions for a minimum of 1.5 years (cumulative).
7. Global control algorithms and automated control functions should execute via 32-bit processor.
8. Controller installation shall include memory-free gel-cell battery providing ongoing power conditioning and noise filtering for operation data integrity. It shall provide up to 5 minutes of powerless operation for orderly shutdown and data backup.
9. BACnet Conformance:
 - a. Building Controller shall as a minimum support Point-to-Point (PTP), MS/TP and Ethernet BACnet LAN types. It shall communicate directly via these BACnet LANs as a Native BACnet device and shall support simultaneous routing functions between all supported LAN types.

Global controller shall be a BACnet conformance class 3 device and support all BACnet services necessary to provide the following BACnet functional groups:

- b. Clock Functional Group
 - 1) Files Functional Group
 - 2) Reinitialize Functional Group
 - 3) Device Communications Functional Group
 - 4) Event Initiation Functional Group
 10. Refer to section 22.2, BACnet Functional Groups, in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 11. Standard BACnet object types supported shall include as a minimum: Analog Value, Binary Value, Calendar, Device, File, Group, Notification Class, Program and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 12. The Building Controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs) and function as a BACnet Broadcast Management Device (BBMD).
- C. Schedules:
1. Each building controller shall support a minimum of 250 BACnet Schedule Objects and 250 BACnet Calendar Objects.
- D. Logging Capabilities:
1. Each building controller shall log as minimum 1000 trendlogs. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
 2. Logs may be viewed both on-site or off-site via remote communication.
 3. Building controller shall periodically upload trended data to networked operator's workstation for long term archiving if desired.
 4. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.
 5. Alarm Generation:
 - a. Alarms may be generated within the system for any object change of value or state either real or calculated. This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
 - b. Each alarm may be dialed out as noted in paragraph 2 above.
 - c. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site via remote communications.
 - d. Controller must be able to handle up to 1500 alarm setups stored as BACnet event enrollment objects - system destination and actions individually configurable.

2.5 WEB BROWSER CLIENTS

- A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Mozilla Firefox™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.
- B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., to allow the Web browser to function with the EMCS shall not be acceptable.
- C. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

- D. The Web browser client shall support at a minimum, the following functions:
1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security authentication and encryption techniques to prevent unauthorized access shall be implemented.
 2. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
 3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
 4. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
 5. Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh" of the Web page.
 6. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
 - a. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
 - 1) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - 2) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
 - b. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
 - c. View logs and charts
 - d. View and acknowledge alarms
 7. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
 8. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

2.6 TERMINAL UNIT APPLICATION CONTROLLERS (ROOFTOPS, HEAT PUMPS, AC UNITS, FAN COILS)

- A. General:
1. Provide one Native BACnet application controller for each piece of unitary mechanical equipment that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output, and self-contained logic program as needed for complete control of unit.
 2. For existing RTUs, all controllers shall be capable of adequately covering the points listed for new RTU equipment (for the expectation of future HVAC replacements).
- B. BACnet Conformance:
1. Application controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4, and 76.8 Kbps, as a Native BACnet device. Application controllers shall be of BACnet conformance class 3 and support all BACnet services necessary to provide the following BACnet functional groups:
 - a. Files Functional Group
 - b. Reinitialize Functional Group
 - c. Device Communications Functional Group
 2. Refer to section 22.2, BACnet Functional Groups in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 3. Standard BACnet object types supported shall include as a minimum-Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as

- part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
4. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0-5 VDC, 4-20 mA, dry contact signals and a minimum of 3 pulse inputs. Any input on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor. Controller shall include binary outputs on board with analog outputs as needed.
 5. All program sequences shall be stored on board controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using same programming tools as building controller and as described in operator workstation section. All programming tools shall be provided and installed as part of system.
 6. Application controller shall include support for intelligent room sensor (see Section 2.9.B.). Display on room sensor shall be programmable at controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.
- C. Smoke Detectors:
1. Smoke detectors (duct and area type) shall be provided, installed, and wired into the Fire Alarm System by the Electrical Contractor. The Controls Contractor shall be responsible for interlock wiring between duct smoke detectors and control relays, and starter safety circuits.

2.7 ELECTRONIC ACTUATORS

- A. General:
1. Shall be Electric unless otherwise specified.
 2. Shall be manufactured by Belimo. **Equal substitutions allowed with written approval by owner prior to bid.**
 3. Five-year manufacturer's warranty. Two-year unconditional and three-year product defect from date of installation.
 4. Furnish a Freeze-stat and install "Hard Wire" interlock to disconnect the mechanical spring return actuator power circuit for fail-safe operation. Use of the control signal to drive the actuators closed is not acceptable.
 5. VAV box damper actuation shall be Floating type or Analog (2-10vdc, 4-20ma) and provide to VAV box manufactured for factory installation.
 6. Booster-heat valve actuation shall be Floating type or Analog (2-10vdc, 4-20ma).
 7. Primary valve control shall be Analog (2-10vdc, 4-20ma).
 8. UL Listed Standard 873 and Canadian Standards Association Class 481302 shall certify Actuators.
 9. Mechanical spring shall be provided when specified. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
 10. Position indicator device shall be installed and made visible to the exposed side of the Actuator. For damper short shaft mounting, a separate indicator shall be provided to the exposed side of the Actuator.
 11. Overload Protection: Actuators shall provide protection against actuator burnout by using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation are acceptable only for Butterfly Valve actuators.
 12. A push button gearbox release shall be provided for all non-spring actuators.
 13. Modulating actuators shall be 24VAC and consume 10VA power or less.
 14. Conduit connectors are required when specified and when code requires it.
- B. Damper Actuators:
1. **All damper actuators shall be provided and installed by EMCS contractor.**
 2. Electronic damper actuators shall be direct-coupled rotary type, suitable for mounting directly on the damper end shaft. Electronic damper actuators shall be properly sized to provide sufficient torque to position the damper throughout its operating range. Damper actuators used on

- economizer and/or outside air dampers shall be spring return.
3. Terminal unit damper actuators shall be electric, low voltage, utilizing floating control.
 4. Outside Air and Exhaust Air Damper Actuators shall be Mechanical Spring Return. Capacitors or other non-mechanical forms of fail-safe are not acceptable. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.
 5. **Economizer Actuators shall be provided and installed by EMCS contractor. Actuators shall utilize Analog control 2-10 VDC and shall give position feedback for Fault Detection and Diagnostics (FDD) monitoring. Floating control is not acceptable. Actuators shall be Mechanical Spring Return. Equal to Belimo LF-24-SR.**
 6. Electric damper actuators (including VAV box actuators) shall be direct shaft mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or setscrew type fasteners are not acceptable.
 7. One electronic actuator shall be direct shaft mounted per damper section. No connecting rods or jackshafts shall be needed. Small outside air and return air economizer dampers may be mechanically linked together if one actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.
 8. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per damper section. (See below execution section for more installation details.)

2.8 DAMPERS AND VALVES

A. Control Dampers:

1. Control air dampers shall be parallel blade for two-position control and opposed blade for modulating control applications. Dampers shall be galvanized with nylon bearings. Blade edge and tip seals shall be included for all dampers. Leakage through the damper shall not exceed **4 CFM per square foot at 1" w.c.** Blades shall be 16-gauge minimum and 10" wide maximum and frame shall be of welded channel iron. Dampers over 48" wide shall be equipped with a jackshaft to provide sufficient force throughout the intended operating range.
2. All dampers used for modulating service shall be opposed blade type arrange for normally open or normally closed operation as required. The damper is to be sized so that when wide open the pressure drop is a sufficient amount of its close-off pressure drop for effective throttling.
3. All dampers used for two-position or open-close control shall be parallel blade type arranged for normally open or closed operation as required.
4. Damper linkage hardware shall be constructed of aluminum or corrosion resistant zinc & nickel-plated steel and furnished as follows:
 - a. Bearing support bracket and drive blade pin extension shall be provided for each damper section. Sheet metal contractor shall install bearing support bracket and drive blade pin extension. Sheet metal contractor shall provide permanent indication of blade position by scratching or marking the visible end of the drive blade pin extension.
 - b. Drive pin may be round only if V-bolt and toothed V-clamp is used to cause a cold weld effect for positive gripping. For single bolt or set-screw type actuator fasteners, round damper pin shafts must be milled with at least one side flat to avoid slippage.

B. Actuator mounting for damper and valve arrangements shall comply to the following:

1. Damper Actuators: Shall not be installed in the air stream
2. A weather shield shall be used if actuators are located outside. For Damper Actuators use clear plastic enclosure.
3. Damper or valve actuator ambient temperature shall not exceed 122°F through any combination of medium temperature or surrounding air. Appropriate air gaps, thermal isolation washers or spacers, standoff legs, or insulation shall be provided as necessary.
4. Actuator cords or conduit shall incorporate a drip leg if condensation is possible. Water shall not be allowed to contact actuator or internal parts. Location of conduits in temperatures dropping below dew point shall be avoided to prevent water from condensing in conduit and running into actuator.
5. Damper mounting arrangements shall comply to the following:
 - a. The ventilation subcontractor shall furnish and install damper channel supports and sheet metal collars.
 - b. No jack shafting of damper sections shall be allowed.

- c. Multi-section dampers shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per section.

2.9 ENCLOSURES

- A. NEMA 2 rated enclosures for inside mounting, provide with weather shield for outside mounting.
- B. All controllers, power supplies, and relays shall be mounted in enclosures.
- C. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment. Indoor enclosures shall be NEMA 12 when installed in other than a clean environment.
- D. Enclosures shall have hinged, locking doors.
- E. Provide laminated plastic nameplates for all enclosures in any mechanical room or electrical room. Include location and unit served on nameplate. Laminated plastic shall be 1/8" thick sized appropriately to make label easy to read.
- F. All direct digital controllers located indoors shall be installed in NEMA 1 enclosures. All direct digital controllers located outdoors shall be installed in NEMA 3R enclosures. Enclosures shall be of suitable size to accommodate all power supplies, relays, and accessories required for the application. Each enclosure shall include a perforated subpanel for direct mounting of the enclosed devices. Include matched key locks for all enclosures provided.

2.10 SENSORS, SWITCHES, CONTROLLERS, TRANSDUCERS, AND MISCELLANEOUS DEVICES

- A. Temperature Sensors:
 - 1. All temperature sensors to be solid state electronic, factory-calibrated to within 0.5°F, totally interchangeable with housing appropriate for application. Wall sensors to be installed as indicated on drawings. Mount 48 inches above finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells provided by control contractor, but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake and in a location that is in the shade most of the day.
- B. Intelligent Room Sensor with LCD Readout:
 - 1. Sensor shall contain a backlit LCD digital display and user function keys along with temperature sensor. Controller shall function as room control unit, and shall allow occupant to raise and lower setpoint, and activate terminal unit for override use all within limits as programmed by building operator. Sensor shall also allow service technician access to hidden functions as described in sequence of operation.
 - 2. The Intelligent Room Sensor shall simultaneously display room setpoint, room temperature, outside temperature, and fan status (if applicable) at each controller. This unit shall be programmable, allowing site developers the flexibility to configure the display to match their application. The site developer should be able to program the unit to display time-of-day, room humidity, and outdoor humidity. Unit must have the capability to show temperatures in Fahrenheit or Centigrade.
 - 3. Override time may be set and viewed in half-hour increments. Override time count down shall be automatic, but may be reset to zero by occupant from the sensor. Time remaining shall be displayed. Display shall show the word "OFF" in unoccupied mode unless a function button is pressed.
 - 4. See sequence of operation for specific operation of LCD displays and function keys in field service mode and in normal occupant mode. Provide intelligent room sensors as specified in point list.
 - 5. Field service mode shall be customizable to fit different applications. If intelligent room sensor is connected to VAV controller, VAV box shall be balanced and all airflow parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.
- C. Field Service Tool:
 - 1. Field service tool shall allow technician to view and modify all setpoints and tuning parameters stored in application controller. In addition, technician shall be able to view status of all inputs and

- outputs on digital readout. Each piece of data shall have a data code associated with it that is customizable.
2. Field service tool shall plug into wall sensor and provide all the functionality specified. Operator workstation shall include the capability to disable operation of the field service tool.
 3. Provide Field Service Tool(s) for this project.
- D. Network Connection Tool:
1. Network connection tool shall allow technician to connect a laptop to any MS/TP network or at any MS/TP device and view and modify all information throughout the entire BACnet network. Laptop connection to tool shall be via Ethernet or PTP.
 2. Provide quick connect to MS/TP LAN at each controller. Tool shall be able to adjust to all MS/TP baud rates specified in the BACnet standard.
 3. Provide 1 Network Connection Tool for this project.
- E. Differential Pressure Switches (Air):
1. Provide differential pressure switches across fans and filters for status indication. Differential pressure switches shall have an adjustable setpoint from 0.05" w.c. to 2" w.c. with a switch differential that progressively increases from 0.02" w.c. at minimum to 0.8" w.c. at maximum. Switch shall be SPDT rated for 15A (non-inductive) at 277VAC.
- F. Float Switches:
1. Provide float switches in condensate drain pans as required by code. Float switches shall utilize a magnetically actuated dry reed switch. Float shall be constructed of seamless polypropylene. Switch shall be SPDT rated for 16A (non-inductive) at 120VAC.
- G. Mixed Air Low Limit Controllers (Freezestats):
1. Mixed air low limit controllers shall be manual reset, adjustable setpoint with 20-foot element serpentine across the entering air face of center cooling coil. Control shall be responsive only to the lowest temperature along the element.
- H. Static High Limit Controllers:
1. Discharge static high limit controllers shall be provided on all VAV AHU systems. When discharge static pressure exceeds setpoint, the supply fan shall be de-energized. Manual reset shall be required.
- I. Static Pressure Transducers (Air):
1. Provide static pressure transducers for monitoring supply duct static pressure. Static pressure transducers shall be 100% solid state and shall include glass on silicon, ultra stable capacitance sensors. Each static pressure transducer shall incorporate short circuit and reverse polarity protection. Transmitter output shall be either 0-10VDC or 4-20mA. Static pressure transducers are to be provided in an enclosure that is suitable for duct mounting. The desired setpoint is to be in the top 50% of the transmitter's operating range.
- J. Differential Pressure Transducers (Air):
1. Provide differential pressure transducers for monitoring air system and airflow measuring station differential pressures. Differential pressure transducers shall be 100% solid state and shall include glass on silicon, ultra stable capacitance sensors. Each differential pressure transducer shall incorporate short circuit and reverse polarity protection. Transducer output shall be either 0-10VDC or 4-20mA. Differential pressure transducers are to be provided in an enclosure that is suitable for duct mounting. The desired setpoint is to be in the top 50% of the transducer's operating range.
- K. Current Sensing Relays:
1. Provide current switches for indication of equipment status. Amperage ratings shall be adjustable with the desired setpoint to be in the top 50% of the current relay's operating range. Current sensing relays shall incorporate trip indication LED's and shall be sized for proper operation with the equipment served.
- L. Relative Humidity Sensors:
1. Relative humidity sensors shall have an accuracy of +/- 2% from 5 to 95% RH. Output signal shall be either be 0-10VDC or 4-20mA. Humidity transmitters shall be factory calibrated and require no field setting.

- M. CO2 Sensors:
1. CO2 sensors shall be space or duct mounted carbon dioxide sensors as required by the application. Space CO2 sensors shall be mounted next to space temperature sensors. The sensor shall have a range of 0-2000 ppm with an accuracy of $\pm 5\%$. The response time for the sensor shall be less than one minute. The sensor shall be capable of providing an analog signal proportional to the CO2 level sensed. The signal shall be either 0-10VDC or 4-20mA.
- N. Duct/Well Sensors:
1. Sensors for duct and water temperature sensing shall incorporate either RTD or Thermistor sensing devices. Sensing element accuracy shall be 0.1% over the sensor span or better. Where the element is being used for sensing mixed air or coil discharge temperatures and/or the duct cross sectional area is in excess of 14 square feet, the element shall be of the averaging type. Averaging duct sensors shall utilize a 6, 12, or 24 foot sensing element. Immersion sensors shall use matched 316 stainless steel bulb wells. All duct and immersion sensors shall be provided with conduit connection housings. Sensors shall be provided with adequate standoffs for insulation installation.
- O. Selector Switches:
1. Selector switches shall be 2 or 3-position, knob, or key type as required by the sequence of operation. Selector switches shall feature oil tight construction and be fitted with snap-fit contact blocks rated for 10A, 600VAC/DC operation. Labels shall be provided indicating switch position.
- P. Pushbutton Switches:
1. Pushbutton switches shall be either maintained or momentary as required by the sequence of operation. Pushbutton switches shall feature oil tight construction and be fitted with snap-fit contact blocks rated for 10A, 600VAC/DC operation. Labels shall be provided indicating switch function.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.
- B. Notify the owners` representative in writing of conditions detrimental to the proper and timely completion of the work.
- C. Do not begin work until all unsatisfactory conditions are resolved.
- D. Each bid must include all costs associated with providing wiring, conduit, concrete trenching, and earth trenching.

3.2 OPERATION

- A. BACnet Object List:
1. The following points as defined for each piece of equipment are designated as follows:
 - a. Binary Out (BO) - Defined as any two-state output (start/stop) (enable/disable), etc.
 - b. Binary In (BI) - Defined as any two-state input (alarm, status), etc.
 - c. Analog In (AI) - Defined as any variable input (temperature) (position), etc.
 - d. Analog Out (AO) - Defined as any electrical variable output. 0-20mA, 4-20mA, and 0-10VDC are the only acceptable analog outputs. The driver for analog outputs must come from both hardware and software resident in the controllers. Transducers will not be acceptable under any circumstance.
 2. Each and every point will be checked out by the Contractor and the Owner`s Representative will inspect each point with the bidder prior to acceptance. Provide complete written documented inspections, test, and checkout report. Calibrate all equipment.
- B. DDC Object Type Summary:
1. Provide all database generation.
 2. Displays:

- a. System displays shall show all analog and binary object types within the system. They shall be logically laid out for easy use by the owner. Provide outside air temperature indication on all system displays associated with economizer cycles.
3. Run Time Totalization:
 - a. At a minimum, run time totalization shall be incorporated for each monitored supply fan, return fan, exhaust fan, hot water and chilled water pumps. Warning limits for each point shall be entered for alarm and or maintenance purposes.
4. Trendlog:
 - a. All binary and analog object types (including zones) shall have the capability to be automatically trended.
5. Alarm:
 - a. All analog inputs (High/Low Limits) and selected binary input alarm points shall be prioritized and routed (locally or remotely) with alarm message per owner's requirements.
6. Database Save:
 - a. Provide backup database for all stand-alone application controllers on disk.

3.3 INSTALLATION

A. General:

1. Install in accordance with manufacturer's instructions.
2. Provide all miscellaneous devices, hardware, software, interconnections installation, and programming required to ensure a complete operating system in accordance with the sequences of operation and point schedules.
3. Provide a complete and operational temperature control and building automation system based on the following points and sequence of operation. The system shall be complete as to sequences and standard control practices. The determined point list is the minimum amount of points that are to be provided. If additional points are required to meet the sequence of operation, they will be provided.

B. Location and Installation of Components:

1. Locate and install components for easy accessibility; in general, mount 48 inches above floor with minimum 3'-0" clear access space in front of units. Obtain approval on locations from owner's representative prior to installation.
2. Enclosures and hardware or wiring shall not block or limit accessibility to service compartments of any other equipment.
3. The work shall be coordinated fully, as it pertains to the fire protection system, fire alarm system, and electrical power system. All items shall be terminated in the DDC controllers in a predetermined order as indicated in the submittal drawings.
4. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration, moisture, and high or low temperatures.
5. Identify all equipment and panels. Provide permanently mounted tags for all panels.
6. Provide stainless steel or brass thermowells suitable for respective application and for installation under other sections - sized to suit pipe diameter without restricting flow.

C. Interlocking and Control Wiring:

1. Provide all interlock and control wiring. All wiring shall be installed neatly and professionally, in accordance with Specification Division 26 and all national, state, and local electrical codes.
2. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions. Provide shielded low capacitance wire for all communications trunks.
3. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the owner's representative prior to rough-in.
4. Provide auxiliary pilot duty relays on motor starters as required for control function.
5. Provide power for all control components from nearest electrical control panel or as indicated on the electrical drawings. Coordinate with electrical contractor.
6. All control wiring in the mechanical, electrical, telephone and boiler rooms to be installed in conduit. All other wiring to be installed neatly and inconspicuously per local code requirements. If local code allows, control wiring above accessible ceiling spaces may be run with plenum rated

cable (without conduit).

D. Installation Requirements:

1. Any panels associated with the control system shall be furnished and installed under this section of the work. Panel wiring shall be terminated by connecting to numbered terminals strips. Wire nut connections shall not be allowed. All wiring shall be color coded and shall be tagged for future identification.
2. Unless otherwise specified, all devices, panels, etc., furnished and/or installed by the Contractor shall be located where they can be calibrated and maintained from the floor without use of a ladder. These items shall be identified by means of plates made of plastic suitably engraved, embossed, or punched, plastic tape will not be acceptable. At completion of job, the Contractor shall submit record drawings of any changes made during construction. This submittal shall be a condition of final payment.
3. Any conduit on roof shall be absolute minimum and shall have prior written approval.
4. All conduit used indoor and outdoor shall be metal and shall be of type and fittings to minimize corrosion and moisture entry.

E. Cable Installation and Attachments:

1. Control System wiring and equipment installation shall be in accordance with good engineering practices as established by the TIA/EIA and the NEC. Wiring shall meet all state and local electrical codes. All wiring shall test free from all grounds and shorts. All cable shall be supported from the building structure and bundled.
2. The support system shall provide a protective pathway to eliminate stress that could damage the cabling. The cable shall not be crushed, deformed, skinned, crimped, twisted, or formed into tight radius bends that could compromise the integrity of the cabling. Controls cables shall not be run loose on ceiling grid or ceiling tiles. Support shall be provided by mounting appropriate fasteners which may be loaded with multiple cables. Provided that the weight load is carried by the support rod or wire, the support assembly may attach to the ceiling grid for lateral stabilization. The required support wires for the ceiling grid or light fixtures shall not be utilized. Any fastener attached to the ceiling grid shall not interfere with inserting or removing ceiling tiles. All cabling and supports must be positioned at least 12 inches above the ceiling grid.
3. Controls cables shall be run in bundles above accessible ceilings and supported from building structure. Cabling shall be loosely bundled with wire wraps randomly spaced at 30 to 48 inches on center, wire wraps shall not be tight enough to deform cabling and shall not be used to support the cabling.
4. Attachments for cabling support shall be spaced at 48 to 60 inches on center. The cable bundle shall not be allowed to sag more than 12 inches mid-span between attachments. Attachments shall be sized as follows:

Bundles up to 1/2" dia. (Ten 1/4" cables)	2" bridle ring, Caddy #4BRT32 or equivalent
Bundles up to 3/4" dia. (Sixteen 1/4" cables)	3/4" J-Hook, Caddy #CAT12 or equivalent
Bundles up to 1-5/16" dia. (Fifty 1/4" cables)	1-5/16" J-Hook, Caddy #CAT21 or equivalent
Bundles up to 2" dia. (Eighty 1/4" cables)	2" J-Hook, Caddy #CAT21 or equivalent

Split bundles greater than 2" dia. or provide cable tray.
5. Do not mix different signal strength cables on the same J-Hook (i.e. fire alarm, 25 volt speaker cable). Multiple J-Hooks can be on the same attachment point up to the rated weight of the attachment device.
6. Controls cables shall be run in conduit stubs, where stubs are provided, from wall mounted devices to above accessible ceilings. Conduit shall be required only within walls and concealed spaces to provide access. Provide a plastic snap bushing or sleeve on the end of each conduit stub such as Thomas & Betts Catalog no. 443 - 3/4", 424 - 1", 425 - 1 1/4", 427 - 2" or equivalent.
7. Conduit, duct, or track shall be used for controls cable in exposed areas.
8. All conduit, ducts, track and raceways shall be supported from the structure at industry standard intervals for the size specified, utilizing proper anchoring devices and techniques for each type of cable used.
9. All penetrations through fire rated walls or floors shall feature a short length of metal conduit. The hole shall be neatly cut, not oversize or irregular. Seal the interior of the conduit sleeve around the cables and around the outside of the sleeve on each side of the penetration with fire-stop caulk or

- putty, such as Minnesota Mining & Mfg. Co. (3M) - CP 25WB+ caulk, MPS-2+ putty, or equivalent. Install according to the manufacturers' instructions.
10. All cable shall have a label on both ends utilizing self-laminating, flexible vinyl film, and non-smear nylon marking pens. Utilize Tyton Corporation Part No. RO175 Rite-On labels and Part No. FTP1 nylon marking pens or equivalent.
 11. Each cable run shall include a three foot service loop with wire tie located in the ceiling above the control unit panel. This is to allow for future re-termination or repair.
 12. No terminations or splices shall be installed in or above ceilings. Cable shall be continuous from one device termination to the next.
 13. Mount all equipment firmly in place. Route cable in a professional, neat, and orderly installation.
 14. All cabling shall be placed with regard to the environment, EMI/RFI (interference) and its effect on communication signal transmission.
 15. Do not route any controls cable within two feet of any light fixture, HVAC unit service access area, electric panel, or any device containing a motor or transformer.
 16. Low voltage controls cable will not be installed in the same conduit, duct or track with line voltage electrical cable.
 17. Maximum pulling tension should not exceed 25 lb/ft. or manufactures recommendation, whichever is less.
 18. Any pulling compounds utilized must be approved by the cable manufacturer and shall not degrade the strength or electrical characteristics of the cable.
 19. Cable bends shall not exceed the manufacturers' suggested bend radius.
 20. Provide for adequate ventilation in all equipment panels.
 21. Provide wiremold where wiring must run exposed. Obtain advance approval from Architect and Owner before running exposed. Coordinate with Owner and Architect.
 22. For all wiring, provide numbering on all terminations (both ends).
 23. Label all panels, cans, enclosures, controllers and correlate with air conditioning units served. Labeling shall relate to shop drawings and equipment served. Provide wiring diagram inside each enclosure.
 24. Provide a rain-tight enclosure for each rooftop unit controller.
 25. Locate outdoor air sensors shielded and on northern exposure.

F. Termination practices:

1. Strip back only as much cable jacket as required to terminate.
2. Preserve wire twists as closely as possible to point of termination (0.5" maximum) to keep signal impairment to a minimum.
3. Avoid twisting cable during installation.
4. Electrical Interlocks:
 - a. All electrical interlocks shall be provided as specified. All electrical interlocks shall be made by means of motor starters or shall be accomplished by separate relays. No motor power lead shall be utilized in an interlock circuit.

3.4 SERVICES

A. Field Services:

1. Prepare and start logic control system under provisions of this section.
2. Start-up and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
3. Provide the capability for off-site monitoring at control contractor's local or main office. At a minimum, off-site facility shall be capable of system diagnostics and software download. Owner shall provide phone line for this service for 1 year or as specified.
4. Provide Owner's Representative with spare parts list. Identify equipment critical to maintaining the integrity of the operating system.

B. HVAC Training:

1. Provide application engineer to instruct owner in operation of systems and equipment.
2. Provide system operator's training to include (but not limited to) such items as the following: modification of data displays, alarm and status descriptors, requesting data, execution of commands, and request of logs. Provide this training to a minimum of 3 persons.
3. Provide on-site training above as required, up to 16 hours as part of this contract.

C. Demonstration:

1. Provide systems demonstration under provisions of Section 23 00 00.
 2. Demonstrate complete operating system to owner's representative.
 3. Provide certificate stating that control system has been tested and adjusted for proper operation.
- D. Programming:
1. Prior to completion of the control installation, schedule time with Owner's designated representatives to evaluate and select programming options and requirements. Contractor shall provide engineer for such meetings and consultations on an as-needed basis. Preparation time for the conference shall be in addition to the "in conference" time, and shall be provided on an as-needed basis without additional cost to the Owner.
 2. The Contractor shall also provide additional coordination as needed with the Owner's representative and Engineer to formulate and determine functions, reports, graphics, and alarms most desirable and suitable for the school district and writing the software capability. Programming of these items shall be provided. The Contractor shall program the system using coordinated Owner provided schedules for time of day and holidays.
 3. No hardware change shall be required for program changes.
- E. Documentation:
1. The Contractor shall provide a complete documentation package to the owner which shall include floor plans indicating location of EMCS equipment, wiring diagrams, bill of materials, data base information, and sequences of operation. The sequences of operation shall be submitted and approved by the owner in writing prior to installation and programming.
- F. Coordination:
1. For construction project installations where electrical and mechanical contractors are responsible for their respective trade, the electrical contractor is to provide line voltage to required equipment and the mechanical contractor is to install any devices that are to be included in systems. It is the controls contractor's responsibility to provide all devices with diagrams for location and coordinate with mechanical contractor prior to mechanical contractor starting installations. Controls contractor shall coordinate and provide all required work and wiring for duct mounted smoke detectors, control relays for unit shutdown, and interface with any fire alarm system. For installations where controls only work is provided, all necessary work shall be performed by the controls contractor.

PART 4 SEQUENCE OF OPERATION

4.1 SEQUENCE OF OPERATION

- A. The following are sequences of operations which will be accomplished by the EMCS. Coordinate with Owner in operating equipment to maximize comfort and economy. All points required to accomplish the sequences will be provided and connected to the EMCS.
- B. DDC Control - Rooftop Units, Split Systems, DX Units, and Heat Pumps: Each unit shall be started and stopped by the EMCS. Automatic override during low or high ambient temperatures shall be provided. Provide one outdoor air sensor per school. Provide an indoor air space sensor for every unit to monitor space temperature, and be capable of remote resetting space temperature by Owner.
- C. Provide one outside air relative humidity sensor and temperature sensor per campus. It is also acceptable to obtain outside air ambient conditions from a nearby weather station.
- D. Acronyms:

EMCS - Energy Management Control System. The EMCS controls all of the HVAC functions as well as lighting schedules and lawn sprinkler schedules.
TCS - Temperature Control Sensor. This is the device that controls the temperature in the space.
VFD - Variable Frequency Drive.
DDC - Direct Digital Control.
OAU - Outside Air Unit.
CO2 - Carbon Dioxide.
CFM - Cubic Feet per Minute
GPM - Gallons Per Minute

A/H - Air Handler
F/C - Fan Coil Unit
CHW - Chilled Water
HW - Hot Water

VAV - Variable Air Volume
UCP - Unit Control Panel

ppm - Parts Per Million - A measurement of the concentration of one substance within another. In this case, it is the number of CO₂ particles in a sample of one million air particles.

Adj - Adjustable - All set points are assumed to be adjustable whether specified or not. The set points specified are values that should be programmed initially but can be changed if necessary.

E. Definitions:

1. Occupancy Period:

a. The period of the day that the owner wants the environmental conditions acceptable for occupancy. Outside air ventilation may not be enabled at all times during the occupancy period. This schedule will be defined for each component of the HVAC system and will not be the same for all components.

2. Outside Air Schedule:

a. The period of the day that outside air ventilation is enabled. This schedule will be defined for each component of the HVAC system.

3. Warm-up Mode:

a. The time between the end of the unoccupied and start of the occupied period during which the space temperature is increased (night setback) to the normal occupancy temperature.

4. Cool-down Mode:

a. The time between the end of the unoccupied and start of the occupied period during which the space temperature is lowered (night setup) to the normal occupied temperature.

5. Unoccupied Period:

a. The period of the day that the temperature control setting is lowered (heating) or raised (cooling) to conserve on the amount of energy required to condition the building. The fans are also turned "OFF" to conserve energy.

F. Documentation:

1. The Contractor shall provide a complete documentation package to the owner which shall include floor plans indicating location of EMCS equipment, wiring diagrams, bill of materials, database information, and sequences of operation. The sequences of operation shall be submitted and approved by the owner in writing prior to installation and programming.

END OF SECTION

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SECTION 23 09 23A
SEQUENCE OF OPERATIONS GENERAL

PART 1 - GENERAL

1.1 NOT USED

PART 2 - PRODUCTS

2.1 NOT APPLICABLE

PART 3 - EXECUTION

3.1 CONTROL

A. Building Electrical:

1. General:

- a. Provide digital monitoring of building MSB's. The EMCS shall monitor the electrical energy consumption at the buildings main electric feeds. Coordinate with all existing conditions and switchgear manufacturer and/or electrical contractor on which peices of equipment have available interfaces.
- b. Provide dashboard with daily, weekly, monthly, and yearly usage totals.

2. Control Points:

Description	Type
KVA	AI
KWH	AI
Demand	AI
Power Factor	AI
Voltage	AI

B. Exterior Lighting - New and Existing:

1. General:

- a. Provide auxiliary contactor(s) to control lighting. Include all hardware and software required and connect to nearest EMCS controller. Coordinate with electrical contractor and existing conditions.

2. Control Points:

Description	Type
Photocell	AI/DI
Lighting Contactor	DO

C. Domestic Water Heater - New and Existing:

1. General:

- a. The domestic hot water heater(s) shall be monitored and associated circulating pump(s) shall be disabled/enabled by the EMCS based on a time schedule. The domestic hot water supply for the hot water heater shall be monitored and shall generate an alarm upon exceeding above or dropping below its assigned alarm limits (adj.). The points required to accomplish this sequence shall be connected to the nearest available EMCS controller.

2. Control Points:

Description	Type
Loop Hot Water Supply Temperature (Each Water Heater)	AI
Water Heater Amps/Status (Each Water Heater)	AI
Circulation Pump Amps/Status (Each Pump)	AI
Circulation Pump Start/Stop Command (Each Pump)	DO

D. Kitchen Cooler/Freezer Monitoring:

1. General:

- a. The walk-in cooler and the walk-in freezer shall each be monitored for space temperature. The EMCS shall generate an alarm should the space temperature exceed or drop below its assigned alarm limits (adj.)

2. Control Points:

Description	Type
Cooler Temperature	AI
Freezer Temperature	AI

E. Ambient Conditions:

1. General:

- a. The EMCS shall monitor and display the ambient outside conditions at the building. An online weather station service shall be used as primary. Additional hardwired sensors shall be located outside the building for northern exposure and be used when connectivity to local weather station has been lost.

2. Control Points:

Description	Type
Outside Temperature	AI
Outside Humidity	AI
Outside CO2	AI

F. Gang Toilet Exhaust Fans:

1. General:

- a. Fans to be disabled/enabled by the EMCS based on a time schedule.

2. Control Points:

Description	Type
Fan Amps/Status (Each Fan)	AI
Fan Start/Stop Command (Each Fan)	DO

G. Destratification Fans:

1. General:

- a. Fans to be disabled/enabled by the EMCS based on a time schedule.

2. Control Points:

Description	Type
Fans Amps/Status (Each Fan)	AI
Fan Start/Stop Command (Each Fan)	DO

H. Variable Frequency Drives:

1. General:

- a. The EMCS shall interface and monitor points from the VFDs.
 b. VFD interfaces shall be achieved via BACnet communication link.
 c. VFD data to be shown on associated unitary graphic.
 d. Provide dashboard with daily, weekly, monthly, and yearly usage totals for KWH and Runtime.

2. Control Points:

Description	Type
Start/Stop (Each VFD)	DI
Alarm (Each VFD)	DI
Percent Output (Each VFD)	AI
Frequency Output (Each VFD)	AI
Amperage (Each VFD)	AI
KWH (Each VFD)	AI
Runtime (Each VFD)	AI

I. MFD/IDF Rooms:

1. General:
 - a. The EMCS shall monitor space temperature for all MDF/IDF rooms. The EMCS shall generate an alarm should the space temperature exceed or drop below its assigned alarm limits (adj.)
2. Control Points:

Description	Type
Space Temperature (Each Room)	AI

END OF SECTION

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SECTION 23 09 23B

SEQUENCE OF OPERATIONS FOR AIR HANDLING

PART 1 - GENERAL

1.1 NOT USED

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 VARIABLE AIR VOLUME AIR HANDLING UNIT AND REMOTE CONDENSING UNIT

A. General:

1. The system shall consist of an indoor VAV air handler with a remote DX condensing unit. The indoor unit shall have a supply fan, cooling coil, and outside air damper. The outside air damper shall be remotely mounted in the outside air ductwork. The control system contractor shall provide a dedicated stand-alone DDC controller for the indoor unit and the remote condensing unit along with all required control wiring and interlock to integrate the AHU and CU to operate as a complete system.

B. Unit Enabling/Disabling:

1. The occupied/unoccupied mode of operation shall be defined by the EMCS optimum start/stop schedule.
2. During unoccupied times, a minimum number of zones, 40% (adj.), shall request the AHU before AHU is allowed to operate.

C. Fan Control:

1. The unit shall operate when the associated VAV boxes it serves are in occupied mode and operational.
2. The supply fan VFD will be controlled by static pressure transducer 2/3rds of the way down the longest supply duct run. If the static pressure is below setpoint, the supply fan speed will be increased. If the static pressure is above setpoint, the supply fan speed will be decreased.
3. A static pressure reset algorithm shall be used with minimum and maximum limits of .5" to 1.2" (adj.). VAV boxes shall be polled for damper position. Static pressure shall be slowly decreased until 25% (adj.) of the VAV box damper positions are at least 90% open.
4. Minimum fan speed shall not be less than 30 Hz (adj.).
5. EMCS contractor shall integrate and control remote mounted VFD for the supply fan.

D. Temperature Control:

1. Warm-up or Cool-down:
 - a. The EMCS shall determine the required warm-up or cool-down period based on the optimized start algorithm.
 - b. Upon enabling the unit, the unit shall heat and cool as required to maintain the occupied heating and cooling setpoints (initially 70°F heating, 74°F cooling) as sensed by the indexed zone space temperature sensors.
 - c. During warm-up, the supply air discharge temperature shall be 90°F (adj.). During cool-down, the supply air temperature shall be 55°F (adj.).
 - d. Once the occupied setpoint temperature threshold has been reached, the EMCS shall switch the unit to the occupied mode.
2. Occupied Mode:
 - a. Cooling Coil:

- 1) The unit will modulate to maintain a scheduled cooling supply air setpoint at all times. Initially unit discharge supply air temperature of 55°F (adj.). There shall be a linear supply air temperature reset algorithm in between:
 - (a) 55°F supply air temperature supply when outside air temperature is at or above 80°F
 - (b) 60°F supply air temperature supply when outside air temperature is at or above 50°F
 3. Condensing Unit:
 - a. The remote condensing unit (consisting of 4 compressors/2 circuits and hot gas bypass) shall operate as required to maintain supply air temperature.
 - b. Condensing unit will have a factory installed RAWAL device.
 - 1) BMS to coordinate with Manufacturer on preferred control strategy:
 - (a) BMS to integrate to Eternal Control Board at the CU and control LAT via 0-10 or 4-20 vdc
 4. Unoccupied Mode:
 - a. The EMCS shall enable the unit as required to maintain the unoccupied cooling setpoints (initially 85°F cooling) as sensed by the indexed zone space temperature sensors. A minimum number of zones, 40% (adj.), shall request the AHU before AHU is allowed to operate.
- E. Outside Air Damper Control:
1. Warm-up or Cool-down:
 - a. The outside air damper shall be closed.
 2. Occupied Mode:
 - a. The outside air damper shall be at the minimum position (adj.) as set by TAB
 3. Unoccupied mode:
 - a. The outside air damper shall be closed.
- F. Dehumidification Mode:
1. Dehumidification mode shall be activated when unit is cooling and the return air relative humidity is above 60% (adj.).
 2. Dehumidification mode shall temporarily disable the cooling supply air temperature reset and maintain constant discharge air temperature at 53°F (adj.).
 3. Dehumidification shall disable when return air relative humidity is 2% (adj.) below humidity setpoint.
- G. Safeties:
1. Freeze Stat:
 - a. A temperature low limit switch shall be provided to disable the air handling unit and disable the call for cooling when it senses that the air temperature is below 36°F (adj.)
- H. Control Points:

Description	Type
Fan Amps/Status	AI
Filter Alarm	DI
Mixed Air Humidity	AI
Mixed Air Temperature	AI
Return Air Temperature	AI
Return Air Humidity	AI
Freeze Stat	AI
Supply Air Temperature	AI
Compressor Amps/Status (Each Compressor)	AI
Hot Gas Bypass	AI
Bipolar Ionization Status (If Scheduled/Equipped)	AI
Fan Start/Stop Command	DO
Fan VFD Speed	AO

Description	Type
Cooling Command (Each Stage)	DO/AO
Heating Control (Each Zone)	DO/AO
Outside Air Damper	AO

3.2 VARIABLE AIR VOLUME AIR HANDLING UNIT (CHILLED WATER/ HOT WATER PREHEAT/ DX COIL)

- A. General:
1. The unit shall have supply fan, hot water coil, chilled water coil, and outside air damper. The control system contractor shall provide a dedicated stand-alone DDC controller for each unit.
- B. Unit Enabling/Disabling:
1. The occupied/unoccupied mode of operation shall be defined by the EMCS optimum start/stop schedule.
 2. During unoccupied times, a minimum number of associated VAV boxes, 40% (adj.), shall request the AHU before AHU is allowed to operate.
 3. When the override pushbutton is depressed, the unit shall be indexed to the occupied mode for an adjustable period of time (initially 1 hour). After the override time period has expired, the unit shall revert back to the unoccupied mode.
- C. Fan Control:
1. The unit shall operate when the associated VAV boxes it serves are in occupied mode and operational.
 2. The supply fan VFD will be controlled by static pressure transducer 2/3rds of the way down the longest supply duct run. If the static pressure is below setpoint, the supply fan speed will be increased. If the static pressure is above setpoint, the supply fan speed will be decreased.
 3. A static pressure reset algorithm shall be used with minimum and maximum limits of .5" to 1.2" (adj.). VAV boxes shall be polled for damper position. Static pressure shall be slowly decreased until 25% (adj.) of the VAV box damper positions are at least 90% open.
- D. Temperature Control:
1. Warm-up or Cool-down:
 - a. The EMCS shall determine the required warm-up or cool-down period based on the optimized start algorithm.
 - b. Upon enabling the unit, the unit shall heat or cool as required to satisfy the occupied heating or cooling setpoints of 60% (adj.) of the VAV boxes (initially 70°F heating, 74°F cooling) as sensed by a space temperature sensor.
 - c. During warm-up, the supply air discharge temperature shall be 90°F (adj.). During cool-down, the supply air temperature shall be 53°F (adj.).
 - d. Once the occupied setpoint temperature threshold has been reached, the EMCS shall switch the unit to the occupied mode.
 2. Occupied Mode:
 - a. Preheat Coil:
 - 1) The preheat valve will modulate to maintain precool discharge air temperature of 50°F (adj.). Preheat coil shall be disabled when ambient outside air temperature is above 55°F (adj.).
 - b. Cooling Coil:
 - 1) The chilled water valve will modulate to initially maintain unit discharge supply air temperature of 53°F (adj.). There shall be a linear supply air temperature reset algorithm in between:
 - (a) 53°F (adj.) supply air temperature supply when outside air temperature is at or above 80°F (adj.)
 - (b) 58°F (adj.) supply air temperature supply when outside air temperature is at or above 50°F (adj.)
 3. After Hours Mode:
 - a. When system is commanded to operate after hours, the unit shall index the chilled water plant to verify if the system is currently running. If the plant is not operational at the time, the unit shall utilize the DX coil for supply air temperature control.
 4. Unoccupied Mode:

- a. The EMCS shall enable the unit as required to maintain the unoccupied heating and cooling setpoints (initially 55°F heating and 85°F cooling) as sensed by the VAV box space temperature sensors. A minimum number of associated VAV boxes, 40% (adj.), shall request the AHU before AHU is allowed to operate.

- E. Outside Air Damper Control:
 - 1. Warm-up or Cool-down:
 - a. The outside air damper shall be closed.
 - 2. Occupied Mode:
 - a. The outside air damper shall be at the minimum position (adj.) as set by TAB
 - b. EMCS shall monitor the CO2 level at return air duct/plenum:
 - 1) When CO2 levels are below 1100 ppm (adj.), the outside air damper shall be at the minimum position (adj.) as set by TAB. Reference scheduled CFM.
 - 2) When CO2 levels are above 1200 ppm (adj.), the outside air damper shall be at the maximum position (adj.) as set by TAB. Reference scheduled CFM.
 - 3. Unoccupied mode:
 - a. The outside air damper shall be closed.

- F. Dry Bulb Economizer Mode:
 - 1. In occupied or unoccupied mode, outside air temperature is 60°F (adj.) or below and there is a call for cooling, the unit shall be in economizer mode. Outside air damper is to open 100% and to provide free cooling. If cold deck setpoint is not met within 10 min (adj.), mechanical cooling will be enabled.

- G. Dehumidification Mode:
 - 1. Dehumidification mode shall be activated when the return air relative humidity is above 60% (adj.).
 - 2. Dehumidification mode shall temporarily disable the cooling supply air temperature reset and maintain constant discharge air temperature at 53°F (adj.).
 - 3. Dehumidification shall disable when return air relative humidity is 2% (adj.) below humidity setpoint.

- H. Safeties:
 - 1. Freeze Protection:
 - a. When the outside air (OA) temperature drops below 36°F (adj.), chilled water and hot water valves will be open to 20% if not already open.
 - b. When the OA temperature rises 2°F above freeze protection setpoint for one hour, the reverse shall occur.
 - 2. Freeze Stat:
 - a. A temperature low limit switch shall be provided to disable the unit and close all dampers when it senses that the air temperature is below 36°F (adj.)
 - 3. Static Pressure Switch:
 - a. A high static pressure switch shall be provided to disable the unit and close all dampers when pressure switch is activated.

- I. Control Points:

Description	Type
Fan Amps/Status	AI
Filter Alarm	DI
Mixed Air Temperature	AI
Return Air Temperature	AI
Return Air Humidity	AI
Return Air CO2	AI
Preheat Supply Air Temperature (PreCool)	AI
Unit Discharge Air temperature	AI
Static Pressure Sensor	AI
Freeze Status Alarm	DI
High Static Alarm	DI

Description	Type
Bipolar Ionization Status (If Scheduled/Equipped)	DI
Fan Start/Stop Command	DO
Fan VFD Speed	AO
Chilled Water Valve	AO
Hot Water Valve	AO
Outside Air Damper	AO

END OF SECTION

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SECTION 23 09 23G

SEQUENCE OF OPERATIONS ROOFTOP UNIT SEQUENCES

PART 1 GENERAL

1.1 NOT USED

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 SINGLE ZONE DX RTU WITH IONIZER

- A. General:
 - 1. System consists of a direct expansion (DX) cooling section, heating section, supply fan section, and an outside air damper.
- B. Unit Enabling/Disabling:
 - 1. The occupied/unoccupied mode of operation shall be defined by the EMCS optimum start/stop schedule.
 - 2. During unoccupied times, as required to maintain the unoccupied heating and cooling setpoints 55°F (adj.) heating and 85°F (adj.) cooling as sensed by the space temperature sensor.
 - 3. When the override pushbutton is depressed, the unit shall be indexed to the occupied mode for an adjustable period of time (initially 1 hour). After the override time period has expired, the unit shall revert back to the unoccupied mode.
- C. Fan Control:
 - 1. Fan speed shall be controlled by the unit's internal controls. If unit requires fan speed to be controlled by external source, contractor to provide everything necessary to achieve fan control as noted below.
 - a. Fan shall run in tandem with each associated stage of cooling/heating. Fan speeds shall correlate and be consistent with what is set by TAB.
 - b. For a two stage unit, fan shall have low and high fan speeds to coincide with each stage.
 - c. For a three stage unit, fan shall have low, medium and high fan speeds to coincide with each stage.
 - d. For a four stage unit, fan shall have low, low-medium, medium high and high fan speeds to coincide with each stage.
- D. Outside Air Damper Control:
 - 1. Warm-up or Cool-down:
 - a. The outside air damper shall be closed.
 - 2. Occupied Mode:
 - a. The outside air damper shall be at the minimum position (adj.) as set by TAB.
 - 3. Unoccupied Mode:
 - a. The outside air damper shall be closed.
- E. Temperature Control:
 - 1. Warm-up or Cool-down:
 - a. The EMCS shall determine the required warm-up or cool-down period based on the optimized start algorithm.
 - b. Upon enabling the unit, the unit shall heat and cool as required to maintain the occupied heating and cooling setpoints (initially 70°F heating, 74°F cooling) as sensed by a space temperature sensor.

- c. Once the occupied setpoint temperature has been reached, the EMCS shall switch the unit to the occupied mode.
 - 2. Occupied Mode:
 - a. Space setpoint shall be user adjustable within $\pm 2^{\circ}\text{F}$ (adj.).
 - b. In the occupied mode of operation, the unit supply fan shall cycle with a call for heating or cooling.
 - c. The unit shall heat and cool as required to maintain the occupied heating and cooling setpoints (initially 70°F heating, 74°F cooling) as sensed by a space temperature sensor.
 - d. When space temperature rises above occupied cooling setpoint, the DDC controller shall energize the first stage of mechanical cooling. Each stage cooling shall have a 20-minute (adj.) runtime before allowing the next stage to engage. When space temperature continues to rise 2°F (adj.) above occupied cooling setpoint, the DDC controller shall energize all stages of mechanical cooling.
 - 1) Unit shall run in second/medium/high stage cooling until space temperature drops to occupied space cooling setpoint. Unit shall then run in first stage of cooling until space temperature drops 1°F (adj.) below space temperature setpoint and then cycle off.
 - e. When space temperature drops below occupied heating setpoint, the DDC controller shall energize the first stage of heating. When space temperature continues to drop 2°F (adj.) below occupied heating setpoint, the DDC controller shall energize the second stage of heating.
 - 1) Unit shall run in second stage heating until space temperature rises to occupied space heating setpoint. Unit shall then run in first stage heating until space temperature rises 1°F (adj.) above space temperature setpoint and then cycle off.
 - 3. Unoccupied Mode:
 - a. The EMCS shall enable the unit as required to maintain the unoccupied heating and cooling setpoints (initially 55°F heating and 85°F cooling) as sensed by the space temperature sensor.
 - b. When override button is pushed, the unit shall index to occupied mode for one (1) hour (adj.). After the override time has expired, the unit shall revert to unoccupied mode.
- F. Dehumidification Mode (Only Applies to Units With Hot Gas Bypass):
- 1. Hot Gas Re-heat:
 - a. Dehumidification mode shall be energized when the space temperature setpoint is satisfied and the space relative humidity is above 58% (adj.). Reheat shall be controlled to supply neutral air. Dehumidification shall disable when space relative humidity is 2% (adj.) below humidity setpoint.

G. Control Points:

Description	Type
Fan Amps/Status	AI
Compressor Amps/Status (Each Compressor)	AI
Mixed Air Temperature	AI
Supply Air Temperature	AI
Outside Air Temperature (Global)	AI
Space Temperature	AI
Space Humidity (Only Units with Hot Gas Bypass)	AI
Bipolar Ionization Status	DI
Outside Air Damper Feedback	AI
Fan Start/Stop Command (Each Fan)	DO
Fan Speed (Only If Required by Unit)	AO
Compressor Cooling Command (Each Stage)	DO
Heating Command (Each Stage)	DO
Hot Gas Bypass Reheat (Only Units with Feature)	DO/AO
Outside Air Damper	AO

END OF SECTION

SECTION 23 09 23H

SEQUENCE OF OPERATIONS SPLIT SYSTEM SEQUENCES

PART 1 - GENERAL

1.1 NOT USED

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 HEAT PUMP SPLIT SYSTEM - DX AND HEAT AND IONIZER

- A. General:
1. The heat pump unit shall be provided with a filter, supply fan, cooling/heating coil, auxiliary heat, and outside air damper. The control system contractor shall provide a dedicated stand-alone DDC controller for each unit.
- B. Unit Enabling/Disabling:
1. The occupied/unoccupied mode of operation shall be defined by the EMCS optimum start/stop schedule.
 2. During unoccupied times, as required to maintain the unoccupied heating and cooling setpoints 55°F (adj.) heating and 85°F (adj.) cooling as sensed by the space temperature sensor.
 3. When the override pushbutton is depressed, the unit shall be indexed to the occupied mode for an adjustable period of time (initially 1 hour). After the override time period has expired, the unit shall revert back to the unoccupied mode.
- C. Fan Control:
1. Fan speed shall be controlled by the unit's internal controls.
- D. Outside Air Damper Control:
1. Warm-up or Cool-down:
 - a. The outside air damper shall be closed.
 2. Occupied Mode:
 - a. The outside air damper shall be at the minimum position (adj.) as set by TAB.
 3. Unoccupied Mode:
 - a. The outside air damper shall be closed.
- E. Temperature Control:
1. Warm-up or Cool-down:
 - a. The EMCS shall determine the required warm-up or cool-down period based on the optimized start algorithm.
 - b. Upon enabling the unit, the unit shall heat and cool as required to maintain the occupied heating and cooling setpoints (initially 70°F heating, 74°F cooling) as sensed by a space temperature sensor.
 - c. Once the occupied setpoint temperature has been reached, the EMCS shall switch the unit to the occupied mode.
 2. Occupied Mode:
 - a. Space setpoint shall be user adjustable within $\pm 2^\circ\text{F}$ (adj.).
 - b. In the occupied mode of operation, the unit supply fan shall cycle with a call for heating or cooling.
 - c. The unit shall heat and cool as required to maintain the occupied heating and cooling setpoints (initially 70°F heating, 74°F cooling) as sensed by a space temperature sensor.

- d. When space temperature rises above occupied cooling setpoint, the DDC controller shall energize the first stage of mechanical cooling. First stage cooling shall have a 20-minute (adj.) runtime before allowing second stage to engage. When space temperature continues to rise 2°F (adj.) above occupied cooling setpoint, the DDC controller shall energize the second stage of mechanical cooling.
 - 1) First stage cooling - Low speed supply CFM and first stage of compressor(s).
 - (a) Second stage cooling - High speed supply CFM and second stage of compressor(s).
 - (b) Unit shall run in second stage cooling until space temperature drops to occupied space cooling setpoint. Unit shall then run in first stage of cooling until space temperature drops 1°F (adj.) below space temperature setpoint and then cycle off.
 - e. When space temperature drops below occupied heating setpoint, the DDC controller shall energize the first stage of heat. When space temperature continues to drop 2°F (adj.) below occupied heat setpoint, the DDC controller shall energize the second stage of heat.
 - 1) First stage heating - Low speed supply CFM and first stage of heat.
 - 2) Second stage heating - High speed supply CFM and second stage of heating
 - (a) Unit shall run in second stage heating until space temperature rises to occupied space heating setpoint. Unit shall then run in first stage heating until space temperature rises 1°F (adj.) above space temperature setpoint and then cycle off.
3. Unoccupied Mode:
- a. The EMCS shall enable the unit as required to maintain the unoccupied heating and cooling setpoints (initially 55°F heating and 85°F cooling) as sensed by the space temperature sensor.
 - b. When override button is pushed, the unit shall index to occupied mode for one (1) hour (adj.). After the override time has expired, the unit shall revert to unoccupied mode.
- F. Dry Bulb Economizer Mode:
- 1. In occupied or unoccupied mode, when space temperature is above space setpoint, outside air temperature is 60°F (adj.) or below and there is a call for cooling, the unit shall be in economizer mode. Outside air damper is to open 100% and to provide free cooling to the space until the space temperature setpoint is satisfied. If space is not satisfied within 10 min (adj.), mechanical cooling will be enabled.
 - 2. All sensors necessary for economizer mode operation and FDD shall be provided and fully controlled by EMCS contractor.
- G. Fault Detection and Diagnostics (FDD):
- 1. Each DX unit shall have its economizer status monitored by the EMCS. The unit's fault detection and diagnostics shall be capable of generating a visible alarm to be seen by the EMCS should the unit be in economizer when conditions are not met, or vice versa.

H. Control Points:

Description	Type
Fan Amps/Status	AI
Compressor Amps/Status (Each Compressor)	AI
Mixed Air Temperature	AI
Supply Air Temperature	AI
Outside Air Temperature (Global)	AI
Space Temperature	AI
Bipolar Ionization Status	AI
Outside Air Damper Feedback	AI
Compressor Command (Each Stage)	DO
Reversing Valve	DO
Auxiliary Heat (Each Stage)	DO
Fan Start/Stop Command	DO
Outside Air Damper	AO

3.2 SPLIT SYSTEM UNIT DX - COOLING ONLY

SEQUENCE OF OPERATIONS SPLIT SYSTEM SEQUENCES

- A. General:
 - 1. The split system unit shall be provided with a filter, supply fan, cooling coil, and outside air damper. The control system contractor shall provide a dedicated stand-alone DDC controller for each unit.
- B. Unit Enabling/Disabling:
 - 1. The unit is to operate continuously (24/7) regardless of time schedule.
- C. Fan Control:
 - 1. Fan speed shall be controlled by the unit's internal controls.
- D. Outside Air Damper Control:
 - 1. Warm-up or Cool-down:
 - a. The outside air damper shall be closed.
 - 2. Occupied Mode:
 - a. The outside air damper shall be closed:
 - 3. Unoccupied Mode:
 - a. The outside air damper shall be closed.
- E. Temperature Control:
 - 1. Occupied Mode:
 - a. Space setpoint shall be user adjustable within $\pm 2^{\circ}\text{F}$ (adj.).
 - b. In the occupied mode of operation, the unit supply fan shall cycle with a call for cooling.
 - c. The unit shall cool as required to maintain the occupied cooling setpoint (initially 74°F cooling) as sensed by a space temperature sensor.
 - d. When space temperature rises above occupied cooling setpoint, the DDC controller shall energize the first stage of mechanical cooling. First stage cooling shall have a 20-minute (adj.) runtime before allowing second stage to engage. When space temperature continues to rise 2°F (adj.) above occupied cooling setpoint, the DDC controller shall energize the second stage of mechanical cooling.
 - 1) First stage cooling - Low speed supply CFM and first stage of compressor(s).
 - 2) Second stage cooling - High speed supply CFM and second stage of compressor(s).
 - (a) Unit shall run in second stage cooling until space temperature drops to occupied space cooling setpoint. Unit shall then run in first stage of cooling until space temperature drops 1°F (adj.) below space temperature setpoint and then cycle off.
- F. Dry Bulb Economizer Mode:
 - 1. In occupied or unoccupied mode, when space temperature is above space setpoint, outside air temperature is 60°F (adj.) or below and there is a call for cooling, the unit shall be in economizer mode. Outside air damper is to open 100% and to provide free cooling to the space until the space temperature setpoint is satisfied. If space is not satisfied within 10 min (adj.), mechanical cooling will be enabled.
 - 2. All sensors necessary for economizer mode operation and FDD shall be provided and fully controlled by EMCS contractor.
- G. Fault Detection and Diagnostics (FDD):
 - 1. Each DX unit shall have its economizer status monitored by the EMCS. The unit's fault detection and diagnostics shall be capable of generating a visible alarm to be seen by the EMCS should the unit be in economizer when conditions are not met, or vice versa.

H. Control Points:

Description	Type
Fan Amps/Status	AI
Compressor Amps/Status (Each Compressor)	AI
Mixed Air Temperature	AI
Supply Air Temperature	AI
Outside Air Temperature (Global)	AI
Space Temperature	AI
Outside Air Damper Feedback	AI

SEQUENCE OF OPERATIONS SPLIT SYSTEM SEQUENCES

23 09 23H - 3

Description	Type
Cooling Command (Each Stage)	DO
Fan Start/Stop Command	DO
Outside Air Damper	AO

END OF SECTION

SECTION 23 09 23I

SEQUENCE OF OPERATIONS VAV BOX SEQUENCES

PART 1 - GENERAL

1.1 NOT USED

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 VAV TERMINAL UNIT WITH ELECTRIC REHEAT

A. General:

1. The variable air volume (VAV) terminal unit with electric reheat shall serve intended spaces. The control system contractor shall provide a dedicated stand-alone DDC controller for each unit.

B. Unit Enabling/Disabling:

1. The occupied/unoccupied mode of operation shall be defined by the EMCS schedule.
2. During unoccupied times, as required to maintain the unoccupied heating and cooling setpoints 55°F (adj.) heating and 85°F (adj.) cooling as sensed by the space temperature sensor.

C. Temperature Control:

1. Warm-up or Cool-down:
 - a. The EMCS shall determine the required warm-up or cool-down period based on the optimized start algorithm.
 - b. Upon enabling the unit, the unit shall heat and cool as required to maintain the occupied heating and cooling setpoints (initially 70°F heating, 74°F cooling) as sensed by a space temperature sensor.
 - c. During warm-up, the VAV box shall modulate to max heating CFM and the electric heat shall be disabled. Once the occupied setpoint temperature threshold has been reached, the EMCS shall switch the VAV box to the occupied mode.
 - d. During cool-down, the VAV box shall modulate to max cooling CFM and the electric heat shall be disabled. Once the occupied setpoint temperature threshold has been reached, the EMCS shall switch the VAV box to the occupied mode.
2. Occupied Mode:
 - a. The unit shall heat and cool as required to maintain the occupied heating and cooling setpoints (initially 70°F heating, 74°F cooling) as sensed by a space temperature sensor.
 - b. On a rise in space temperature, the unit will modulate to provide max cooling CFM. As space temperature decreases, the box will modulate down to its minimum cooling CFM. As the space temperature continues to fall below the spaces heating setpoint, the VAV terminal shall modulate its heating minimum heating CFM. At this point, the electric heater shall enable. The VAV box shall modulate CFM to maintain space temperature setpoint.
3. Unoccupied Mode:
 - a. The VAV box shall modulate CFM and electric heat as needed to maintain unoccupied space temperature setpoints.

D. Control Points:

Description	Type
Space Temperature	AI
Discharge Air Temperature	AI
Discharge Air CFM Flow	AI

Description	Type
Damper Position	AO
Electric Heat Command (Each Stage)	DO

END OF SECTION

SECTION 23 09 25
VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. Variable Frequency Drive (VFD) and options including bypasses.

1.3 SCOPE OF WORK

- A. This section provides specifications for AC variable frequency drives or herein identified as VFD's for use with AC motors.
- B. The VFD manufacturer shall furnish, test, adjust and certify all packages systems for satisfactory operation prior to shipment.
- C. Any exceptions/deviations to this specification shall be indicated in writing and submitted.

1.4 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements

1.5 REFERENCES

- A. IEEE 519-2014 - Recommended Practice and Requirements for Harmonic Control in Electric Power Systems
- B. IEEE C62.41.1 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- C. NEC - National Electrical Code
- D. NEMA ICS 6 - Industrial control and systems enclosures.
- E. NEMA 250 - Enclosures for electrical equipment.
- F. NEMA FU 1 - Low Voltage Cartridge Fuses.
- G. NEMA ICS 7 - Industrial Control and Systems: Adjustable Speed Drives.
- H. NEMA ICS 7 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems.

1.6 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 23 00 90, General Conditions, and Division 1.
- B. Product Data:
 - 1. Provide as outlined in the contract documents previously issued:
 - a. General description, voltage, horsepower, max current ratings, diagrams.
 - b. Ratings and weights.
- C. Shop Drawings:

1. Provide as outlined in the contract documents previously issued:
 - a. Outline dimensions.
 - b. Mounting points.
 - c. Interconnecting wiring diagrams.
- D. Manufacturer`s Installation Instructions:
 1. Provide with each variable frequency drive at time of shipment and submittal:
 - a. Installation methods
 - b. Connection points
- E. Submit product data for Variable Frequency Drive (VFD) with submittal package. Include manufacturer, dimensions, ratings, listings, elementary power and control wiring diagrams and data on features and components. Provide mounting points and connection points. Any exceptions to the specification shall be clearly noted in the submittal.

1.7 QUALITY ASSURANCE

- A. The VFD and options shall comply with the applicable requirements of the latest standards of ANSI, IEEE, and the National Electrical Code.
- B. The VFD and options shall be tested to ANSI/UL 508 and listed by a nationally recognized testing agency such as UL or ETL. Device shall bear label.
- C. To ensure quality and minimize infantile failures at the job site, the VFD shall be "burned in" for 24 hours by the manufacturer.
- D. All VFD shall be UL listed for short circuit current rating of 65 kA and UL label shall be attached accordingly.
- E. All VFD system door mounted pilot devices shall be tested to verify successful operation. Documentation shall be provided upon the request of the engineer.
- F. All features shall be functionally tested at the factory for proper operation.

1.8 WARRANTY

- A. VFD shall be free from defects in materials and workmanship under normal use and service for a period of twenty-four (24) months from shipment.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Manufacturers:
 1. ABB
 2. Danfoss
 3. Yaskawa
 4. Eaton
 5. Square D
 6. Franklin Electric
- B. Furnish complete variable speed drives as specified herein. All standard and optional features requested shall be included within the VFD enclosure unless otherwise specified. Drives shall be for variable torque load, unless otherwise noted.
- C. The variable speed drives shall convert three-phase, 60 HZ utility power to adjustable voltage and frequency, three-phase, AC power for step less motor speed control from 10% to 100% of the motor`s 60 Hz speed. Input voltage shall be as specified on the schedule.
- D. The VFD power input stage shall convert three-phase AC line power to a fixed DC bus voltage. This will be accomplished with a solid state three-phase full-wave diode rectifier with metal oxide varistor (MOV)

three-phase protection. Displacement power factor shall not be less than 0.95 throughout the speed range. Input line inductors (3%) shall be included on the line side of the power input state for units that have saturating (non-linear) DC link reactors.

- E. The VFD output power shall vary frequency to the motor from 6 to 60 Hz with resultant motor speed varying at the motor nameplate rated speed, with output voltage variation from zero to motor rated voltage for optimum volts per hertz (V/Hz) ratio for fan and pump loads. Output current shall be rated 110% of motor full load amps (FLA) for 1 minute based upon VFD's variable torque FLA rating. The output must be a voltage source type generating a sine coded PWM waveform utilizing an asynchronous carrier frequency (output transistor switching frequency is to be independent of drive output frequency). This carrier frequency shall be adjustable to minimize harmonically induced noise or vibration.
- F. All VFD shall contain integral EMI filters to attenuate radio frequency interference conducted to the AC power line.
- G. VFD shall minimize the audible motor noise through the use of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD operation while reducing motor noise. VFDs with fixed carrier frequency are not acceptable.

2.2 FEATURES

- A. The VFD shall include the following features:
 - 1. The VFD shall be housed in a NEMA 1 enclosure for indoor applications.
 - 2. The VFD shall be housed in a NEMA 3R enclosure for outdoor applications.
 - 3. For all VFD sizes of 60hp and greater, the VFD shall have no greater than a 5% distortion limit for individual voltage distortion and no greater than a 8% distortion limit for total voltage distortion.
 - 4. The following display/control parameters shall be located on the front of the enclosure:
 - a. Hand/Off/Auto selector to start and stop the motor. In the auto position, the drive shall start/stop from a remote contact closure. In the auto position, motor speed shall be determined by the follower signal. In the manual position, motor speed shall be determined by manual adjustment.
 - b. Power on indication that the VFD is being supplied by the power line.
 - c. Fault indication that the VFD has tripped on a fault condition.
 - d. Display shall indicate load parameters such as load percent, frequency, or running load amps.
 - e. A set of form C, dry contacts to indicate when the VFD is in the run mode.
 - f. A set of form C, dry contacts to indicate when the VFD is in fault mode.
 - g. Terminations for safety interlocks such as freeze and smoke shut-down.
 - h. For a fault condition other than a ground fault, short circuit or internal fault, an auto restart function shall provide up to 6 programmable restart attempts. The time delay before restart attempts shall be a minimum of 30 seconds. This function permits automatic restarting after the drive controller detects a fault, provided that the other operating functions are correct, a run command is present, and the fault has disappeared. This shall be a function that is field selectable.
 - i. The VFD shall include a door interlocked, padlockable, input power disconnect switch.
- B. The following bypass features shall be included:
 - 1. Manual bypass shall provide all the circuitry necessary to transfer the motor from the VFD to the power line, or from the line to the controller.
 - 2. The AC Drive shall include mechanically and electrically interlocked isolation and bypass contactors, and AC line isolation contactor, complete with thermal overload relay, VFD/OFF/BYPASS switch, and TEST/NORMAL selector switch.
 - 3. Motor overload protection shall be provided in both the controller mode and the bypass mode.
 - 4. The operator shall have full control of the bypass starter by operation of the VFD/OFF/BYPASS selector switch.
 - 5. In the automatic mode of operation, the isolation and bypass contactors shall be sequenced by the 110 volt rated auto start contact provided by user.
 - 6. A test/normal selector switch shall provide test operation of the power converter while operating the motor in bypass.
 - 7. A pilot light shall indicate whether motor is operating in drive or bypass mode.

- C. Speed Reference Input:
 - 1. Shall accept both a manual speed signal and a 0-10 VDC speed reference analog input signal from the Building Automation System (BAS).
- D. Feedback Signal:
 - 1. Provide 0-5 VDC or 0-20 mA analog output signal to indicate actual operating speed of VFD. Output signal shall be fed into the BAS.
- E. The VFD shall include a standard communications port and capabilities to be connected to the following serial communications protocols at no additional cost and without the need to install any additional hardware or software in the VFD.
 - 1. RS-485 for Modbus, N2, FLN, P1, and BACnet.
 - 2. Ethernet for Modbus/ TCP/IP and BACnet/ IP.
 - 3. Lonworks FTP shall be available as an option for factory or field installation.

2.3 PROTECTIVE FEATURES

- A. The VFD shall include the following protective features:
 - 1. Protection against input transient voltage spikes.
 - 2. Minimum 65,000 A short circuit current rating for the VFD and enclosure
 - 3. Separate overload protection for each motor controlled.
 - 4. Protection against input power under voltage, over voltage, and phase loss.
 - 5. Protection against output current overload and over current.
 - 6. Protection against over temperature within the VFD enclosure.
 - 7. Protection against over voltage on the DC bus.
 - 8. DC bus discharge circuit for protection of service personnel.
 - 9. Insensitive to incoming power phase sequence.
 - 10. The number of restart attempts shall be adjustable from 0 to 20 and the time between attempts shall be adjustable between zero and 600 seconds. The original set-up shall be 4 restarts with 120 seconds between restarts.
 - 11. Four programmable critical frequency lockouts ranges to prevent the VFD from operating the load at a speed that causes vibration in the driven equipment.
 - 12. An automatic start delay may be selected from 0 to 120 seconds. During the start delay the VFD shall be programmed to provide either no voltage to the motor or apply DC braking current if desired.

2.4 ADJUSTMENTS

- A. The VFD shall include the following adjustments inside the enclosure:
 - 1. Maximum speed, adjustable 50-100% base speed.
 - 2. Minimum speed, adjustable 0-50% base speed.
 - 3. Acceleration time, adjustable 3 to 1800 seconds.
 - 4. Deceleration time, adjustable 3 to 1800 seconds with override circuit to prevent nuisance trips if deceleration time is set too short.
 - 5. Current limit, adjustable 0-100%.

2.5 SERVICE CONDITIONS

- A. The VFD shall be designed to operate within the following service conditions:
 - 1. Ambient temperature, 14°F to 113°F.
 - 2. 0 to 95% relative humidity, non-condensing.
 - 3. Elevation to 3,300 feet without derating.
 - 4. AC line voltage variation, -10% to +10% of nominal.
 - 5. No side clearance shall be required for cooling.
 - 6. All VFD shall be plenum rated.

PART 3 - EXECUTION

3.1 INSTALLATION AND START-UP SERVICE

- A. Variable frequency drives shall be provided by the mechanical contractor, installed by the electrical contractor, and controlled by the controls contractor.
- B. The manufacturer shall provide start-up service by a factory trained service technician. The service technician shall verify correct installation, start up the drive, and check for proper operation.
- C. The VFDs shall be mounted and installed in accordance with all local, state, federal and NEC codes.
- D. Before and during the installation, the VFD shall be protected from site and environmental contaminants. VFDs shall be stored as necessary in a clean and dry location.
- E. Installation shall be in compliance with the manufacturer's instructions, drawings, and recommendations.
- F. Start-up Assistance:
 - 1. On-site assistance shall be available from a factory certified technical representative who shall supervise the contractor's installation, testing, and start-up of the VFD.
- G. Do not install VFD until building environment can be maintained in accordance with manufacturer's instructions and requirements.

END OF SECTION

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SECTION 23 09 63

SAFE SHELTER EMERGENCY SYSTEMS CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Safe shelter emergency control system as provided turn-key, fully integrated, and compatible with the Energy Management Control System provided under section 23 09 23 and/or Division 25.

1.2 RELATED SECTIONS

- A. Section 23 09 23 - Energy Management Control System
- B. Division 25

1.3 CODES AND REGULATIONS

- A. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards except when requirements are exceeded by the contract documents.
- B. The equipment, materials, and installation shall conform to the latest version of all applicable codes, standards, and regulations of authorities having jurisdiction including the following:
 - 1. NFPA 70, National Electrical Code.
 - 2. NFPA 101, Code for Safety to Life in Buildings and Structures.
 - 3. International Building Codes (IBC).
 - 4. Local and State Building Codes.
 - 5. All requirements of the local Authority Having Jurisdiction (AHJ).

1.4 SUBMITTALS

- A. Submit a complete submittal package within 30 calendar days after award of this work for review. Equipment is not to be ordered without review. Partial submittals are not acceptable for review. Each submittal shall include a dated transmittal.
- B. Electronic Submittals: E-mail or other electronic forms of submittals from the contractor are required. The procedures described in this section shall be as follows:
 - 1. The contractor shall supply one electronic copy of the submittal.
 - 2. The electronic files will either be e-mailed to the architect or posted to a project management and information exchange website, depending on the architect's requirements. The architect and contractor can distribute copies of the files as desired.
 - 3. The engineer will retain an electronic copy of the submittal and all responses.
- C. Product Data Submittal including special boxes, cable, and other material as requested by the Architect including:
 - 1. A cover sheet with the name and location of the project, the name, address, and telephone number of the Contractor, and the name, address, and telephone number of the submitting sub-contractor. Include on or after the cover sheet sufficient space for review stamps.
 - 2. An indication of any deviations from Contract Document requirements, including variations and limitations. Show any revisions to equipment layout required by use of selected equipment.
 - 3. A product data index and complete equipment list including for each product submitted for approval the manufactures name and part number, including options and selections.
 - 4. Cut sheets or catalog data illustrating the physical appearance, size, function, compatibility, standards compliance, and other relevant characteristics of each product on the equipment list. Indicate by prominent notation (an arrow, circle, or other means) on each sheet the exact product and options being submitted.
 - 5. Submit design data, when the scope of work requires, including calculations, schematics, risers, sequences, or other data.

- 6. Any resubmittal shall include a complete revised equipment list and any product data that is revised.
- D. Submit shop drawings locating all components of the system, indicating circuit routing, cable type, and gauge. Shop or coordination drawings shall include information that will allow the Contractor to coordinate interdisciplinary work and when necessary guide the manufacturer or fabricator in producing the product. Shop or coordination drawings shall be specifically prepared to illustrate the submitted portion of work, this may require diagrams, schedules, details, and accurate to scale equipment and device layouts prepared using a CAD or BIM engineering drawing program.

PART 2 - PRODUCTS

2.1 SUMMARY

- A. It is the intent of this specification to describe the Safe Shelter Emergency Systems Controls system shall be a turn-key fully integrated and compatible sub-section of Section 23 09 23 Energy Management Control System and/or Division 25.
- B. Systems shall be furnished and installed complete in all respects, including any and all equipment, controls, wiring, instrumentation, enclosures, labor, engineering, training, commissioning, programming, supervision, calibration, coordination with other trades, etc. It is the intent of these specifications that the Contractor shall furnish and install the systems complete in every respect and ready to operate. All equipment, miscellaneous items and accessories required for such installation and for the correct and convenient operation of the entire installation whether or not each such item or accessory is shown on the plans or mentioned in these specifications shall be furnished and installed.
- C. Codes, Permits, and Fees: This contractor shall comply with all local, state, and national codes and shall secure and pay all applicable costs, fees, permits, and licenses. No additional costs shall be allowed for these items.
- D. All basic equipment for which there are Underwriters` Laboratories Standard requirements shall be listed by Underwriters` Laboratories and be so labeled, or shall conform to their requirements, in which case, certified statements to the effect shall be furnished by the manufacturer with a copy of an examination report by a recognized laboratory acceptable to the Local Authority.

2.2 SYSTEM FUNCTIONAL DIAGRAM

A. Programmable BACnet Controller (See Section 23 09 23 for acceptable manufacturers and/or Division 25):
8 VAC/VDC Power feed.
Input 1 - Button 1 SHELTER DOOR LOCKDOWN ACTIVATION.
Input 2 - Button 2 MECHANICAL OR NATURAL VENTILATION SYSTEM.
Input 3 - Button 3 NATURAL GAS SHUT OFF
Input 4 - Button 4 PRESSURIZATION TANK
Input 5 - spare
Input 6 - spare
Input 7 - spare
Input 8 - spare
Output 1 - SHELTER DOOR LOCKDOWN ACTIVATION.
Output 2 - MECHANICAL OR NATURAL VENTILATION SYSTEM
Output 3 - NATURAL GAS SHUT OFF
Output 4 - PRESSURIZATION TANK
Output 5 - Shelter Door Lockdown Activation Indicator Light
Output 6 - Ventilation System Activation Indicator Light.
Output 7 - Natural Gas Shut Off Activation Indicator Light.

Output 8 - Pressurization Tank Activation Indicator Light.
Additional Outputs - Door Position Switches (verify quantity with drawings).
Additional Sensor Input - Carbon Dioxide sensor

2.3 SYSTEM COMPONENTS

- A. Wall flush mount control housings: Provide two (2) Hoffa CONCEPT Flush-Mounted Steel Enclosures model CP1612 with wall mounting brackets and key lock kits.
- B. System Controller: Programmable BACnet Controller (See Section 23 09 23 Or Division 25 for acceptable manufacturers): Stand-alone controller to be provided by the awarded EMCS contractor and shall be powered by emergency power. Coordinate installation and wiring with electrical contractor.
- C. EMCS contractor is responsible for all necessary wiring and programming of stand-alone controller to building EMCS. Storm shelter system status shall be displayed and monitored through EMCS front end. All activation and control of safe shelter emergency system shall be through stand-alone controller.
- D. EMCS contractor shall provide and install all necessary actuators and control wiring between stand-alone controller and storm shelter devices. Including, but not limited to: exhaust fans, roll up door motors, damper actuators, valve actuators, door status contacts, etc.
- E. EMCS contractor shall coordinate with access control contractor to add open contact to allow access as needed during "storm mode". EMCS contractor shall provide all necessary control wiring.
- F. 1" conduits installed from the nearest accessible ceiling space to the inside of the wall cabinet. All conduit and protective bushings to be provided and installed by electrical contractor. Install single gang back boxes inside the wall cabinet for a dedicated pathway for each wire that will run to a specific button.
- G. Mount one (1) color-coded indicator light below each large mushroom-button specified below:
 - 1. Menics LED Indicator Light model M06F24R, or equivalent, Indicator LED Red 24VDC, for Button 1.
 - 2. Menics LED Indicator Light model M06F24B, or equivalent, Indicator LED Blue 24VDC, for Button 2.
 - 3. Menics LED Indicator Light model M06F24Y, or equivalent, Indicator LED Yellow 24VDC, for Button 3.
 - 4. Menics LED Indicator Light model M06F24W, or equivalent, Indicator LED White 24VDC, for Button 4.
- H. Door Position Magnetic Contract Switches: Sentrol 1084D Natural, DPDT screw mount with leads, 2.56" long x .056" wide, x 0.50" each half 0.5" thick.
- I. The Safe Shelter Emergency Systems Control inputs shall be comprised of a flush wall mount enclosure with three buttons as follows:
 - 1. One large mushroom-button marked SHELTER DOOR LOCKDOWN ACTIVATION.
 - 2. One large mushroom-button marked LOUVER ROLL UP DOORS.
 - 3. One large mushroom-button marked NATURAL GAS SHUT OFF.
- J. Button 1 SHELTER DOOR LOCKDOWN ACTIVATION switch. This switch shall be colored red and secure all shelter perimeter doors. That action shall also activate immediate campus wide lockdown on all doors connected to the card access system and release any door hold opens.
 - 1. For doors not already controlled by the door access system, latching at the top and bottom of the doors shall not be visible and should occur automatically, inside the door itself, when the door is firmly shut. For doors already controlled by door access system, the EMS shall interface with card access system through relay to disable doors. This switch shall have an indicator light to show that a lockdown has been activated. When the key reset is initiated the doors shall open and the access control system log must show this reset as a "reset by owner" entry in the log. STI model SS2000ZA-EN, Red Shell, No cover, Push Button #0 Key to Reset, Custom English Two Line Label: "1 SHELTER DOOR" "LOCKDOWN ACTIVATION".
 - 2. For each door within storm shelter, provide door position magnetic switch and indicator light. When Button 1 is activated, indicator lights will indicate door closure. Lights should be identified with each door and placed within the same enclosure as Button 1.

- K. Button 2 LOUVER ROLL UP DOORS switch shall be colored blue and control the opening of the louver roll up doors and activate the ventilation system through the EMS system. When the key reset is initiated the interior Exhaust Fans should turn off and the Ventilation Doors should begin to close. These roll up doors and exhaust fans shall only be activated via this button or through the EMS software and through no other interface. STI model SS2400ZA-EN, Blue Shell, No cover, Push Button #0 Key to Reset, Custom English Two Line Label: "2 LOUVER ROLL" "UP DOORS".
- L. Button 3 NATURAL GAS SHUT OFF switch shall be colored yellow and activate the natural gas shutoff valve. When the key reset is initiated this valve shall return to normal operation. STI model SS2200ZA-EN, Yellow Shell, no cover, Push Button #0 Key to Reset, Custom English Two Line Label: "3 NATURAL GAS" "SHUT OFF". Natural gas valve shall be provided by EMS contractor and installed by Plumbing Contractor. See Section 23 09 23 and drawings for gas valve location.
- M. Adjacent to the Safe Shelter Emergency Systems Control enclosure, mount a single button flush wall mount with one large mushroom button as follows:
1. One large mushroom-button marked "4 PRESSURIZATION TANK". When Button 4 is pressed, the button indicator light turns on up to indicate that the Pressurization Tank has begun to empty pressurized air into the water storage tank serving toilets and sinks. If this button is ever pressed, the District will need to replace/refill the Pressurization Tank. And, the button should be reset by the Maintenance Department at that time.
 2. Warning Light: If the large button to the left is pressed or if the air pressure in the tank is insufficient, the WARNING Light to the left should turn on to indicate that the Pressurization Tank needs to be replaced/refilled.
 3. Button # 4 - air pressure release button for water pressure. This button is in its own enclosure. Reference drawings for button location. Pushing this button will activate the EMS system to engage the release of pressurized air into the water tanks that provide water to the toilets in the shelter. The LED light will come on when the pressure in the air tank is below 55 psi or when the button to release the air pressure has been pressed and the air has been released. Key reset will shut the warning light off. Water pressurization panel enclosure - contractor shall provide and install a white label with red text on the exterior lid of the enclosure. The text shall read "press the button in this box only if necessary to re-pressurize the water in the toilets/sinks".
- N. Each switch cover plate shall have an adjacent label containing written instructions on what the button will do when pressed and how the button should be reset and when. Coordinate with the owner on all final texts for this direction. All labeling shall be machine generated.
- O. Wall enclosure for the shelter control panel buttons shall be mounted at 44" OFF measured from the bottom of the enclosure. The main control panel enclosure shall include a white label with red text on the exterior lid of the enclosure. The text shall read "Press all buttons in this box to activate tornado shelter". Do not place the label over the Plexiglas door in such a manner that the operator cannot see the switch illumination lights.
- P. For all Safe Shelter Emergency Systems Control functions other than the exhaust fans, each relay shall be mounted in a surface mount metal enclosure with conduit knockouts. Relays shall be UL recognized and rated for ten million mechanical operations. At each location provide two Air Products & Controls models # MR-201/C relays, or equivalent, one for the emergency function, and one for the reset function. Relays shall be operated by a multi-voltage coil (24 VDC), feature DODD dry Form C contacts rated 10 Amps @ 120 VAC, and a status LED to indicate that the relay is energized.
- Q. For the exhaust fan Safe Shelter Emergency Systems Control function, provide Square Latching Plug-In Relays. The latching relays shall perform a basic memory function and maintain their contact position after the control power has been removed. To be 24VDC control coil, 8-pin square base latching plug-in relay with an AC contact rating of 16A @ 277V, Dayton model # 1EHY3 or equivalent. Provide a base, to be Dayton model # 1FC13 or equivalent, finger safe 8-pin square socket, rated at 16A @ 300VAC.

2.4 DAMPERS AND VALVES CONTROL

- A. Control air dampers:
1. The sheet metal contractor shall furnish and size all automatic control dampers unless provided with packaged equipment.

2. The sheet metal contractor shall install all dampers unless provided with packaged equipment.
 3. Control air dampers shall be parallel blade for two-position control and opposed blade for modulating control applications. Dampers shall be galvanized with nylon bearings. Blade edge and tip seals shall be included for all dampers. Leakage through the damper shall not exceed 4 CFM per square foot at 1" wick. Blades shall be 16-gauge minimum and 10" wide maximum and frame shall be of welded channel iron. Dampers over 48" wide shall be equipped with a jackshaft to provide sufficient force throughout the intended operating range.
 4. All dampers used for modulating service shall be opposed blade type arranged for normally open or normally closed operation as required. The damper is to be sized so that when wide open the pressure drop is enough its close-off pressure drops for effective throttling.
 5. All dampers used for two-position or open-close control shall be parallel blade type arranged for normally open or closed operation as required.
 6. Damper linkage hardware shall be constructed of aluminum or corrosion resistant zinc & nickel-plated steel and furnished as follows:
 - a. Bearing support bracket and drive blade pin extension shall be provided for each damper section. Sheet metal contractor shall install bearing support bracket and drive blade pin extension. Sheet metal contractor shall provide permanent indication of blade position by scratching or marking the visible end of the drive blade pin extension.
- B. Drive pin may be round only if V-bolt and toothed V-clamp is used to cause a cold weld effect for positive gripping. For single bolt or set-screw type actuator fasteners, round damper pin shafts must be milled with at least one side flat to avoid slippage.

2.5 INSTALLATION AND SUPPORT

- A. System equipment installation shall be in accordance with good engineering practices as established by the NEC and the TIA/EIA. Wiring shall meet all state and local electrical code requirements.
- B. All devices shall be supported from the building structure. Do not attach any supports to joist bridging or other lightweight members.
- C. In all exposed areas such as gymnasiums, shops, field houses, janitors' closets, or mechanical/electrical rooms all safety and security system cable shall be fully enclosed in conduit.
- D. Support shall be provided by mounting appropriate fasteners. If the weight load is carried by the support rod or wire, the support assembly may attach to the ceiling grid for lateral stabilization. The required support wires for the ceiling grid or light fixtures shall not be utilized. Any fastener attached to the ceiling grid shall not interfere with inserting or removing ceiling tiles. The cable pathway of supports must be positioned at least 12 inches above the ceiling grid.
- E. All devices shall be placed with regard to the environment, EMI/RFI interference, and its effect on safety and security system signal transmission.
- F. Mount all equipment firmly in place such that vibration or jarring will not interfere with system operation.
- G. Devices mounted on a drop ceiling shall feature a back box fitted with a support hanger (Caddy #512 or #512A for deep boxes), or equivalent with independent drop wires to support the weight of the device.

2.6 FIRE STOPPING, DRAFT/NOISE STOPPING, PENETRATIONS, AND CORING

- A. UL Listed fire stopping methods that match the fire rating of the wall or floor being penetrated are to be used at all fire barrier penetrations. Seal the interior of the conduit sleeve around the cables and around the outside of the sleeve on each side of the penetration with fire-stop caulk or putty, and install according to the manufacturer's instructions.
- B. All penetrations through fire rated walls or floors shall feature a suitable length of metal conduit. Hole diameter shall not exceed 1/2" larger than the conduit or sleeve to be installed. The hole shall be neatly cut, not oversized or irregular. Do not share wall/floor penetrations with ductwork, piping, line voltage electrical conduits, etc.
- C. All gypsum board or plaster penetrations shall be cut using an appropriate hole saw/mandrel or manufactured assembly.

- D. Draft/Noise Stopping - All penetrations through non-rated walls shall include draft/noise stopping to minimize the transfer of air and sound between enclosed areas. This shall include but not limited to:
 - 1. Neatly cutting all non-rated wall penetrations with a 1" maximum clearance. All gypsum board or plaster penetrations shall be tool cut using an appropriate hole saw/mandrel or manufactured assembly. The hole shall be neatly cut and not oversize or irregular. Do not share wall penetrations with other types of ductwork, piping, line voltage electrical conduits, safety and security systems cabling, etc.
 - 2. Provide and install non-combustible mineral wool, fiberglass, cellulose insulation, caulk, and/or sealant as required. Seal the interior of conduit sleeves around the cables and around the outside of the sleeve on each side of the penetration with caulk or putty, and install materials according to the manufacturer's instructions.
- E. The Contractor shall make every effort to coordinate with the building Architect, Engineer, Builder, and Electrical Contractor to have sleeves placed in new construction so that later coring or drilling of building structural members will not be required. The Contractor must consult with the building Architect, Engineer, and Builder prior to drilling, coring, or sawing of any wall, floor, etc. All penetrations shall be made at approved, appropriate, locations.
- F. Upon approval, the Contractor shall be required to supply all labor, equipment, tools, and materials to create any additional penetrations, and shall provide the sleeve, temporary and final fire stopping. Exceptional care shall be taken not to stress, overheat, or penetrate any building support member. Coring shall be made with equipment appropriate for the dry penetration of concrete and block materials. Under no circumstances shall penetrations be made utilizing a chisel or percussion type equipment. Concrete, block, or plaster cores shall be made by dry saw/core methods only.

PART 3 - EXECUTION

3.1 WARRANTY

- A. The Safe Shelter Emergency Systems Control shall guarantee all workmanship and material in the installed system for a period of one (1) year, such guarantee dating from the date of final acceptance by the Architect/Engineer.
- B. This warranty shall cover the repair or replacement without additional costs to the Owner of any defective materials, parts, etc. of facility workmanship.
- C. During the warranty period, this contractor shall respond to calls for warranty service within eight (8) working hours. Emergency service shall be obtainable within four (4) hours of notification by the Owner. Emergency service shall be obtainable on a 24-hour basis, seven (7) days per week.
- D. The temperature control contractor's office shall be within a 150-mile radius of the job site.
- E. Warranty Access:
 - 1. The Owner shall grant to the Contractor, reasonable access to the EMCS system during the warranty period. The owner shall provide, at no cost to the contractor, remote software access to an on-site computer or VPN access for the following functions:
 - a. Access to the entire facility control system by the contractor to provide service and diagnostic support.
 - b. Service: All service of the system shall be furnished by the Contractor, at no cost to the Owner, for a period of one (1) year, concurrent with the warranty period specified above.
 - c. Testing and Warranty Service: A factory trained service technician shall supervise the final connections and testing of the system and it shall be subject to the final acceptance of the Architect, Engineer, and local authorities.
 - d. Testing shall ensure the following: Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
 - e. Complete and functional system.
- F. Installed in accordance with manufacturer's instructions.

3.2 DRAWINGS, MANUALS, AND TRAINING

- A. As-built drawings and operating and maintenance manuals may be electronically transmitted in PDF file format (preferred) or paper copies may be provided in quantities indicated in Division 1. Paper copies shall be organized including index tabs in a 3-ring black binder of sufficient size.
- B. Upon completion of the installation, and prior to final inspection, the Contractor shall furnish as-built drawings.
- C. In addition, the contractor shall furnish complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets. Manuals shall include wiring diagrams to indicate internal wiring for each device and the interconnections between the items of equipment. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system. Provide a parts list with manufacturer and model number for commonly replaced parts. Include complete instructions for the inspection, testing, and maintenance of the system. Include copies of all programming sheets used to configure the system.
- D. The Contractor shall conduct a formal on-site training session for the Owners Representative/Maintenance personnel, which shall include instruction in the operation, testing, location, inspection, and maintenance, of all system components. Provide a minimum of two (2) hours of documented general instruction.

END OF SECTION

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SECTION 23 23 00
REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 01 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. Refrigerant piping for split system (including heat pumps) cooling/heating units.

1.3 RELATED SECTIONS

- A. Section 22 05 24 - Valves - General
- B. Section 22 05 30 - Pipe and Pipe Fittings - General
- C. Section 23 00 00 - Basic Mechanical Requirements
- D. Section 23 07 19 - Hydronic Piping Insulation
- E. Section 23 07 21 - Refrigerant Piping Insulation
- F. Section 23 33 33 - Access Doors

1.4 REFERENCES

- A. ASTM B280 - Seamless Copper Tube for Air Conditioning & Refrigeration Service

1.5 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 23 00 90, General Conditions, and Division 1.

1.6 COORDINATION

- A. Coordinate the refrigerant line sizing, lengths, traps, and all other aspects of the refrigerant systems with the air conditioning unit manufacturer to ensure a completely working and reliable system.
- B. Submit product data on piping materials and fittings.
- C. Provide letter stating air conditioning manufacturer has reviewed refrigerant line design. Provide drawings on any lines that are longer than 80 feet.
- D. If units have to be moved due to line lengths, then all associated costs will be at the Contractor's expense.

PART 2 - PRODUCTS

2.1 PIPING

- A. ACR hard drawn copper tubing, conform to ASTM B280.
- B. ACR soft drawn copper tubing with long bend radius is allowed in concealed locations, such as behind walls. Above ceiling is not considered a concealed location.

2.2 FITTINGS

- A. Wrought copper fittings
- B. Use silver solder at connections

2.3 VALVES

- A. Manufacturers:
 - 1. Alco Controls
 - 2. Sporlan Valve Company

2.4 ACCESSORIES

- A. Provide strainer-dryer combination and liquid solenoid valves at refrigerant coil and condensing units. Provide and install distributors for multistage units that are suitable for modulating flow rates. Provide specialties such as solenoid valves, sight glasses, accumulators, and filter/dryers as required for proper system operation. Components shall be specifically designed for refrigeration service.

PART 3 - EXECUTION

3.1 MATERIAL PREPARATION

- A. Cut tubing with a sharp pipe cutter.
- B. Ream and thoroughly clean to remove all burrs, filings, dirt, and grease before assembly and soldering.
- C. Remove oxide and discoloration prior to assembly.

3.2 SLEEVES

- A. Sleeve piping as required in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- B. All refrigerant piping passing under slab shall be sleeved.
- C. Sleeves shall be of an adequate size to permit removal of the piping at a later date.

3.3 HANGER SUPPORTS

- A. Support as required in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- B. Do not fasten liquid and suction lines together unless there is insulation between them. Use wire ties. Duct tape not allowed.
- C. Insulate all refrigerant lines from structure.

3.4 INSTALLATION

- A. Route with building lines, vertical lines to be plumb, grade horizontal suction lines to compressor.
- B. All brazing shall be done with 2-8 psig dry nitrogen purge.
- C. Protect all valves and paint from excessive heat.
- D. Keep refrigerant lines sealed from atmosphere during construction.
- E. All refrigerant line sets to receive insulation.
- F. No welded or mechanical joints in concealed areas, such as walls. Soft drawn copper is acceptable.

- G. Follow A/C manufacturer's instructions.

END OF SECTION

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SECTION 23 31 13
METAL DUCTWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnishing and installation of all ductwork as shown on the construction documents. Acoustical and thermal linings and wrappings; flexible ductwork and connections; combination smoke and fire dampers, smoke dampers, and fire dampers; duct access doors; air diffusers, grilles, and registers; air volume control devices; hangers and supports; plenums and casings; turning vanes; air filters; installation of temperature control dampers, and other appurtenances necessary for a complete and operational system.
- B. All work shall be preceded by taking measurements at the job site, fully coordinating all work with other disciplines, verifying available spaces for ductwork, and developing shop drawings.

1.2 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 05 93 - Testing, Adjusting and Balancing for HVAC
- C. Section 23 07 13 - Duct and Grille Insulation
- D. Section 23 33 33 - Access Doors
- E. Section 23 34 16 - HVAC Fans
- F. Section 23 37 13 - Diffusers, Registers, and Grilles
- G. Section 23 81 19 - Packaged HVAC Units
- H. Section 23 81 26 - Split System HVAC Units

1.3 REFERENCES

- A. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters
- B. AMCA 511 - Certified Ratings Program for Air Control Devices
- C. ASTM A653/A653M - Sheet Metal, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process
- D. ASTM A924/A924M - Hot Dip Galvanized Coils & Sheets - Tolerances
- E. ASTM A463/A463M - Steel Sheet Aluminum Coated by the Hot-Dip Process
- F. NFPA 90A - National Fire Protection Association - Installation of Air Conditioning and Ventilation Systems
- G. NFPA 92 - Smoke Control Systems
- H. SMACNA - Sheet Metal and Air Conditioning Contractors Association
- I. SMACNA HVAC Duct Construction Standards, Latest Edition, for Metal and Flexible Ducts
- J. UL - Underwriter's Laboratories

K. UL 555 - Standard for Safety; Fire Dampers

L. UL 555S - Standard for Safety; Leakage Rated Dampers for Use in Smoke Control Systems

1.4 SYSTEM DESCRIPTION

A. Design static pressure:

1. 1-inch w.g. minimum for all low-pressure ductwork applications.
2. 3-inch w.g. minimum for all medium pressure ductwork applications.

1.5 SUBMITTALS

A. Product Data:

1. Provide submittal data on all equipment specified in this section in accordance with Section 23 00 90, General Conditions, and Division 01.
2. Submit product data indicating typical catalog of information including arrangements.
3. Submit product data sheets indicating dimensions, general assembly, and materials used in fabrication.
4. Indicate mechanical and electrical service locations and requirements of equipment.
5. Submit manufacturer's installation instructions.

B. Shop Drawings:

1. Submit 1/4" per foot shop drawing(s) showing all ducts, piping, and equipment shown by plans and specifications. Submit drawings on all mechanical rooms. Before starting shop drawings or fabrication of any ductwork, the Contractor must be coordinated with structural and electrical and have an approved reflected ceiling plan with which he can coordinate location of air outlets, lights, tile patterns, etc. Provide sections for all congested areas and mechanical rooms. Submit prior to construction of ductwork.

1.6 QUALITY ASSURANCE

- A. All equipment and materials shall be new and of the quality as specified herein. All work shall comply with the Local Building Code, Mechanical Code, Fire Code, and all other applicable State and Local Codes or ordinances.
- B. All equipment and materials shall be installed in a workmanlike manner by trained and experienced sheet metal technicians and mechanics as recommended by the manufacturers of the products installed.
- C. All ductwork to be manufactured, constructed, installed, sealed, joined, reinforced, supported, tested and conform in accordance with the latest SMACNA standards.
- D. Where the standards and requirements of this specification exceed those of SMACNA, the requirements herein shall govern.

1.7 WARRANTY

- A. Warranty all ductwork and dampers for 1 year from the date of final acceptance. The warranty will cover workmanship, noise, chatter, whistling, and vibration. Ductwork must be free from pulsation under all conditions of operation.

PART 2 PRODUCTS

2.1 RECTANGULAR AND ROUND RIGID DUCTS

A. Material:

1. New, prime grade sheet or coil steel

B. Gauge:

1. Select gauge in accordance with latest SMACNA Duct Construction Standards Tables

- C. Auditorium and stages:
 - 1. Increase two gauges (heavier) for the first 20 feet of supply and return duct.
- D. Coating:
 - 1. Type:
 - a. Continuous, hot-dip, galvanized coating
- E. Application:
 - 1. 1-1/4 ounces per 1 square foot, two-sided sheet
 - 2. Comply with ASTM A653/A653M
- F. Identification:
 - 1. Sheet steel:
 - a. Stencil each sheet with manufacturer`s name and gauge.
- G. Elbows:
 - 1. Elbows shall be mitered with double thickness turning vanes or smooth radius long sweep elbows.
- H. Coil steel:
 - 1. Stencil coils on 10-foot centers with manufacturer`s name and gauge.
- I. Construction:
 - 1. Manufacture in accordance with latest SMACNA Round Duct Standards Tables
 - 2. Pre-manufactured round duct may be used if approved by the Architect/Engineer.

2.2 ACCESS DOORS

- A. Install access doors to facilitate cleaning as required by code.
- B. Install access doors as required for access to fire protection devices.

2.3 EXHAUST DUCTS FOR SHOWER ROOMS

- A. Aluminum:
 - 1. Gauge in accordance with the latest SMACNA Standards.

2.4 EXHAUST DUCTS FOR FUME HOODS IN SCIENCE LABS

- A. Materials:
 - 1. Gauge in accordance with the latest SMACNA standards.
 - 2. Stainless steel - welded or Factory Prefabricated Single Wall system

2.5 DOUBLE-WALL INSULATED SPIRAL/RECTANGULAR DUCTWORK

- A. Types:
 - 1. Round
 - 2. Flat Oval
 - 3. Rectangular
- B. Materials:
 - 1. Duct: Sheet metal, select gauge in accordance with the latest SMACNA Standards.
 - 2. Perforated: Galvanized steel
 - 3. Insulation liner:
 - a. 1-inch fiberglass with R-value greater than 6.0 for conditioned areas (gyms)
 - b. 2-inch fiberglass with R-value greater than 6.0 inside building unconditioned space.
 - c. 3-inch fiberglass with R-value greater than 8.0 for exterior duct.
- C. Conform to ASTM A653/A653M and ASTM A924/A924M.
- D. Conform to ASTM 463 for aluminized ductwork

- E. Construction:
 - 1. Double wall insulated
 - 2. Spiral with lockseams
 - 3. "Paint grip" finish on outer shell for exposed ductwork
 - 4. Conform to ASTM A653/A653M
 - 5. Fittings:
 - a. Spot welded and bonded construction
 - 6. Outer joints:
 - a. Use flanged couplings that will withstand the maximum design pressure with no leakage.
 - 7. Inner Liner Joints:
 - a. Use a separate slip coupling to connect the inner liner sections at duct to duct joints to allow for expansion/contraction.
 - b. Do not mechanically fix or seal inner lining couplings.
 - F. Flanged Joints:
 - 1. Seal with a duct sealant that has a synthetic elastomeric base.
 - 2. Sealant:
 - a. Formulated to withstand temperatures from -20 to 150 degrees F.
 - b. Formulated so that no surface preparation or solvent cleaning is necessary.
 - c. UL classified.
 - G. Control Dampers:
 - 1. Construct with a 2-inch insulation layer and a solid inner liner.
 - 2. Press stainless steel bearing sleeves into the frame of the outer shell to support the damper axle.
 - 3. Extend the axle 6 inches from the outer shell body.
 - 4. Attach a 1½ inch x 1½ inch reinforcement to the damper.
 - H. Elbow Radius:
 - 1. 90-degree: 1-1/2 times duct diameter with 5 gores
 - 2. 45-degree: 1-1/2 times duct diameter with 3 gores
 - I. Manufacturer/Model:
 - 1. United McGill Corporation
 - 2. Lewis & Lambert, LLP
 - 3. Linx Industries
 - 4. Precision Spiral Pipe
 - 5. Spiral Pipe of Texas Corporation, Inc.
- 2.6 SINGLE-WALL, ROUND, AND FLAT OVAL DUCT AND FITTINGS (FOR MEDIUM PRESSURE APPLICATION)
- A. Medium Pressure (3-inch w.g.) rectangular duct not allowed.
 - B. Material:
 - 1. New, prime grade sheet or coil steel.
 - a. Select gauge in accordance with latest SMACNA Duct Construction Standards.
 - C. Fittings:
 - 1. By Duct Manufacturer
 - D. Coatings:
 - 1. Type:
 - a. Continuous, hot-dip galvanized coating.
 - E. Application:
 - 1. 1-1/4 ounces per 1 square foot, two-sided sheet.
 - 2. Comply with ASTM A653/A653M.
 - F. Identification:
 - 1. Sheet Steel

2. Stencil each sheet with manufacturer's name and gauge.

G. Construction:

1. Manufacture in accordance with the latest SMACNA Standards.

H. Approved Manufacturers:

1. United McGill Corporation
2. Lewis & Lambert, LLP
3. Linx Industries
4. Precision Spiral Pipe
5. Spiral Pipe of Texas Corporation, Inc.

2.7 FLEXIBLE DUCTS

- A. Material: In accordance with the latest SMACNA Metal and Flexible Duct Standards,

B. Construction:

1. Factory insulate with high-density fiberglass to a minimum R-value of 6.
2. Provide a positive interior air seal permanently bonded to a carbon steel spring helix.
3. Sheath seal in a Class 1 vapor barrier and factory seal at both ends.
4. Conform to UL 181, NFPA 90A

C. Manufacturer/Model:

1. ATCO 30 Series or equal

2.8 VOLUME CONTROL DAMPERS

A. Manufacturer:

1. Nailor Industries Series 1020, 1021, or equal.

B. Type:

1. Manually operated single-blade or multi-blade
2. Conform to the latest SMACNA Duct Standards (Metal & Flexible)

C. Application:

1. Provide in all branches, splits, and taps whether indicated on plans or not.

D. Construction:

1. Provide an indicating device with lock to hold damper in proper position.
2. All manual dampers installed above hard ceilings or at other inaccessible areas shall be supplied with a cable operated damper equal to Young Regulator Model 830A-CC. Damper(s) to be opposed blade type constructed of .050 minimum heavy duty extruded aluminum frames and blades. All necessary hardware to ensure compatibility with remote cable control system shall be included. Damper blades to include individual blade bushings for smooth and quiet operation. Damper blades shall rotate between a matched pair of formed and punched 306 stainless steel connecting slide rails which facilitate smooth blade movement and ensure alignment.

2.9 TURNING VANES

- A. Provide in all rectangular supply elbows.

- B. Conform to the latest SMACNA Duct Standards

2.10 DUCT SEALANT

- A. Equal to Glenkote "Seal-Flex" duct sealer, Hardcast "Irongrip 601", Foster 32-19" or "Childers CP-146"

2.11 FIRE DAMPERS

A. Manufacturer/Model:

1. Fire Dampers - Pottorff, Ruskin, Greenheck, National Controlled Air or Nailor

2. Ceiling Fire Dampers/Thermal Blankets - CK-2000-1 thermal blanket and Model CFSR-2 ceiling damper for supply outlets (round or square) and CFSR-2 for return outlets (square).
- B. Type:
1. 212°F fusible link fire damper.
 2. Fire protection rating: 1.5 hours
 3. Conform to UL 555 and be UL labeled
 4. Tested in accordance with AMCA 500.
- C. Application:
1. Provide at locations shown on plans and where required by Local and State ordinances.
- D. Features:
1. Maximum leakage 8 cfm at 4-inch S.P.
 2. Vertical or horizontal installation
 3. Radiation blanket
 4. Wall Sleeve and retaining angle collar
 5. Blades 16 gauge galvanized, maximum 6-inch width.
 6. 5-year warranty
- E. Manufacturer/Model:
1. Ceiling Fire Dampers:
 - a. Pottorff Ceiling Fire Dampers/Thermal Blankets - Series CFD
 - b. Equals by Nailor Industries, NCA, United Air, Ruskin, Greenheck

2.12 DUCT SILENCERS/SOUND ATTENUATORS

- A. Manufacturers:
1. Price
 2. IAC Acoustics
 3. Kinetics Noise Control
 4. McGill Airflow LLC.
 5. Ruskin Co.
 6. Vibro-Acoustics
- B. Rectangular Silencer Outer Casing:
1. ASTM A653/A653M, G90 Galvanized sheet steel, 0.034-inch thick.
- C. Inner Casing and Baffles:
1. ASTM A653/A653M, G90 Galvanized sheet metal, 0.034-inch thick, with 1/8-inch diameter perforations.
- D. Connection size: Match connecting ductwork, unless otherwise noted.
- E. Sound Absorbing Mechanism:
1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
 2. Dissipative type with fill media
 - a. Fill material - inert and vermin-proof fibrous material, packed under moisture-proof non-fibrous material.
 - b. Erosion barrier - polymer bag enclosing fill, heat sealed before assembly.
- F. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or react to system pressure variations. Do not use mechanical fasteners for unit assemblies. Units shall be completely factory fabricated. No field assembly required.

2.13 FIRE SAFETY FUNCTIONS - DUCT MOUNTED SMOKE DETECTORS, CONTROL RELAYS, AND SMOKE FIRE DAMPER CONTROL

- A. At minimum, duct mounted smoke detectors required on all air handlers, fan coil units, fan powered boxes, and packaged rooftop units rated at 2000 CFM or more. Control relays required on all air handlers, fan coil units, fan powered boxes, and packaged rooftop units feeding any path of egress or

corridors.

- B. The Fire Alarm Contractor shall provide the Duct Mounted Smoke Detectors, Control Modules, Power Relays, and Control Relay devices and perform the final low-voltage hook-up to the fire alarm system.
- C. Duct-mounted smoke detector housings and sample tubes shall be furnished by the Fire Alarm Contractor and mounted by the Mechanical Contractor.
- D. Line voltage hook-up shall be by the Electrical Contractor.
- E. Fire Alarm Safety Control Functions, which may include the operation of fire alarm Control Relays CR associated with duct mounted smoke detector D/air handler shut down, high volume low speed (HVLS) fan shut down, fire door hold-back and release, smoke fire damper motor control, et cetera, shall be initiated via Control Relays which shall be de-energized under fire alarm conditions. These Control Relays shall be provided and mounted by the Fire Alarm Contractor and located within three feet of the unit. These Control Relays shall be controlled by a fail-safe Fire Safety Control Function circuit. For each controlled device, the contractor providing the device shall wire it internally for fail-safe shut-down and provide a labeled 3' coil of cable outside the unit to allow the fire alarm contractor to make final connection to the Common and N.O. or N.C. dry contacts on the fire alarm SPDT Control Relay. Each Fire Safety Control Function circuit controlled device shall be configured such that when the fire alarm system safety control circuit is re-energized, by the fire alarm control panel, the device shall return to normal operation (e.g. be ready to re-start) without a need for manual or environmental control system intervention.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Erect all ductwork in the general locations shown.
- B. Conform to all structural and finish conditions of the building.
- C. Ductwork shall not be allowed to pass through or over designated electrical rooms.
- D. Before fabricating any ductwork, check the physical conditions at the job site and make all necessary changes in cross sections, offsets, and similar items, whether they are specifically indicated or not.
- E. Where ductwork is shown to be lined on the inside with duct liner, the sizes shown on the plans are the inside dimensions. Therefore, sheet metal dimensions shall be increased accordingly.
- F. Seal all joints both transverse and longitudinal seams, with duct sealant.
- G. Install 1" roll type filter media on all return duct openings prior to starting blowers. Leave in place and change as necessary during construction.
- H. Before installing grilles, operate air conditioning unit fans and remove all debris or foreign matter.
- I. Rectangular ductwork:
 - 1. Construct in accordance with the latest SMACNA, Duct Construction Standards for the specific duct pressure classification involved. Do not use radius ells with square throats.
- J. Round ductwork:
 - 1. Connect with slip type joints using a minimum of three sheet metal screws per joint and in accordance with the latest SMACNA Duct Construction Standards.
- K. Flexible ductwork:
 - 1. All flexible ducts shall be demountable and individual lengths shall not be in excess of seven feet. Flexible ducts are not allowed to substitute rectangular return air ductwork unless approved by engineer.
 - 2. Use only factory-made connectors.
 - 3. Flexible ducts should be installed fully extended, free of sags and kinks.

- L. Science Lab and Fume Hood Exhaust Ducts:
 - 1. Provide a liquid tight continuous external weld on all seams and joints in the ductwork.
 - 2. Provide access doors to duct and shaft.
 - 3. Fume hood exhaust ductwork shall not pass through any fire rated wall.

- M. Shower Room Exhaust Ductwork:
 - 1. Provide shower room with aluminum or stainless steel exhaust ductwork as specified for standard duct construction for sheet metal ductwork.
 - 2. Make all joints in the bottom of horizontal runs watertight.
 - 3. Slope horizontal runs to exhaust grille.
 - 4. Use unlined duct in all shower room installations.

- N. Double-wall insulated spiral/rectangular ductwork:
 - 1. Install without exposed insulation in all exposed ceiling areas.
 - 2. Provide ductwork installation that is high quality, very neat, and aesthetically pleasing.
 - 3. The final appearance of the ductwork shall be approved by the Architect/Engineer.

- O. Exterior Ductwork:
 - 1. Exterior ductwork shall use a Ductmate Industries connection and sealing system. Install per manufacturers recommendations.
 - 2. All exterior ductwork to be protected and sealed with a weather-proofing, protective finishing system such as Alumaguard All Weather, Venture Clad System, or equivalent. Both insulation and protective finish cover system shall be pitched in order to shed water. Level or flat covers will not be accepted.

- P. Reinforcement:
 - 1. Reinforce all ducts to prevent buckling, breathing, vibration, or unnecessary noise.
 - 2. Reinforcing shall be in accordance with the latest SMACNA Duct Construction Standards (Metal and Flexible), plus any additional reinforcing to meet job conditions.
 - 3. All ducts shall be supported in accordance with the latest SMACNA Duct Construction Standards (Metal and Flexible).

- Q. Flexible Connections:
 - 1. Where ducts connect to fans or air handling units, make flexible airtight connections using "Ventglas" fabric.
 - 2. The fabric must be fire-resistant, waterproof, and mildew resistant with a weight of approximately 30 ounces per square yard.
 - 3. Provide a minimum of 1/2 inch slack in the connections, and a minimum of 2-1/2 inches distance between the edges of the ducts.
 - 4. Provide a minimum of 1-inch slack for each inch of static pressure on the fan system.
 - 5. Securely fasten fabric to apparatus and to adjacent ductwork by means of galvanized flats or draw bands.
 - 6. Do not install outdoors, except where detailed on plans.
 - 7. Where connections are made in outdoor locations, seal fabric to metal with mastic.

- R. Access Doors:
 - 1. Install ductwork access doors in structural angle frames and provide with sash locks and hinges arranged for convenient access.
 - 2. Construct doors which occur in insulated ducts with an insulation filler.
 - 3. All access doors shall be appropriately labeled.

- S. Flashing and Opening Sealing:
 - 1. Ducts passing through roofs or exterior walls:
 - a. Provide suitable flashing to prevent rain or air currents from entering the building as detailed on plans.
 - b. The flashing shall be minimum No. 24 gauge galvanized steel.

- T. Ducts passing through mezzanine walls:
 - 1. Completely seal the penetration with acoustic sealant and fill all gaps between the ductwork and the wall materials.

2. Sealant must be capable of preventing sound from exiting the mechanical rooms through these openings.
- U. Ducts penetrating the floor:
1. Make the entire penetration watertight by installing appropriate flashing and/or application of G.E. silicone sealant.
 2. The penetration must be capable of maintaining standing water in the mechanical area without allowing any water through the opening.
- V. Duct Leakage:
1. Seal ductwork in accordance with the latest SMACNA HVAC Duct Construction Standards - Metal and Flexible.
 2. Minimal leakage is expected for ductwork constructed to these standards but in no case shall the total leakage exceed 1% of designed CFM.
 3. All joints to be sealed with duct sealant.
- W. Fire and Smoke Dampers:
1. Install fire and smoke dampers at locations shown on plans, and where required by local and state ordinances.
 2. Do not compress or stretch SFD, FD frame into duct or opening.
 3. Install dampers square and free from racking with blade running horizontally.
 4. Handle damper suing sleeve or frame. Do not lift damper using blades actuator, or jackshaft.
 5. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.
 6. Provide access doors in attached ductwork for inspection.
 7. Stencil each door "Fire Damper Access" per UL 555 Standard.
 8. Install fire dampers in openings utilizing steel angles, sleeves, and other materials, and practices required to provide an installation equivalent that used by manufacturer when dampers were tested at UL.
 9. Install in accordance with damper manufacturer's published recommendations and instructions and NFPA 90A.

3.2 BALANCING DAMPERS

- A. Volume Control Dampers:
1. Install manually operated volume control dampers in all branch ducts, splits, or taps whether indicated on the drawings or not. Install a minimum of 5'-0" from grille/diffuser.
 2. Provide indicating device with lock to hold damper in position.
- B. Cable Operated Dampers:
1. Install a minimum of 5'-0" from grille/diffuser.
 2. Install to facilitate smooth blade movement and ensure alignment.
- C. Back Draft Dampers:
1. Install back draft dampers as shown on plans.
 2. Manufacturer: Nailor Industries Series 1300 or equal.
- D. Air Intake Ducts:
1. Insulate all outside air intake ducts.

3.3 DAMPER IDENTIFICATION

- A. Provide a securely attached red band and a label reading "Damper Location" at the location of all concealed manual dampers.
- B. All manual dampers which are not readily visible after duct insulation installation shall be identified in this manner.

3.4 DUCTWORK SUPPORT

- A. All ducting must be supported from building structure.

- B. Duct straps are not allowed to be screwed to roof decks, support from cross bridging, or supported from bottom chord of joists.
- C. Do not support from roof or floor deck joist bridging.
- D. Support sizes and spacing shall conform to the latest SMACNA Standards.

END OF SECTION

SECTION 23 31 16
FABRIC DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. Furnishing and installation of all fabric ductwork as shown on the construction documents. Fabric ductwork connections to rigid plenums, hangers and support systems, and other appurtenances necessary for a complete and operational system.
- B. All work shall be preceded by taking measurements at the job site, fully coordinating all work with other disciplines, verifying available spaces for ductwork, and developing shop drawings.

1.3 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 05 93 - Testing, Adjusting and Balancing for HVAC
- C. Section 23 07 13 - Duct and Grille Insulation
- D. Section 23 33 33 - Access Doors
- E. Section 23 34 16 - HVAC Fans
- F. Section 23 37 13 - Diffusers, Registers, and Grilles
- G. Section 23 81 19 - Packaged HVAC Units
- H. Section 23 81 26 - Split System HVAC Units

1.4 REFERENCES

- A. Perform all work pertaining to fabric ductwork in strict accordance with the requirements and recommendations stated in the codes and standards, except when requirements are modified by the contract documents.

1.5 QUALITY ASSURANCE

- A. Product must be Classified by Underwriters Laboratories in accordance with the 25/50 flame spread/smoke developed requirements of NFPA 90A and are also classified in accordance with ICC Evaluation Service AC167.
- B. All products must be labeled with the logo and classification marking of Underwriters Laboratories.

1.6 SUBMITTALS:

- A. Product Data:
 - 1. Submit manufacturer's specifications on materials and manufactured products used for work of this section.
 - 2. Submit UL file number under which product is Classified by Underwriters Laboratories for both NFPA 90A and ICC AC167.

1.7 WARRANTY

- A. Manufacturer must provide a 20 Year Product Warranty for products supplied for the fabric portion of this system as well as a Design and Performance Warranty.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect fabric ductwork systems from damage during shipping, storage, and handling.
- B. Where possible, store products inside and protect from weather. Where necessary to store outside, store above grade and enclose with a vented waterproof wrapping.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. DuctSox
- B. KE Fibertec
- C. Fabric Air
- D. Qsox
- E. SoftDucts

2.2 AIR DISPERSION SYSTEM

- A. Air diffusers shall be constructed with internal tensioning frame.
- B. Manufacturer must have documented design support information including duct sizing, vent and orifice location, vent and orifice sizing, length, and suspension. Parameters for design, including maximum air temperature, velocity, pressure, and fabric permeability, shall be considered and documented.
- C. Air diffusers shall be constructed with one or a combination of an internal retention frame and external tensioning. System shall utilize internal skeleton, ring/hoops and tensioning to maintain shape.

2.3 FABRIC MATERIAL

- A. Color and/or Design Logo: Must coordinate with Owner/Architect/Engineer
- B. Textile Construction: Filament/filament twill polyester, fire retardant in accordance with UL 2518.
- C. Machine washable antimicrobial agent.
- D. Air Permeability: 2 (+2/-1) CFM/ft² per ASTM D737. The air permeability of the fabric must NOT be created by perforating the fabric. The air permeability must be confirmed by third party testing to eliminate the formation of condensate on the fabric.
- E. Weight: 6.8 oz. /yd² per ASTM D3776
- F. Temperature Range: 0°F to 180°F
- G. Warranty: 15 years with standard inlet velocity

2.4 SYSTEM FABRICATION REQUIREMENTS

- A. Integrated air dispersion shall be specified and approved by manufacturer.
 - 1. Air dispersion accomplished by linear vent and permeable fabric. Linear vents must be sized in 1 CFM per linear foot increments (based on .5" SP), starting at 1 CFM through 90 CFM per linear foot. Linear vent is to consist of an array of open orifices rather than a mesh style vent to reduce

- maintenance requirements of mesh style vents. Linear vents should also be designed to minimize dusting on fabric surface.
2. Size of vent openings and location of linear vents to be specified and approved by manufacturer.
- B. Air dispersion to be one or a combination of linear vents, orifices and fixed/adjustable nozzles. Size, quantity, and location of orifices to be specified and approved by manufacturer.
 - C. System to be constructed in modular lengths (zippered) with proper radial securing clips (inlets, endcaps and mid-sections) and top access zippers for vertical cable safety attachment.
 - D. End cap includes zipper for easy maintenance.
 - E. Inlet connection to metal duct via fabric draw band with anchor patches as supplied by manufacturer. Anchor patches to be secured to metal duct via. zip screw fastener – supplied by contractor.
 - F. Inlet connection includes zipper for easy removal/maintenance.
 - G. Lengths to include required zippers as specified by manufacturer.
 - H. System to include Adjustable Flow Devices to balance turbulence, airflow, and distribution as needed. Flow restriction device shall include ability to adjust the airflow resistance from 0.06 to 0.60 in w.g. static pressure.

2.5 SUSPENSION HARDWARE

- A. 3x1 Suspension:
 1. System shall include a 3 Row connection to fabric system at 10, 12, and 2 o'clock locations. Attachment spacing is not to exceed 3 feet. The powder-coated aluminum hangers are secured and integrated to a single (1 Row) tension cable every 3' and connect to the fabric system at the 10 and 2 o'clock locations with detachable D-Clasps. The fabric system will also have clips located at 12 o'clock to attach directly to the single tension cable system located 3" above top-dead-center location of the fabric system. Tension cable hardware to include cable, eye bolts, cable clamps, and turnbuckles as required. Component options include:
 - a. Galvanized Steel Cable
- B. Suspended H-Track:
 1. System shall include a single (1 Row) or double (2 Row) runs of aluminum H-Track system located 1.5" above top-dead-center (1 Row) or 1.5" above the 10 and 2 o'clock (2 Row) locations of fabric ductwork system. 2 Row supports are required for systems of 32" diameter and larger. Hardware to include 10' sections of track, splice connectors, track end caps, and vertical cable support kits - consisting of a length of cable with a locking stud end and Gripple quick cable connectors. Radius aluminum track must be included for all radius sections.
 - a. Fabric/Track attachment
 - 1) Cord In continuous supporting cord (not suggested for systems >24" Dia.)
 - 2) Snap Tabs are a detachable sliding tab positioned every 24" along the length of the system (all diameters).
 - b. Hardware components
 - 1) Provide 316 Stainless Steel components including coupler assembly, vertical cable support, and Gripple quick cable connector.
- C. Flush-Mount Track:
 1. System shall include aluminum Flush-Mount system located 1.5" above top-dead-center of fabric ductwork system. Hardware to include 12' section of track, Snap Tabs, splice connections, and end caps as required. Snap Tabs must promote easy sliding movement through aluminum track and must be detachable from the fabric. Radius aluminum track for support of the elbows through the corners using either Snap Tabs or Cord-In.
 - a. Fabric / Track Attachment
 - 1) Cord In continuous supporting cord (not suggested for systems >24" Dia.)
 - 2) Snap Tabs are a detachable sliding tab positioned every 24" along the length of the system (all diameters).

- D. Surface Mount:
 - 1. System shall include aluminum Flush-Mount system located flush with the top of fabric ductwork system. Width between mounting points (of the track to the ceiling) shall be 2" wider than the specified diameter of the D-Shape fabric duct. Hardware to include 12' sections of track, splice connections, and end caps as required. System attachment shall be made by cord sewn into top side flaps of fabric duct system supported entire length.

PART 3 INSTALLATION

3.1 INSTALLATION OF FABRIC DUCTWORK SYSTEM

- A. Install chosen suspension system in accordance with the requirements of the manufacturer. Instructions for installation shall be provided by the manufacturer with product.

3.2 CLEANING AND PROTECTION

- A. Clean air handling unit and ductwork prior to the fabric system unit-by-unit as it is installed. Clean external surfaces of foreign substance which may cause corrosive deterioration of facing.
- B. Temporary Closure: At ends of ducts which are not connected to equipment or distribution devices at time of ductwork installation, cover with polyethylene film or other covering which will keep the system clean until installation is completed.
- C. If fabric systems become soiled during installation, they should be removed and cleaned following the manufacturers standard terms of laundry.

END OF SECTION

SECTION 23 33 33

ACCESS DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Access doors and their installation requirements.

1.2 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements

1.3 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 23 00 90, General Conditions, and Division 01.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acudor
- B. Elmdor
- C. Mifab
- D. Commercial Access Doors

2.2 ACCESS DOORS

- A. Locations requiring access doors:
 - 1. Concealed valves
 - 2. Traps
 - 3. Trap primers
 - 4. Controls
 - 5. Cleanouts
 - 6. Dampers
 - 7. Ducts adjacent to fire doors, fire dampers, and smoke detectors.
 - 8. Equipment above hard ceilings.
 - 9. Other equipment requiring accessibility for operation and maintenance.
- B. Type:
 - 1. Hinged flush-type steel framed door with straps and exposed narrow border.
- C. Minimum size:
 - 1. 18" x 18" unless otherwise indicated.
 - 2. 24" x 24" trap primers.
 - 3. 24" x 24" for equipment above hard ceilings.
 - 4. Conform to architectural panel pattern for acoustical ceilings.
 - 5. Confirm size with Building Inspector and Engineer.
- D. Construction:
 - 1. Hinges: Concealed continuous type.
 - 2. Locking Device: Flush cam type, screwdriver operated.
- E. Fire Rating:

1. Same or better fire rating than the surrounding area.

F. Access doors located in kitchens, restrooms, or areas where water is present shall be stainless steel.

2.3 FACTORY PAINTING

A. Apply prime coat of rust inhibiting paint, unless located in wet area.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions and recommendations.

B. In suspended acoustical ceilings, provide a beaded pin or other approved means for identification and easy removal where necessary.

C. Access doors shall only be installed in areas/locations that are readily accessible.

D. Doors shall be installed in such a manner that door will open 180 degrees.

END OF SECTION

SECTION 23 34 16

HVAC FANS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Centrifugal fans
- B. Destratification fans

1.2 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 37 13 - Diffusers, Registers, and Grilles

1.3 REFERENCES

- A. AMCA (DIR) - Air Moving and Conditioning Association, Inc.
- B. UL - Underwriter's Laboratory

1.4 QUALITY ASSURANCE

- A. UL Listed and Bear Label
- B. Tested in accordance with AMCA standards

1.5 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 23 00 90, General Conditions, and Division 01.
- B. Submit product data indicating typical catalog data, including arrangements, dimensions, general assembly, and materials used in fabrication.
- C. Provide in table form a schedule similar to drawings with data listing all fans, information, accessories, etc.
- D. Indicate mechanical and electrical service locations and requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acme
- B. Cook
- C. Greenheck
- D. CaptiveAire
- E. PennBarry
- F. Twin City Fans
- G. S&P USA Ventilation

2.2 GENERAL

- A. Provide fan type, arrangement, capacity, size, motor horsepower, and motor voltage as shown on the drawings.
- B. Rate fans according to appropriate Air Moving and Conditioning Association, Inc. (AMCA) approved test codes and procedures. Seal to be attached.
- C. Supply fans with sound ratings below the maximums permitted by AMCA standards.
- D. All fans provided must bear the UL Label.
- E. Sound levels shall be as listed or quieter. Fans with excessive noise will be replaced at Contractor's expense.
- F. Fans are to be supplied with engraved aluminum nameplates indicating CFM, static pressure, manufacturer, serial number, and model number.

2.3 ROOF MOUNTED EXHAUST FANS

- A. Type:
 - 1. Roof mounted, up blast, direct driven centrifugal exhaust ventilator. Fan shall be spun aluminum and mounted on vibration isolators.
- B. Motors:
 - 1. NEMA design B with a minimum of Class B insulation rated for continuous duty and furnished at the scheduled voltage.
 - 2. Motor shall be electronically commutated motor rated for continuous duty and furnished either with internally mounted potentiometer speed controller or with leads for connection to 0-10 VDC external controller.
 - 3. Exhaust fan motor to be located outside of the exhaust airstream and enclosed in a weather-tight compartment.
- C. Mounting:
 - 1. Resilient mounts outside the air stream.
- D. Cooling:
 - 1. Forced air cooling.
- E. Bearing Rating:
 - 1. Heavy duty regreasable ball type in a cast iron pillowblock housing selected for a minimum L50 life in excess of 200,000 hours at maximum catalogued operating speed.
- F. Construction:
 - 1. Fan shall be bolted and welded construction utilizing corrosion resistant fasteners.
 - 2. Spun aluminum structural components shall be constructed of minimum 18 gauge marine alloy aluminum, and bolted to a rigid aluminum support structure.
 - 3. Aluminum base shall have continuously welded curb cap corners for maximum leak protection.
 - 4. Fan wheel shall be backward inclined, constructed of 100% aluminum or steel, and provided with an aerodynamic aluminum inlet cone.
 - 5. Integral conduit chase shall be provided through the curb cap and into the motor compartment to facilitate wiring connections.
 - 6. Provide 1/2 inch galvanized or poly mesh bird screen over openings
- G. Features:
 - 1. High Wind Rated
 - 2. Disconnect switch: Factory wire the switch and motor to the junction box
 - 3. Backdraft dampers (barometric or motorized as scheduled) with damper tray
 - 4. Insulated, prefabricated curb with cant strips and with resilient gasket on top flange.
 - 5. Minimum 18 gauge galvanized steel or aluminum.
 - 6. Factory installed variable speed controller.

7. Minimum 18-inch curb height.
8. Lifting lugs.

- H. Verify roof slope so that fans are installed in a level condition.
- I. Coordinate and furnish curbs that are compatible with roof being installed.

2.4 CEILING MOUNTED EXHAUST FANS

- A. Type:
1. Centrifugal, direct driven exhaust fans
- B. Motors:
1. Motor shall be totally enclosed type with permanently lubricated bearings and built-in thermal overload protection.
- C. Construction:
1. Fan housing shall be minimum 20 gauge galvanized steel and acoustically insulated.
 2. Blower and motor assembly shall be mounted to a minimum 14 gauge reinforcing channel.
 3. Fan wheels shall be twin DWDI centrifugal forward curved type, constructed of galvanized steel.
 4. Integral aluminum or poly backdraft damper.
- D. Features:
1. Disconnect switch: Internal wiring box with switch.
 2. Blower assembly to be easily removed without disconnecting the ductwork.
 3. Powder painted white aluminum or steel grille.
 4. Factory installed variable speed controller.
 5. Provide 277 volt to 120-volt transformer.

2.5 DIRECTIONAL DESTRATIFICATION FANS

- A. Type:
1. Direct driven fan.
 2. EC motor
 3. 0-10 VDC CONTROL. On/Off by EMCS.
- B. Features:
1. Factory supplied steel mounting cables
 2. 10 foot wiring pigtail with plug. Coordinate all requirements with electrical contractor.

2.6 SUPPLEMENTAL EQUIPMENT

- A. PSC motors and fractional HP motors to have thermal overload protection
- B. Weatherproof motor covers for outdoor installations:
1. Apply the same finish as used on the fan.
- C. Belt driven fans:
1. Equip the fan motors with variable pitch sheaves. Select the sheave size for the approximate midpoint of adjustment and to provide not less than 20 percent speed variation from full open to full closed.
- D. Nonadjustable motor sheaves:
1. Use for motor sizes over 15 horsepower.

2.7 PROTECTIVE COATINGS

- A. Apply manufacturer's standard prime coat and finish to all fans, motors, and accessories, except on aluminum surfaces or where special coatings are required.
- B. Galvanizing:
1. Hot dip coat all surfaces which require galvanizing.

2. Where galvanizing is specified, a zinc coating may be used.
3. After fabrication, apply the zinc coating and air dry the coating to 95 percent pure zinc.
 - a. Zinc Coatings:
 - 1) Amercoat
 - 2) Diametcoat
 - 3) Sealube
 - 4) Zincilate
- C. All exhaust fans which will operate in a corrosive environment (Science Labs, etc.) shall have a factory applied acid resistant coating with UV resistant topcoat.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install fans according to the manufacturer's instructions and in the locations shown on the drawings.
- B. All fans shall utilize spring type vibration isolation hangers for when used in a suspended application.
- C. All roof mounted fans shall have electrical wiring and conduit internal to roof curb and fan housing. No external wiring or conduit will be allowed on roof.
- D. Verify compliance of "in Situ" vibration readings with AMCA 204-05.
- E. All fans shall be air balanced in accordance with Section 23 05 93.
- F. Top of level curb to have minimum 11" from finished roof to top of curb.
- G. Screw fans to curbs with gasketed screws.

3.2 START-UP

- A. Start fans to verify rotation and operation sequence prior to test and balance.

3.3 IDENTIFICATION

- A. Provide identification per Section 23 05 53.

END OF SECTION

SECTION 23 36 16

VARIABLE AIR VOLUME TERMINAL UNITS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. Variable volume terminal units.

1.3 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements

1.4 REFERENCES

- A. UL Listed - Underwriters Laboratory
- B. ARI 880 - Air Terminals
- C. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- D. UL 181 - Factory-Made Air Ducts and Connectors.
- E. ARI 885 - Air-Conditioning and Refrigeration Institute Standard Rating Conditions for Air Terminals for UNLINED duct.
- F. UL - Shutoff terminal must be UL listed as a Room Air Terminal.
- G. ASTM A527 (Steel Sheet, Zinc Coated Galvanized)

1.5 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 23 00 00, General Conditions, and Division 1.
- B. Submit shop drawings and product data.
- C. Submit shop drawings and product data for manufactured products and assemblies required for this project.
- D. Submit performance data at the scheduled conditions.
- E. Indicate water, drain, and electrical rough-in connections on shop drawings or product data.
- F. Submit manufacturer's installation instructions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. General
 - 1. Unit performance data must be rated in accordance with ARI Standard 880 and must display the ARI Symbol on all standard units.

2. Shutoff terminals must be UL listed as a Room Air Terminal and bear UL label.

B. Acceptable Manufacturers

1. Trane
2. Carrier
3. Daikin
4. York/JCI
5. Greenheck
6. Titus
7. Krueger
8. Price
9. ETI
10. Nailor

- C. Substitution: Any manufacturer desiring to furnish equipment on this project shall submit COMPLETE submittal data ten (10) days prior to the bid date. Catalog cut sheets and sales data are not acceptable. The unit manufacturer shall list all deviations from the specified unit.

2.2 MANUFACTURED UNITS

- A. The contractor shall furnish and install constant or variable air volume air terminal units for connection to single medium pressure duct. Terminal units are to be connected to central air systems with an electric actuator wired to terminal strip. The direct digital controller shall be provided by the building automation system contractor for mounting at the variable air volume manufacturer's factory. The unit manufacturer shall provide and mount a 120/24VAC transformer.
- B. Identify each terminal unit with clearly marked identification label and airflow indicator. Label shall include unit nominal air flow, maximum factory set airflow, minimum factory set airflow, and heating coil type.

2.3 FABRICATION

- A. Casings - Units shall be completely factory assembled, manufactured of corrosion protected welded or screwed steel, and fabricated with a minimum of 18-gauge metal on the high pressure (inlet) side of the VAV damper and 22-gauge metal on the low pressure (outlet) side and unit casing. Plenum air filter shall be provided on all fan powered units.
- B. Insulation - Interior surface of unit casing is acoustically and thermally lined with a minimum of 3/4" inch foil face insulation. All exposed edges are sealed to prevent fibers in the airstream. Meets NFPA 90A, UL 181, and bacteriological standard ASTM C665.
- C. Assembly - Air volume damper, fans, and controls in single cabinet.
- D. Plenum Air Outlets - Flange duct connections on integral outlets. Fan discharge with flange duct connection.

2.4 VOLUME DAMPER

- A. Locate air volume damper assembly inside unit casing. Construct from extruded aluminum or a minimum of 18 gauge galvanized steel components. Key damper blades into shaft with nylon fitted pivot points. Flow sensor must be provided regardless of control chosen. Flow sensor must be a ring or cross. Bar or single-point sensing device is not acceptable.
- B. Mount manually operated damper quadrant or automatic damper operator and automatic flow control assembly.
- C. Air volume control damper shall be factory calibrated assembly consisting of air modulation damper and extension for connection to control actuator. All actuator linkage shall be protected by a sheet metal enclosure provided by the terminal unit manufacturer.
- D. Air volume control damper shall be factory calibrated assembly consisting of air valve with integral actuator.

- E. Electric actuator shall position damper. The electric actuator shall be provided by the terminal unit manufacturer.

2.5 ELECTRIC HEATING COILS

- A. Electric Heating Coil: Slip-in type, open coil design, factory wired and mounted, and equipped with primary and secondary over-temperature protection, integral control box with built-in magnetic contactors, minimum airflow switches, sail switches. Heater must be factory mounted on unit discharge to minimize air temperature stratification.
- B. Capacity and stages to be clearly shown on VAV box identification. All electric heaters with scheduled capacity of five (5) kW and greater shall be provided with two (2) stage heaters.
- C. Heater shall be externally insulated.

2.6 WIRING

- A. Factory mount and wire controls. Mount electrical components in control box with removable cover. Incorporate single point electrical connection to power source.
- B. Factory mount transformer for control voltage on units. Provide terminal strip in control box for field wiring of thermostat and power source.

2.7 TESTS

- A. Factory set and check all electronic controllers to within 5% of scheduled maximum and minimum settings. Base performance on tests conducted in accordance with ARI 880.
- B. Maximum Casing Leakage: 1 percent of nominal airflow at 0.5 in w.g. inlet static pressure.
- C. Maximum Damper Leakage: 1 percent of design airflow at 4 in w.g. inlet static pressure.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Inlet collar and heating coil shall be externally insulated.
- C. The sheet metal contractor shall install a minimum of 2'-0" of straight hard duct on the high-pressure inlet connection to the terminal unit. Attached to the straight duct the sheet metal contractor can use a maximum of 3'-0" of high-pressure flex duct for connection to the main supply duct.
- D. In addition to name plate tags on HVAC equipment, provide and install 1/2" diameter nameplate marker (color to be approved by A/E), and apply to T-bar ceiling below any mechanical equipment above lay-in ceiling.

3.2 ADJUSTING

- A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design airflow to 30 percent nominal airflow. Set units with heating coils for minimum 30 percent full flow, or as scheduled.

END OF SECTION

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SECTION 23 37 13

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Grilles
- B. Diffusers
- C. Registers
- D. Storm Rated FEMA Louvers

1.2 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC
- C. Section 23 31 13 - Metal Ductwork
- D. Section 23 34 16 - HVAC Fans

1.3 REFERENCES

- A. ARI Standard 890-94 - Rating of Air Diffusers and Air Assemblies.
- B. ICC 500 - 2014

1.4 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 23 00 90, General Conditions, and Division 01.
- B. Product data for review prior to placement of purchase order:
 - 1. Outlets
 - 2. Grilles
 - 3. Registers
 - 4. Control devices
 - 5. Diffusers
 - 6. Storm Rated FEMA Louvers
 - 7. Similar equipment
- C. Product data shall be submitted for each device specified. Data shall be arranged to match grille schedule.
- D. If a manufacturer other than the one scheduled on the plan is used, the sizes shown on the plans shall be checked for performance, noise level, face velocity, throw, pressure drop, etc., before the submittal is made.
- E. Selections shall meet the manufacturer's own published data for the above performance criteria.
- F. If grilles other than those scheduled by name are furnished, manufacturer shall be prepared to demonstrate compliance with noise criteria at Engineer's request and to Engineer's satisfaction.

1.5 COORDINATION

- A. Coordinate this work with work under Division 26 to ensure that intended functions of lighting and air systems are achieved.
- B. Locations of outlets on plans are approximate and shall be coordinated with other trades to make symmetrical patterns.
- C. Locations shall be governed by the established pattern of the lighting fixtures or architectural reflected ceiling plan.
- D. The Contractor shall move any grille, register, or outlet up to four feet in any direction as directed by the Engineer at no additional cost.

PART 2 PRODUCTS

2.1 GENERAL

- A. Provide grilles, registers, and diffusers as shown or scheduled on the plans. Conform to ARI 890-94.
- B. All air distribution devices in shops, kitchen and any wet areas such as locker rooms, showers, and bathrooms/restrooms shall be 100% aluminum construction.
- C. All air distribution devices for 1-hour structures (walls or ceilings) shall be steel construction conforming to all codes and standards.
- D. Provide storm rated FEMA louvers in all wall and/or roof penetrations of FEMA P-361 or FEMA P-320 compliant storm shelters or safe rooms.

2.2 MANUFACTURERS

- A. Metalaire
- B. Krueger
- C. Titus
- D. Nailor
- E. Price
- F. Greenheck
- G. Tuttle & Bailey
- H. Anemostat
- I. Hart Cooley
- J. Pottorff
- K. United Enertech

2.3 PERFORMANCE CRITERIA

- A. Throw: Velocity at the end of the throw, in the 5'-0" occupancy zone, will be between 25 to 50 FPM.
- B. Noise levels (NC Curve):
 - 1. Not to exceed those scheduled below.
 - a. Classrooms, Libraries, and Offices - 25 N.C.
 - b. Cafeterias - 30 N.C.
 - c. Gymnasiums - 40 N.C.

- C. All devices shall be tested per Air Diffusion Council and labeled as such.

2.4 FINISHES

- A. Paint exposed devices with factory standard prime coat or factory finish coat. Architect/Engineer to determine final color of grille.

2.5 STORM RATED FEMA LOUVERS

- A. Construction:
 - 1. Aluminum construction with inverted V-blades
 - 2. 5 1/2" frame depth x 1/4" frame thickness
- B. Mount Configuration:
 - 1. Cantilevered. Flush mount installation will not be allowed.
- C. Pressure Drop:
 - 1. Maximum pressure drop of 0.25 in. w.g. across storm rated louver.
 - 2. Louver size and pressure drop to be coordinated with engineer prior to submittal

PART 3 EXECUTION

3.1 INSTALLATION

- A. Where called for on the schedules, the grilles, registers, and ceiling outlets shall be provided with deflecting devices and manual dampers. These shall be the standard product of the manufacturer, subject to review by the Engineer.
- B. All ceiling devices shall be furnished to be compatible with the ceilings in which they are installed.
- C. All storm rated FEMA louver(s) dimensions and pressure drops to be coordinated with engineer.

END OF SECTION

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SECTION 23 43 23

BIPOLAR IONIZATION AIR PURIFICATION SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. This section describes the design, performance, and installation of a bipolar ionization air purification system intended for use on the project.
- B. Where the air purification system is intended to reduce outside ventilation air in accordance with the International Mechanical Code and ASHRAE Std 62.1, the manufacturer shall provide calculations to justify such reduction.

1.2 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC
- C. Section 23 31 13 - Metal Ductwork
- D. Section 23 37 13 - Diffusers, Registers, and Grilles

1.3 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 23 00 90, General Conditions, and Division 01.
- B. Submit product data indicating typical catalog data, including arrangements, dimensions, general assembly, and materials used in fabrication.
- C. Provide in table form a schedule similar to drawings with data listing all units, information, accessories, etc.
- D. Indicate mechanical and electrical service locations and requirements.

1.4 QUALITY ASSURANCE

- A. The air purification system shall be a product of an established manufacturer with a minimum of 10 outside air reduction installations in successful operation in the USA. Technologies that do not operate through a gas disassociation process like UV lights, powered particulate filters, and/or polarized media filters, will not be considered.
- B. The air purification system products shall be tested and listed by UL and ETL according to UL Standard 2998 - Electrostatic Air Cleaners. Air purification system products shall specifically be tested and passed UL 2043 to ensure plenum rating.
- C. The operation of bi-polar ionization units shall conform to UL 867 with respect to ozone generation.
- D. The manufacturer must submit Indoor Air Quality calculations to confirm acceptable indoor conditions at the scheduled air flows in accordance with ASHRAE Std 62.1. The calculations shall be independently validated to verify accuracy of the IAQ calculations and conformance with ASHRAE Std 62.1 by third-party testing on a previous installation.

1.5 RELATED WORK PERTAINING TO OTHER SPECIFICATIONS

- A. Electrical wiring

B. Ductwork

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Plasma Air International
- B. Bioclimatic
- C. GPS
- D. Phenomenal Air
- E. Air Oasis
- F. Other qualified manufacturers meeting the requirements of this specification may be
 - 1. submitted for approval 10 business days prior to bid date.

2.2 PERFORMANCE CRITERIA

- A. The bipolar ionization system shall operate and be a zero ozone product.
- B. Each piece of air handling equipment, so designated on the plans, details, equipment schedules, and/or specifications shall contain a plasma ion generator with bipolar ionization output as described here within.
- C. The Bi-polar Ionization system shall be capable of:
 - 1. Effectively neutralizing microorganisms downstream of the bipolar ionization equipment (mold, bacteria, virus, etc.).
 - 2. Controlling gas phase contaminants generated from human occupants, building structure, furnishings, and outside air contaminants.
 - 3. Reducing space static charges.
 - 4. Reducing space particle counts.
 - 5. When mounted to the air entering side of a cooling coil, keep the coil free from pathogen and mold growth.
 - 6. All manufacturers shall provide documentation by an independent accredited laboratory that proves the product has minimum neutralized rates for the following pathogens given the allotted time and in space conditions.
 - a. MRSA - 99.75% in 30 minutes
 - b. Influenza Virus (H1N1) - 80.5% in 30 minutes, 86.6% in 60 minutes
 - c. E. Coli - 99.43 % in 120 minutes
 - d. Cladosporium Cladosporiodes - 97.7% in 120 minutes
 - e. Aspergillus Niger - 97.1% in 120 minutes
 - f. Staphylococcus Aureus - 81.7% in 120 minutes
 - 7. Manufacturers not providing the equivalent space neutralized rates shall not be acceptable. All manufacturers requesting prior approval shall provide to the engineer independent test data from an accredited independent lab confirming the neutralized rates and time per the above.
- D. The bipolar ionization system shall operate in such a manner that equal amounts of positive and negative ions are produced. Single pole ion devices shall not be acceptable.
 - 1. Airflow rates may vary through the full operating range of a VAV system. The quantity of air exchange shall not be increased due to requirements of the air purification system.
 - 2. Velocity Profile: The air purification device shall not have a maximum velocity profile.
- E. Humidity: Plasma Generators shall not require preheat protection when the relative humidity of the entering air exceeds 85%. Relative humidity from 0 - 100%, condensing, shall not cause damage, deterioration, or dangerous conditions to the air purification system.

2.3 EQUIPMENT REQUIREMENTS

- A. Electrode Specifications (Bi-polar Ionization):
 - 1. Each plasma generator with bipolar ionization output shall include the required number of electrodes and power generators sized to the air handling equipment capacity.
 - 2. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating.
 - 3. Ionization output from each electrode shall be a minimum of 5 million ions/cc when tested at 2" from the ion generator.
 - 4. Manufacturer shall demonstrate that no voltage potential exists due to exposed electrical components in the duct system or plenum.
- B. Air Handler mounted units
 - 1. Where so indicated on the plans and/or schedules, Plasma generators shall be supplied and installed. Ion generators for air handling units shall be furnished in a linear or rack mounted configuration so as to minimize the space required for installation. Ionization "rack" shall be no more than 3" deep in the direction of airflow.
 - 2. The mechanical contractor shall mount the plasma ionization rack and wire it to the remote mount power supply panel using only low voltage wiring. Low voltage wiring shall be defined as 24V. The use of line voltage (120V or 230V) or high voltage cabling (600V or higher) shall not be acceptable due to safety concerns.
 - 3. The remote mount power supply panel shall be capable of accepting voltage ratings of 12V DC, 24V AC, 120V AC, or 230V AC. The panel shall have an on/off switch, power indicator LED, and a set of dry contacts which will indicate ionizer functionality. Dry contacts that indicate power available only shall not be acceptable.
- C. Duct mounted units
 - 1. Where so indicated on the plans and/or schedules, plasma ion generators shall be supplied and installed by the mechanical contractor. The contractor shall follow all manufacturer IOM instructions during installation.
 - 2. Ion generators shall be furnished with a factory-equipped gasketed mounting flange to prevent air leakage. Gasketed flange shall be a minimum of 1 1/8" wide around the perimeter of the ionizer to ensure no leakage occurs.
 - 3. Ion generators shall be field installed in a location that is convenient for visual inspection, removal, and servicing. They shall include an ion indicator light clearly visible from below the installed location.
 - 4. Ion generators shall be wired from the 24V AC fan and common terminal of the control power circuit. Ion generators shall be capable of directly accepting 24V AC power. The use of loose step down transformers or power converters shall not be acceptable.

2.4 ELECTRICAL AND CONTROL REQUIREMENTS

- A. Ion generators shall contain a built-in power supply and operate on 24V AC and shall connect to the fan and common terminals of the fan coil unit or air handling unit served. Ion generators requiring a loose 24V, 120V, or 230V transformer or power supply will not be accepted.
- B. Wiring, conduit, and junction boxes shall be furnished and installed by the electrical contractor within housing plenums and shall be UL and NEC NFPA 70 approved.
- C. All plasma ion generators shall include internal short circuit protection, overload protection, and automatic fault reset. Overload protection and associated automatic fault reset shall occur internally to the unit and be performed through circuitry on the unit's PCB. Manual fuse replacement and manual fault reset of each unit shall not be accepted.
- D. All plasma ion generators shall include an external BMS interface to indicate ion generator status and alarm.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. Ionization units shall be installed per manufacturer's installation instructions and requirements.

3.2 ASSEMBLY AND INSTALLATION

- A. Assemble ionization units and install in supply ductwork downstream of all coils and upstream of the first supply tap. Ionization units are not to be installed in return air ductwork.
- B. Ionization units to be installed inside unit cabinet. No screws or penetrations will be allowed to attach inside unit. The preferred mounting location is upstream of the fan inlet, downstream from unit particle filter(s), and upstream of unit's cooling coil.
- C. Electrical contractor shall complete single point power connections.
- D. Protect equipment from water and damage before and after installation.

3.3 WARRANTY

- A. Equipment shall be warranted by the manufacturer against defects in material and workmanship for a period of twelve months after shipment or eighteen months from owner acceptance, whichever occurs first. Labor to replace equipment under warranty shall be provided by the installing contractor.

END OF SECTION

SECTION 23 63 13
AIR COOLED CONDENSING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. Condensing unit package.
- B. Charge of refrigerant and oil.
- C. Controls and control connections.
- D. Refrigerant piping connections.
- E. Motor starters.
- F. Electrical power connections.

1.3 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- C. Section 23 07 21 - Refrigerant Piping Insulation
- D. Section 23 09 23 - Energy Management Control System
- E. Section 23 23 00 - Refrigerant Piping

1.4 REFERENCES

- A. Refer to Section 23 00 00 for complete names of references identified in this section.
 - 1. AMCA 300-85 - Sound Rating Air Moving Devices
 - 2. ARI 210/240 - Unitary Air-Conditioning and Air Source Heat Pump Equipment
 - 3. ARI 270 - Sound Rating of Outdoor Equipment
 - 4. ARI 270 - Sound Rating of Outdoor Unitary Equipment
 - 5. ARI - Sound Rating of Larger Refrigerant & Air Conditioning Equipment
 - 6. ARI - Unitary Air Conditioning Equipment
 - 7. ANSI/ASHRAE 15 - Safety Code of Mechanical Refrigeration
 - 8. ASTM B117 - Salt Spray Test
 - 9. UL - Underwriters Laboratory

1.5 SUBMITTALS

- A. Submit shop drawings indicating components, dimensions, weights and loadings, required clearances, and location and size of field connections. Include schematic layouts showing condensing units, cooling coils, refrigerant piping, and accessories required for complete system.
- B. Submit product data indicating rated capacities, weights, specialties and accessories, electrical, nameplate data, and wiring diagrams.
- C. Submit design data and drawing indicating refrigeration pipe sizing.

D. Submit manufacturer's installation instructions.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include manufacturer's descriptive literature, start-up instructions, installation instructions, and maintenance procedures.

1.7 HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Protect units on site from physical damage.

1.8 WARRANTY

A. Provide a full parts warranty for one year from substantial completion or 18 months from shipment, whichever occurs first.

B. Provide five-year extended warranty for compressors including materials only.

1.9 REGULATORY

A. Unit shall conform to UL 1995 for construction of condensing units and shall have UL label affixed to unit.

1.10 SUMMARY

A. The contractor shall furnish and install air-cooled condensing unit as shown as scheduled on the contract documents. The unit shall be installed in accordance with this specification and perform at the specified conditions as scheduled. The contractor shall pay particular attention to the refrigerant piping requirements and adhere to all the manufacturer's recommendations and contract documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Trane

B. Lennox

C. Daikin

D. Dunham Bush

2.2 GENERAL UNIT DESCRIPTION

A. Provide self-contained, packaged, factory-assembled and pre-wired units suitable for outdoor use consisting of cabinet, compressors, condensing coil and fans, sub-cooling circuits, and controls. Tested in accordance with ARI and have seal and UL label affixed.

B. All units SEER/EER values shall meet or exceed Energy Efficiency Ratios shown on schedule.

2.3 CASING

A. Cabinet: Galvanized steel, phosphatized, and finished with an air-dry paint coating durable enough to withstand 1000 consecutive-hour salt spray application in accordance with standard ASTM B117. Structural members shall be 14 gauge with access doors and removable panels of minimum 18-gauge steel.

- B. Control Panel: the unit control panel section shall be compartmented to separate high and low-voltage components. The control panels shall also be fully gasketed, hinged, and provided with quick release latches for easy access.

2.4 CONDENSER SECTION

- A. Coils: aluminum fins mechanically bonded to copper tubing. Provide sub-cooling circuit(s) Factory leak test underwater to 450 psig and vacuum dehydrate.
- B. The condenser section shall be furnished with factory installed louvered hail guards, not wire screen.

2.5 REFRIGERANT CIRCUIT

- A. A2L Refrigerant with factory installed leakage detection system and sensors
- B. Provide two independent refrigerant circuits.
- C. Hot gas bypass or rawal valve

2.6 FANS AND MOTORS

- A. Vertical discharge direct driven propeller type condenser fans with fan guard on discharge. Fans shall be statically and dynamically balanced.
- B. Provided motors suitable for outdoor use, three phases with permanently lubricated ball bearings and built in current and thermal overload protection.

2.7 COMPRESSORS

- A. Compressor system shall be 2 stage and/or multiple compressors. Compressors shall be industrial grade, energy-efficient direct-drive 3600 RPM maximum speed scroll type. The motor shall be of a suction gas cooled hermetic design. Compressor shall have centrifugal oil pump with dirt separator, oil sight glass, and oil charging valve. A Solid state temperature sensor shall be embedded in the motor windings to protect against excessive winding temperatures.
- B. Motor shall be designed for across-the-line starting and suitable for a voltage utilization range of +/- 10 percent from nameplate voltage.

2.8 SYSTEM CONTROLS

- A. No System Control: Provide compressors wired to a terminal strip inside the control panel. Include guaranteed fixed-on and off timers for compressor protection. Temperature controls not included in unit. The temperature controls contractor shall be responsible for properly controlling the condensing unit's six stages and the four stages of gas heat. The controls contractor shall be responsible for wiring all the solenoid valves required.
- B. Unit Control: Provide 115-volt control circuit with fusing and control power transformer. Unit wired with contractors for compressor and condenser motors, compressor overload protection, high/low cutouts, differential oil pressure control, reset relay, and anti-cycle compressor timer.

2.9 LOW AMBIENT CONTROLS

- A. Provide low ambient electronic damper assemblies to allow the unit to start and operate down to 0 degrees F outdoor ambient conditions. Low ambient damper operation shall be modulated based upon refrigerant head pressure.

2.10 MISCELLANEOUS FEATURES

- A. Vibration Isolators: Provide field installed vibration isolators, for all units mounted on roof and ground.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide for connection to electrical service.
- C. Contractor to provide and install thermostat wire from air handler to condensing units.
- D. Install units on vibration isolation.
- E. Contractor to provide and install at minimum, 4" concrete housekeeping pad for each condensing unit that will sit on ground.
- F. Provide connection to refrigeration piping system and evaporators.
- G. Supply complete charge of refrigerant and oil for each refrigerant circuit.
- H. Manufacturer's to provide equipment performance check at start-up.

END OF SECTION

SECTION 23 73 13

MODULAR INDOOR CENTRAL STATION AIR HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 01 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. Double wall indoor central station air handling units.

1.3 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements

1.4 REFERENCES

- A. AHRI 430 - Standard for Central Station Air Handling Units.
- B. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- C. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- D. SMACNA - HVAC Duct Construction Standards.
- E. AHRI 410 - Standard for Forced Circulation Air-Cooling and Air-Heating Coils.
- F. ANSI/UL 900 - Test Performance of Air Filter Units.
- G. AMCA 300 - Reverberant Method for Sound Testing of Fans.
- H. ARI 260P - Method for Rating Air Handling Units for Sound.
- I. AMCA 301 - Method for Publishing Sound Ratings for Air Moving Devices.
- J. ASHRAE 68 - Laboratory Method of Testing In-Duct Sound Power Measurement Procedure for Fans.
- K. NEC - National Electric Code

1.5 QUALITY ASSURANCE

- A. Unit will conform to AMCA 210 for fan performance ratings.
- B. Unit will conform to E.T.L. standards. Unit will be ETL listed.
- C. Unit sound ratings will be reported in accordance with AHRI 260 for inlet and discharge sound power levels.
- D. Unit casing radiated sound ratings will be reported in accordance with ISO 9614 parts 1 and 2, and ANSI S12.12.
- E. Unit will conform to AHRI 410 for capacities, pressure drops, and selection procedures of air coils.
- F. Unit will conform to ANSI/ AHRI 430 for all fabrication procedures of air handling units.
- G. Damper performance will comply with AMCA 500

- H. Air handling unit will be ISO 9001 certified.
- I. Air handling unit will be manufactured in an ISO 9002 certified facility.

1.6 SUBMITTALS

- A. Included with submittal shall be a line by line specifications compliance. Manufacturer must clearly define any exceptions made to Plans and Specifications. Mechanical Contractor is responsible for expenses that occur due to exceptions made.
- B. Submit unit performance including: capacity, nominal and operating performance, and fan curves with fan operating point clearly marked.
- C. Submit Mechanical Specifications for unit and accessories describing construction, components, and options.
- D. Submit shop drawings indicating overall dimensions as well as installation, operation and service clearances. Indicate lift points and recommendations. Indicate unit shipping, installation, and operating weights including dimensions.
- E. The contractor shall provide a 1/4" scale drawing of the mechanical equipment rooms where all air handling units will be located. The drawing shall show all piping, equipment, and required maintenance clearances for the equipment. This drawing shall be furnished prior to commencement of work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of the contract documents. Units shall ship fully assembled up to practical shipping and rigging limitations. Units not shipped fully assembled shall have tags and airflow arrows on each section to indicate location and orientation in direction of airflow. Each section shall have lifting lugs or shipping skid to allow for field rigging and final placement of section.
- B. Deliver units to site with fan motors completely assembled and mounted in units. Mount motors as specified in these contract documents.
- C. Store and protect products under provisions of the contract documents.
- D. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish. The contractor shall be responsible for the repair of the units if any damage occurs due to improper storage and handling. The contractor shall protect the units with tarpaulins, not plastic covering. Indoor units shall ship from the factory shrink-wrapped. Outdoor units shall have coverings protected and weatherproof.

1.8 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.10 EXTRA FILTERS

- A. Provide two (2) sets of unit filters. One set, minimum, shall be utilized during the construction phase of the project. During the construction phase of the project, the contractor shall maintain clean filters in the unit. The construction filters shall be replaced at time of owner acceptance of substantial completion.

1.11 WARRANTY

- A. Unit manufacturer shall warrant unit and factory packaged controls for eighteen (18) months from date of shipments or twelve (12) months from manufacturer supervised on-site start-up.

PART 2 -PRODUCTS

2.1 MANUFACTURERS

- A. Daikin
- B. Trane
- C. Temtrol
- D. Dunham Bush

2.2 GENERAL

- A. Unit will be complete with fan(s), motors, coils, dampers, access doors, and other components/options as described and scheduled on drawings.
- B. Factory fabricate air handling units of dimensions, capacities, and configurations as scheduled and shown on drawings. Any deviations in physical dimensions are the contractor's responsibility to verify. All manufacturer clearances must be maintained.
- C. Provide formed or welded structural steel base rails shall be installed around entire perimeter or unit to support all sections.
- D. Unit will be draw through type configuration.
- E. Fans and drives will be balanced to limit vibration at operating speeds.
- F. The general contractor shall provide a concrete housekeeping pad for all units located on the floor. The concrete housekeeping pad shall be tall enough to provide proper trapping of the air handling unit. The concrete pad height shall have a minimum height of 4".
- G. Lifting lugs will be provided where required for proper lifting.
- H. If shown on plans or schedule, provide an 18" access door between all coils for cleaning and inspection.

2.3 UNIT CASING

- A. Unit shall be constructed of a complete structural frame with removable panels. Removal of side panels shall not affect the structural integrity of the unit. Contractor shall be responsible to provide connection flanges and all other framework that is needed on unit to ensure that removal of unit's panels shall not affect structural integrity.
- B. Panels shall be fully removable to allow for a proper way to thoroughly clean panels of microbial growth and to access internal parts. If panels are not removable, then manufacturer shall provide access sections with doors between all internal components to ensure access and cleanability of the air handler.
- C. Unit casing will be factory insulated with spray injected foam to achieve a minimum thermal resistance of R-13. Insulation application will meet the requirements of NFPA 90A. Insulation system will be resistant to mold growth in accordance with UL 181 or ASTM C1338. Unit shall have subfloor.
- D. Unit will conform to ASHRAE Std 111 Class 6 for casing leakage no more than 1% of design airflow at 8" of total static pressure.
- E. Unit will have double wall, 2" insulated panels for walls, roof, and floor. Exterior casing will be galvanized steel.

- F. Wall panels and access doors will deflect no more than L/240 when subjected to 8" of total static pressure. Floor panels will be double wall construction, designed to provide at most L/240 deflection when subjected to a 300lb. point load at mid-span.
- G. Casing shall have full-size removable access doors. Access doors shall have double wall construction. Provide automotive style neoprene gasketing around full perimeter of access doors to prevent air leakage. Provide "ventlock" style non-corrosive alloy latches operable from the inside or outside of unit. If access doors open against unit operating pressure, provide safety latches that allow access doors to partially open after first handle movement and fully open after second handle movement.
- H. Double wall insulated access doors will be provided. Access doors will be of the same material type as exterior/ interior casing.
- I. Provide 10" x 10" window in all sections. All viewports will be double-pane UV-resistant tempered glass or thermal resin.
- J. Exterior panel finish shall be corrosion-resistant galvanized.

2.4 DRAIN PAN CONSTRUCTION

- A. Provide sealed double wall insulated drain pans constructed of stainless steel.
 - 1. Coil supports and bulkheads shall be 304 Stainless Steel
 - 2. Encase insulation between exterior and interior walls.
 - 3. Drain pans shall be double sloped at least 1/8" per foot and have no horizontal surfaces.
 - 4. Drain pans shall drain to one point.
 - 5. Drain connections shall be welded to drain pans.
 - 6. Drain pans shall have at least 1" clearance between pan and coil supports.

2.5 FAN SECTION

- A. Units shall be provided with the fan configurations (Quantity) shown in the schedule. Units provided with fewer fans will not be acceptable.
- B. The fan array shall consist of multiple, direct driven, arrangement plenum fans constructed per AMCA requirements for the duty specified. All fans shall be selected to deliver the specified airflow quantity at the specified operating Total Static Pressure and specified fan/motor speed. The Fan Wall Array shall be selected to operate at a system Total Static Pressure that does not exceed 90% of the specified fan's peak static pressure producing capability at the specified fan/motor speed. Each fan/motor "cube" shall include a galvanized steel intake wall, spun steel inlet funnel, and a galvanized steel motor support plate and structure. The fan intake wall, inlet funnel, and motor support structure shall be powder coated for superior corrosion resistance. All motors shall be high efficiency pedestal mounted type, T-frame motors selected at the specified operating voltage and RPM, as specified or as scheduled elsewhere. All motors shall include isolated bearings or shaft grounding. Each fan/motor cartridge shall be dynamically balanced to meet AMCA 204-96, category BV-5, to meet or exceed Grade 2.5 residual unbalance.
- C. The fan array shall be provided with acoustical silencers that reduce the bare fan discharge sound power levels by a minimum of 15 db re 10⁻¹² watts throughout the eight octave bands with center frequencies of 125, 250, 500, 1000, 2000, 4000, and 8000 HZ when compared to the same unit without the silencers. The silencers shall not increase the fan total static pressure, nor shall it increase the airway tunnel length of the Air Handling Unit when compared to the same fan wall array unit without the silencer array.
- D. The fan array shall consist of multiple fan and motor "cubes", spaced in the airway tunnel cross-section to provide a uniform air flow and velocity profile across the entire airway tunnel cross-section and components contained therein. Each fan cube shall be individually wired to a motor overload control panel for a connection to a single VFD, as specified elsewhere, for the total connected HP for all fan motors contained in the fan array. Panel shall have individual motor overloads for each motor. Wire sizing shall be determined, and installed, in accordance with applicable NEC standards.
- E. The fan array shall produce a uniform air flow profile and velocity profile within the airway tunnel of the air handling unit not to exceed the specified cooling coil and/or filter bank face velocity when measured at a point 12" from the intake side of the Fan Wall array intake plenum wall and at a distance of 48" from

the discharge side of the Fan Wall intake plenum wall.

- F. Each fan/motor assembly shall be removable through a 30" wide, free area, access door located on the discharge side of the fan wall array.
- G. The unit must be provided with a close-off plate to cover a fan cube upon failure. Back-draft dampers are not acceptable. Provide fans with zero net effect vertical backdraft dampers. These non-controlled dampers shall provide for isolation in event a fan fails or is turned off. Ruskin type or weighted backdraft dampers are not acceptable.
- H. The manufacturer shall have at least two years of experience in the fabrication and installation of fan wall arrays.
- I. Motors greater than 10 HP must have 1 motor removal rail per row of fans.
- J. TEFC, TEAO, or ECM motors only. ODP motors not allowed.
- K. Motors shall be 1800 rpm or 3500 rpm (900 rpm and 1200 rpm motors are not acceptable).

2.6 COILS

- A. Water coils, direct expansion (DX) coils, and steam coils shall have capacity and pressure drop performance certified in accordance with AHRI 410.
- B. Maximum face velocity across coils shall be 490 fpm.
- C. Coils shall be manufactured by the same company as the supplier of the air handling unit. Install coils such that headers and return bends are fully enclosed by unit casings.
- D. Coils shall have aluminum fins and seamless copper tubes. Fins shall have collars drawn, belled, and firmly bonded to tubes by mechanical expansion of tubes. Do not use soldering or tinning in bonding process.
- E. Construct coil casings of 304 stainless steel with formed end supports and top and bottom channels.
- F. Coils will be removable from the side of the unit via removable air handling unit panel. No more than one panel must be removed in order to remove coil.
- G. DX Coils:
 - 1. Clearly label suction and discharge headers on outside of unit.
 - 2. Coils shall be proof tested to 450 psig and leak tested under water to 300 psig air pressure.
 - 3. After testing, the inside of the coils shall be dried, all connections shall be sealed, and the coil shall be shipped with a charge of dry nitrogen.
 - 4. Suction headers shall be constructed of copper tubing with connections penetrating unit casing to permit sweat connections to refrigerant lines.
 - 5. Construct tubes of 5/8 inch O.D. minimum 0.020-inch thick copper and construct fins of aluminum.
 - 6. If two or more coils are stacked in unit, install intermediate drain channels between coils to drain condensate to main drain pans without flooding lower coils or passing condensate through airstream.

2.7 SOUND ATTENUATORS

- A. Sound attenuation shall be accomplished by a series of full and half lenses spanning across the unit air tunnel. The attenuators shall be 36" in the direction of airflow. The lenses shall be manufactured of perforated steel with rounded leading and trailing edges constructed of solid material. The attenuating fill material shall be fiberglass insulation with an insulating film with standoff to prevent prohibit the erosion of the insulation into the air stream.

2.8 COMBINATION FILTER/MIXING BOX WITH FILTERS

- A. Provide factory fabricated filter/mixing box section of the same construction and finish as unit casings. Filter sections shall have filter guides and full height, double wall, hinged, removable access doors for

filter removal. Provide filter blockoffs as required to prevent air bypass around filters.

- B. Each filter bank shall be furnished with a magnehelic filter gauge with a nominal 4 3/4" OD white static pressure dial with black figures and zero pointer adjustment.
- C. Provide filter sections with pleated media filters. Filters shall be removable from one side of filter sections. The contractor shall replace the construction filters whenever they are dirty and replaced with clean filters, prior to occupancy.
- D. Dampers shall be ultra low leak and modulate the volume of outdoor, return, or exhaust air. The dampers shall be of double-skin airfoil design with metal, compressible jamb seals, and extruded-vinyl blade-edge seals on all blades. The blades shall rotate on stainless steel sleeve bearings. Provide internally mounted low leak outside air and return air dampers. Construct damper blades and damper frames of galvanized steel. Leakage rate shall not exceed 4 CFM/square foot at 1-inch w.g. and comply with ASHRAE 90.1 maximum damper leakage.

PART 3 - EXECUTION

3.1 INSTALL PER THE MANUFACTURER'S RECOMMENDATIONS.

- A. Provide and install a 4" concrete housekeeping pad for floor mounted units. Each unit shall utilize neoprene pads to sit on.
- B. Install temporary roll filter media on all return air ducts prior to start-up. Replace as necessary during construction.
- C. Inspect unit for any damage and notify the vendor of same. Repair or replace any damaged components.
- D. Check and maintain required clearances required by the local and National Electric Codes.
- E. Verify the height of housekeeping pad for proper trapping of the condensate drain.
- F. Verify power requirements and voltage.
- G. Pipe the coils per the detail diagrams in the contract documents.
- H. Connect all control wiring and control components.
- I. Install filters prior to operation of the system.
- J. Flush all chilled and hot water lines of debris and cutting oils. Properly clean the piping with surfactant prior to use.
- K. Release the shipping bolts from the fan isolation base and assure the fan is free floating.
- L. Commission the unit and assure that all control algorithms operate properly.
- M. Coordinate with Test and Balance Contractor.

END OF SECTION

SECTION 23 81 19
PACKAGED HVAC UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 01 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. Rooftop mounted or ground mounted packaged HVAC units.

1.3 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements

1.4 REFERENCES

- A. Underwriters Laboratory UL Listed
- B. NFPA 90A & NFPA 90B - Installation of Air Conditioning and Ventilation Systems and Installation of Warm Air Heating and Air Conditioning Systems.
- C. ANSI/ASHRAE Std 15 - Safety Code for Mechanical Refrigeration.
- D. AHRI 360 - Commercial and Industrial Unitary Air Conditioning Equipment testing and rating standard.
- E. AHRI 340 - Commercial and Industrial Unitary Heat pump Equipment.
- F. ANSI/ASHRAE 37 - Testing Unitary Air Conditioning and Heat Pump Equipment.
- G. ANSI/ASHRAE/IES 90.1 - A Energy Conservation in New Building Design Standard.
- H. ANSI/UL 465 - Central Cooling Air Conditioners Standard for safety requirements.
- I. AHRI 210/240 - Unitary Air Conditioning Equipment and Air-Source Heat Pump Equipment.
- J. AHRI 270 - Sound Rating of Outdoor Unitary Equipment.
- K. ANSI/NFPA 70-1990 - National Electric Code (NEC).
- L. AGA - American Gas Association

1.5 SUBMITTALS

- A. Product Data:
 - 1. Provide submittal data on all equipment specified in this section in accordance with Section 23 00 90, General Conditions, and Division 01.
 - 2. Included with submittal shall be a line by line specifications compliance. Manufacturers must clearly define any exceptions made to Plans and Specifications. Mechanical Contractor is responsible for expenses that occur due to exceptions made.
 - 3. Submit product data indicating typical catalog of information including arrangements.
 - 4. Submit product data sheets indicating dimensions, general assembly, and materials used in fabrication. List all accessories available for units and clearly mark accessories being provided. List all field-installed items.
 - 5. Provide in table form a schedule similar to drawings with data listing all information, capacities, fan data, voltages, accessories, etc.

6. Indicate mechanical and electrical service locations and requirements.
 7. Submit manufacturer's installation instructions.
- B. Shop Drawings:
1. Submit 1/4" per foot shop drawing(s) showing all piping, ductwork, and equipment shown by drawings and specifications. Submit drawings on all mechanical rooms. The drawings shall be coordinated with structural, electrical, and fire sprinkler drawings.
- C. Equipment Start-up Report:
1. Submit an equipment start-up report as provided by the equipment manufacturer. Start-up report shall include the following, but not limited to: verification of system airflow, proper operation of all motors and fans, proper tensioning of belts and pulleys, proper operation of on-board microprocessor control system, proper control of economizer damper, proper compressor operation, and proper operation of cooling, heating, and dehumidification modes.

1.6 QUALITY ASSURANCE

- A. UL listed and must display UL label on all units.
- B. All units must comply with ASHRAE Standard 90.1 and the applicable International Energy Conservation Code.
- C. Unit performance data must be rated in accordance with AHRI 210/240 and must display the AHRI symbol on all standard units.
- D. Conform to applicable ANSI/NFPA 70 code for internal wiring of factory wired equipment.
- E. AGA, with label.
- F. Tested in accordance with DOE.
- G. The air-conditioning equipment manufacturer shall be solely responsible for their equipment that does not comply with the performance of their published catalogs and specifications.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance, and repair data, including filter replacement and unit lubrication.

1.8 WARRANTY

- A. Complete 1-year parts and labor warranty on all equipment.
- B. 5-year warranty provided for the compressors.
- C. 15-year warranty provided for heat exchangers.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. All units are to comply with latest ASHRAE Standard 90.1.
- B. All units are to be tested in accordance with AHRI 340/360 (I-P), AHRI 210/240, and Bear Label.

2.2 MANUFACTURERS

- A. Lennox
- B. Trane

C. Daikin

2.3 PACKAGED HEATING/COOLING UNITS

- A. All units to have standard mechanical thermostat terminal strip for 3rd party control. Units with OEM branded controls and/or integration boards not allowed. Controls to be provided by others.
- B. All units 3 tons to 6 tons to be nominal 17 SEER and/or 16 SEER2 rated with direct drive fans, two stage compressor and a minimum two speed fan.
- C. All units 7.5 tons to 17.5 tons are to have a minimum 3 stages of cooling with at least two compressors .
- D. All units 20 tons and above are to have a minimum 4 stages of cooling with at least two compressors.
- E. Minimum Cooling Efficiencies:
 - 1. EER ratings by AHRI 210/240 and AHRI 340/360 (I-P):
 - a. All unit SEER/EER, SEER2/EER2 or IEER values shall meet or exceed Energy Efficiency Ratios shown on schedule.
 - b. All units to comply with latest International Energy Conservation Code.
 - c. All units shall comply with the latest Department of Energy Requirements.
- F. Supply Fan Section:
 - 1. Units shall have plenum fans with ECM or VFD.
- G. Gas Furnace Design:
 - 1. Heating capacities:
 - a. Equal to or greater than those shown on plans. Bear AGA label.
 - 2. Ignition:
 - a. Electronic pilot ignition
 - b. Standing pilot not allowed
 - 3. Efficiency:
 - a. Minimum 81% A.F.U.E. rating.
- H. Electric Furnace Design:
 - 1. Heating Capacities:
 - a. As scheduled on plans at rated voltage. UL Listed with label, meets NEC.
- I. Three Phase Electrical Power:
 - 1. Impose an equal electrical load on all phases of heater.
 - 2. Electrical resistance elements which are not balanced over all three phases are not acceptable.
- J. Mixing Box Section:
 - 1. All units shall have return air and outside air compartment. Units shall have at minimum: barometric relief, ultra low leak outside air damper and fully modulating 0-100% outside air actuator. Actuators to be modulating 0-10v, spring return with position sensing feedback. Proprietary actuators not allowed.
 - 2. Class I motorized outside air dampers. All outside air dampers to be ultra low leak dampers. Dampers shall have an air leakage rate not greater than 4 cfm/sqft. and shall be labeled by an approved agency when tested in accordance with AMCA 500-D.
- K. Construction:
 - 1. Design for roof curb mounting with "down shot" duct connection. Full perimeter curb only.
 - 2. Units which require the installation of a separate plenum (such as side discharge units) are not acceptable.
 - 3. Coils: copper tubes, aluminum fins, factory test 450 psig, metal hail guards for all condenser coils. Aluminum microchannel condenser coils are acceptable.
 - a. Features:
 - 1) Easy access to filters, 2" filter rack
 - 2) Factory installed 1" filters
 - 3) Low voltage terminal board

- 4) All blowers shall deliver a minimum of 450 cfm/ton at .5" E.S.P.
 - 5) Filter racks to be provided at each unit.
 - 6) High efficiency motors.
 4. Stainless steel heat exchanger.
 5. Single point electrical power entry through bottom of unit inside curb perimeter.
 6. Cabinet: Galvanized Steel, enamel paint, all sides & edges.
 7. Hinged service doors.
 8. Top of cabinet to be one piece, level, no step downs.
 9. Unit to be completely wired, piped, etc.
 10. Designated location to install electrical disconnect
 11. Fused disconnect provided by electrical contractor. Do not install fused disconnect on any access panels or over unit information tag(s).
 12. All sides shall be enclosed. All-access panels shall be metal.
 13. A2L Refrigerant with factory installed leakage detection system and sensors
 14. Comply with ASHRAE 62.
 15. Comply with NFPA 90A.
 16. Condensate drain pan with float switch
 17. All unit components to be UL listed.
- L. Accessories:
1. 2-Stage Compressor Unit:
 - a. All rooftop units that are shown and/or scheduled as two stage shall have a minimum of two stage compressors and two fan speeds. In first stage cooling, the compressor is to be in first stage, and the fan is to be set to low speed. In second stage cooling, the compressor is to be in second stage, and the fan is to be set to high speed.
 2. Unit With Hot Gas Reheat:
 - a. All rooftop units that are shown and/or scheduled with hot gas reheat shall be provided with hot gas condenser reheat.
 3. Unit with Economizer Module and Fault Detection and Diagnostics:
 - a. All units that are shown and/or scheduled with F.D.D Economizer shall be provided with a dry bulb economizer. When outdoor dry bulb conditions are met, and the space temperature sensor is calling for cooling, the economizer mode of the unit shall provide free cooling to the space.
 - b. All units 20 tons and above that are shown and/or scheduled to be provided with a dry bulb economizer and a power exhaust fan. The powered exhaust fan shall be sized to be at least 50% of total supply CFM. Powered exhaust shall only be enabled during economizer mode.
 - c. All units with fault detection and diagnostics shall be capable of reporting faults to a fault management application system or displayed on the zones thermostat. The fault detection system shall be capable of detecting the following faults:
 - 1) Air temperature sensor failure.
 - 2) Not economizing when the unit should be economizing.
 - 3) Economizing when the unit should not be economizing.
 - 4) Dampers not modulating.
 - 5) Excess outdoor air.
- M. Other:
1. Furnish crankcase heaters, timed off control, freeze thermostats, low ambient to 45°F, high pressure switch, and expansion valves on all units.
 2. Provide extra set of filters MERV 8, pleated 2" thick.
 3. List all accessories available for units and identify which accessories are being provided in submittals.
- N. See Specification Section 23 05 32 for roof curb requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Contractor is not to open refrigeration system to install accessories.

- B. Install in accordance with all manufacturer`s instructions and requirements.
- C. Install all units so that they are LEVEL.

3.2 IDENTIFICATION

- A. Provide identification per Section 23 05 53.

3.3 EQUIPMENT START-UP

- A. Follow all manufacturers` directions.
- B. Equipment manufacturer to provide start-up.
- C. Start-up by contractor will not be allowed.
- D. Equipment manufacturer/supplier to provide equipment performance checkout with contractor and provide report to Engineer.
- E. Make wiring changes as required to control transformer to accommodate job voltage.
- F. Provide 1" roll filter media on each return air opening during construction if blower is operational. Replace as required.
- G. Start-up Data and Report:
 - 1. Follow all manufacturers` directions and requirements.
- H. Measure:
 - 1. Outside air temperature, entering and leaving conditions of evaporators and condensers, compressor amps, indoor blower amps, gas pressure, pressure drop across evaporator coil.
 - 2. Operate all units in heating and cooling modes with make-up air units operating.
 - 3. Provide start-up report with final request for payment.
 - 4. Install new, clean MERV 8 - 2" thick filters prior to test and balance.
- I. Test and Balance:
 - 1. Coordinate with Test and Balance Contractor after units are started.

END OF SECTION

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SECTION 23 81 27

SMALL CAPACITY SPLIT SYSTEM UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. Split system cooling units for elevator machine rooms, electrical rooms, MDF, and IDF Rooms as noted in schedule and shown on drawings.

1.3 RELATED SECTIONS

- A. Section 22 13 18 - Condensate Piping
- B. Section 22 16 01 - Natural Gas Piping and Appurtenances
- C. Section 23 00 00 - Basic Mechanical Requirements
- D. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- E. Section 23 05 93 - Testing, Adjusting and Balancing for HVAC
- F. Section 23 09 13 - Programmable Control Devices for HVAC
- G. Section 23 09 23 - Energy Management Control System
- H. Section 23 23 00 - Refrigerant Piping
- I. Section 23 31 13 - Metal Ductwork

1.4 REFERENCES

- A. Refer to Section 23 00 00 for complete names of references identified in this section.
- B. ARI 210/240 - Unitary Air-Conditioning and Air Source Heat Pump Equipment
- C. ARI 270 - Sound Rating of Outdoor Equipment
- D. ARI 270 - Sound Rating of Outdoor Unitary Equipment
- E. ANSI/ASHRAE Std 15 - Safety Code of Mechanical Refrigeration

1.5 SUBMITTALS

- A. Product Data:
 - 1. Provide submittal data on all equipment specified in this section in accordance with Section 23 00 90, General Conditions, and Division 1.
 - 2. Submittals shall include:
 - a. Unit model number
 - b. Refrigerant type
 - c. Sound rating in accordance with ARI 270
 - d. Cooling efficiency in accordance with ARI Standard 210
 - e. All accessories
 - 3. Submit product data indicating typical catalog of information including arrangements.

4. Submit product data sheets indicating dimensions, general assembly, and materials used in fabrication.
5. Indicate mechanical and electrical service locations and requirements.
6. Submit manufacturer's refrigerant piping.
7. Submit manufacturer's installation instructions.

B. Shop Drawings: (adjust as required)

1. Submit 1/4" per foot shop drawing(s) showing all piping and equipment shown by drawings and specifications. Submit drawings on all mechanical rooms. The drawings shall be coordinated with structural, electrical, and fire sprinkler drawings.

1.6 QUALITY ASSURANCE

- A. UL listed and must display UL label on all units.
- B. Unit performance data must be rated in accordance with ARI Standard 210/240 and must display the ARI symbol on all standard units.
- C. Conform to applicable ANSI/NFPA 70 code for internal wiring of factory wired equipment.
- D. Manufacturer to size refrigerant lines.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance, and repair data, including filter replacement and unit lubrication.

1.8 WARRANTY

- A. Complete 1-year warranty on all equipment
- B. Additional 5-year warranty provided for the compressors and heat exchangers.
- C. The warranted compressor assembly consists of the starter, rotor, eccentric shaft, eccentric rods, pistons, wrist pins, suction valves, discharge valves, unloading mechanisms, oil pump, and the housing in which these parts are enclosed.
- D. The warranty shall indicate model, serial number of the unit, and commencing date. The commencing date of the warranty shall be after the building has been accepted for occupancy.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Daikin
- B. Trane/Mitsubishi
- C. Lennox

2.2 CONDENSING UNITS

- A. Features:
 1. A2L Refrigerant with factory installed leakage detection system and sensors
 2. Hail guard/screen kit
 3. Crankcase heaters
 4. Timed off control
 5. Low Ambient to 50°F
 6. Hi/Low pressure switches
 7. Over current protection

8. Filter Dryer

2.3 CONTROLS

- A. Controller Features:
1. Manually activated "dry" mode. Low speed indoor fan, high speed compressor.
 2. Temperature Settings/Display
 3. 24 Hour Timer
 4. Fan Speed Indicator
 5. Mode Settings (auto, cool/dry)
 6. BACnet EMCS Gateway

2.4 ALL AIR HANDLERS

- A. Features:
1. Easy access to filters
 2. Low voltage terminal strip
 3. All blowers shall deliver a minimum of 450 cfm/ton at .5" E.S.P.
 4. Filter racks to be provided in each air handler.
 5. Condensate pump to be Aspen pumps Mini White

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with the plans, manufacturer's instructions, and approved shop drawings.
- B. Contractor to provide and install at minimum, 4" concrete housekeeping pad for each condensing unit that will sit on ground.
- C. Both suction and liquid lines are to be insulated.
- D. Do not install condensate pumps over any equipment panels.
- E. Condensate pumps are to operate any time the unit is in the cooling mode and water is in drain pan. Follow manufacturer's instructions.
- F. Install new, clean filters. Cover return air with filter media until construction is complete.
- G. Provide connection to refrigeration piping system and evaporators.
- H. All condensers located on the ground shall be fitted with refrigerant locking tamper resistant caps. Locking caps to use standard screwdriver or hex/allen wrench. Caps utilizing a special bit, tool or custom key is not allowed.

3.2 IDENTIFICATION

- A. Provide identification per Section 23 05 53.

3.3 EQUIPMENT START-UP

- A. Provide start-up.
1. Start-up Data and Report:
 - a. Follow all manufacturers' directions.
- B. Measure:
1. Outside air temperature, entering and leaving conditions of evaporators and condensers, compressor amps, indoor blower amps, gas pressure, pressure drop across evaporator coil.
 - a. Operate all units in each mode.
 - b. Provide report with final request for payment.

END OF SECTION

SECTION 23 82 16
DUCT MOUNTED AIR COILS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. Duct mounted electric heating coils

1.3 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC
- C. Section 23 09 23 - Energy Management Control System
- D. Section 23 21 13 - Hydronic Piping, Valves, and Appurtenances
- E. Section 23 31 13 - Metal Ductwork

1.4 REFERENCES

- A. ARI Standard 410
- B. AMCA 210, 310, 410, and 500.
- C. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- D. UL 181 - Factory-Made Air Ducts & Air Connectors

1.5 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 23 00 90, General Conditions, and Division 1.
- B. Submit unit performance including: rated capacities, operating characteristics, and pressure drops for each coil.
- C. Submit construction details, material descriptions, dimensions of individual components and profiles, and finishes of each air coil.
- D. Certify that coils are tested and rated in accordance with ARI 410 for capacities, pressure drops, and selection procedures of air coils.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of the contract documents. Units shall ship fully assembled in factory-fabricated protective containers.
- B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish. The contractor shall be responsible for the repair of the units if any damage occurs due to improper storage and handling.

- C. Protect coil fins from crushing and bending by leaving in shipping cases until installation.
- D. Protect coils from entry of dirt and debris with pipe caps or plugs.
- E. Inspect for damage and make any necessary repairs at no additional expense to the owner.

1.7 WARRANTY

- A. Provide one-year manufacturer's warranty for materials and workmanship.
- B. Electric heating elements: Manufacturer to provide two-year limited warranty.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Electric Heating Coils:
 - 1. Greenheck
 - 2. INDEECO
 - 3. Qmark
 - 4. Tutco
 - 5. Nepronic

2.2 ELECTRIC HEATING COILS

- A. Heaters shall be CSA and UL Listed for zero clearance and shall meet all NEC requirements. Voltage, size, kW, steps, and control voltage shall be as scheduled on the drawings. Three phase heaters shall have balanced phases.
- B. Element type:
 - 1. Finned Tubular: Elements for finned tubular heaters shall have steel fins brazed to copper plated sheath. Element wire shall be 80/20 Nickel/ Chromium. Elements shall be protected against corrosion by high-temperature aluminum coating. Terminals shall be sealed with silicone rubber to protect against moisture. Type C alloys containing iron or other alloys are not acceptable.
 - 2. Open Coil: Open coil heating elements shall be 80% nickel and 20% chromium. Type C alloys containing iron or other alloys are not acceptable. Steps shall be arranged to prevent stratification when operating at less than full capacity. Elements shall be de-rated to 25 watts per square inch for duct mounted applications.
- C. Element terminals shall be stainless steel; insulators and bracket bushings shall be nonporous ceramic and securely positioned. Terminals shall be machine crimped to elements.
- D. Frame shall be constructed of heavy gauge galvanized steel with galvanized steel brackets, stiffening ribs, and gussets spot welded to the frame.
- E. Terminal box shall be spot welded construction with solid, hinged cover, totally enclosed, without louvers or grilles per the CSA and UL Standard. A recessed terminal box shall be provided when coils are installed in ducts with internal insulation or obstruction greater than 1".
- F. Terminal box shall be insulated and dust tight with a protective screen on both inlet and outlet sides.
- G. Electric heater shall be factory wired to an electronic step controller relay bank. This type of control may be connected to a 0-10VDC or 4-20mA signal from a standalone thermostat or building automation system, which is converted to stages of heat.
- H. Direction of airflow: Heaters shall be interchangeable for horizontal left, right, or vertical up airflow.
- I. Safety Devices: A disc-type automatic reset thermal cutout shall be furnished for primary over temperature protection. For secondary protection, a sufficient number of replaceable thermal cutouts in the power lines shall de-energize elements if the primary cutout fails. All safety devices shall be

serviceable through the terminal box without removing the heater from the duct.

- J. Built in components shall include safety interlocking disconnect switch, disconnecting break magnetic contactors, transformer with primary fusing per CSA and UL, pressure-type airflow switch set at 0.05" w.c., supplementary circuit fuses per NEC, and separate load and control terminal blocks to accept conductors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.
- B. Examine roughing in for piping systems to verify actual locations of piping connections before coil installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.
- B. Install coils level and plumb.
- C. Install access door(s) in ductwork immediately upstream of each coil.
- D. Install piping adjacent to coils to allow service and maintenance.
- E. Install coils in metal ducts and casings constructed in accordance with SMACNA.
- F. Protect coils to prevent damage to fins and flanges. Comb out bent fins.
- G. Clean coils using materials and methods recommended in writing by manufacturer. Clean inside of casing and enclosures to remove dust and debris.
- H. Make connections to coils with unions and flanges.
- I. Hydronic Coils:
 - 1. Connect water supply to leaving air side of coil.
 - 2. Provide shut-off valve on supply line and lockshield balancing valve with memory stop on return line.
 - 3. Locate water supply at bottom of supply header and return water connection at top.
 - 4. Provide manual air vents at high points complete with stop valve.
 - 5. Ensure water coils are drainable and provide drain connection at low points.
- J. Electric coils shall maintain minimum working clearances around the heater electrical panel in accordance with NEC Article 110.
- K. Electric coils shall be wired in accordance with NFPA 70.
- L. Perform the following tests on electric heating coils:
 - 1. After electrical circuitry has been energized, operate electrical coils to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

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SECTION 23 82 39
ELECTRIC UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. Electric unit heaters.

1.3 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 09 23 - Energy Management Control System

1.4 REFERENCES

- A. UL - Underwriters Laboratories and Bear Label
- B. NEC - National Electric Code

1.5 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 23 00 90, General Conditions, and Division 1.
- B. Submit product data with ratings, capacities, electrical connections, etc.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Berko
- B. Indeeco
- C. Markel
- D. Qmark
- E. Redd-i
- F. Trane
- G. Ouellet

2.2 GENERAL

- A. Provide electric unit heater with capacity, horsepower, and motor voltage as shown on schedule.

2.3 FEATURES

- A. Draw through design.

- B. Fan and limit safety controls.
- C. Supply voltage as shown on drawings.
- D. 24 Volt transformer and terminal block.
- E. All elements 80/20 nichrome wire and copper clad steel sheath.
- F. Automatic reset thermal overloads - instantaneous de-energizing.
- G. Fan guard.
- H. Mounting brackets.
- I. Horizontal directional louvers.
- J. Threaded suspension couplings (2, 1" ISP).
- K. Baked enamel finish. Cabinet 18 ga. baked enamel finish.
- L. Manual summer winter switch on thermostat base with relay.
- M. Units to bear UL listing and meet NEC requirements.

2.4 MOTORS

- A. Totally enclosed, designed for continuous duty, built-in overload protection.
- B. 25 kW and larger to have 2-speed motors.
- C. Heaters that draw 48 amps or greater shall be provided with factory installed, subdivided, and fused circuits.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install per manufacturer's instructions and locations shown on plans.
- B. Install for service access to any electrical control panel, etc.

3.2 IDENTIFICATION

- A. Per Section 23 05 53.

END OF SECTION

SECTION 26 00 00

ELECTRICAL

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, apply to this Division. Refer to these articles in the specifications for additional information.
- B. Provide all materials, equipment, labor, and transportation required to install a complete and working electrical system. It is the intent of the drawings and specifications to provide complete installations even though each and every item necessary is not specifically mentioned or shown.
- C. Bidders shall determine the contents of a complete set of Drawings and Specifications and be aware that they may be bidding from a partial set of drawings, applicable only to the various separate contracts, subcontracts, or trades as may be issued for bidding purposes only. The submission of bids shall be deemed evidence of the review and examination of all existing conditions on site and all drawings, specifications, and addenda issued for this project as no allowances will be made because of unfamiliarity with any portion of the complete set of documents or site conditions.
- D. Perform all Division 26 work in strict accordance with the requirements and recommendations stated in the latest adopted version of all federal, state, and local codes, ordinances, and standards (NFPA, NEC, IECC, etc.) except when requirements are modified by the Authority Having Jurisdiction.
- E. Where local codes or practices exceed or conflict with the NEC, it shall be the Contractor's responsibility to perform the work in accordance with the local code prevailing and local interpretations thereof by the Authority Having Jurisdiction. This Contractor shall bear all costs for correcting any deficiencies due to non-compliance.

1.2 REFERENCES AND STANDARDS

- A. All adopted State and Local Building Codes and Facility Standards.
- B. All requirements of the local authority having jurisdiction.
- C. CSA - Canadian Standards Association.
- D. NEC - the abbreviation is the National Electrical Code (NFPA Ch 70). Where used, this shall mean the latest adopted version of the NEC.
- E. NEMA - National Electrical Manufacturers Association
- F. NFPA - National Fire Protection Association. Where used, this shall mean the latest adopted version of the NFPA.
- G. UL - Underwriters' Laboratories (One of several listing agencies accepted by the NEC)

1.3 ABBREVIATIONS

- A. AFF - Above finished floor
- B. AFG - Above finished grade
- C. AHJ - Authority Having Jurisdiction
- D. ALT - Alternate
- E. ATS - Automatic transfer switch

- F. CLG - Ceiling
- G. DFA - Down from above
- H. DISC - Disconnect
- I. EOR - Engineer of Record
- J. EWC - Electric water cooler
- K. EXIST / EX - Existing
- L. FAP - Fire alarm plan
- M. FACP - Fire alarm control panel
- N. FAGA - Fire alarm graphic annunciator
- O. FARA - Fire alarm remote annunciator
- P. GND, GRN - Ground
- Q. GFCI - Ground-fault circuit interrupters
- R. LED - Light Emitting Diode
- S. MTS - Manual transfer switch
- T. MCC - Motor control center
- U. NC - Normally closed
- V. NO - Normally open
- W. NTS - Not to scale
- X. NIC - Not in contract
- Y. PNL - Panel
- Z. RCP - Reflected ceiling plans
- AA. RTU - Roof-top unit
- BB. SFD - Smoke / Fire Damper
- CC. TX - Transformer
- DD. TYP - Typical

1.4 DEFINITIONS

- A. Owner's Representative - Indicates the entity designated or hired to represent an owner on a project. This entity could be the owner themselves, an Architect or could be another third party hired to represent the owner. Verify who will be representing the owner on this project before bidding.
- B. Contract Documents - Shall include, but not limited to Drawings, Specifications, Addenda, etc.
- C. Approval - It is understood that approval must be obtained from the Owner's Representative in writing before proceeding with the proposed work. Approval by the Owner's Representative of any changes, submitted by the Contractor, will be considered as general in nature and only to aid the Contractor in expediting his work.

- D. As required - Indicates that the contractor shall perform the work or provide the material as indicated in accordance with manufacturer's installation instructions and in accordance with the latest adopted version of applicable codes or regulations.
- E. Contractor - Where the word(s) "contractor" or "this contractor" is used herein it refers to the contractor engaged to execute the work under this division of the specifications only, even though they may be technically described as a sub-contractor.
- F. Directed - Terms such as directed, requested, authorized, selected, approved, required, and permitted mean directed by the Owner's Representative, requested by the Owner's Representative, and similar phrases.
- G. EMCS - Energy Management Control System (Building Management System / BMS), used to control mechanical systems in the building via hardware and / or software.
- H. Furnish - The term furnish means to equip with what is needed, supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- I. Indicated - The term indicated refers to graphic representations, notes, or schedules on the Drawings, or other Paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Terms such as shown, noted, scheduled, and specified are used to help the reader locate the reference. There is no limitation on location.
- J. Install - The term install describes operations at the Project site including setting in position, connecting or adjusting for use, the actual unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- K. Or equal - Indicates that the contractor may substitute equipment by another manufacturer if the salient features of the equipment indicated by manufacturer's name and / or described are adequate in the judgment of the Owner's Representative.
- L. Provide - Furnish and install all material and labor required for a complete installation ready for operation as required in accordance with the intent of the Contract Documents.
- M. Shall - Indicates a mandatory requirement or requirements.
- N. Unless otherwise noted, refer to NEC 100 for additional definitions used in these specifications.

1.5 COORDINATION

- A. For additional requirements, see Section 01 30 00 - Administrative Requirements.
- B. Electrical service to all portions of existing buildings at the construction site not involved with the project shall remain in operation throughout construction. Provide all required temporary electrical service in the base bid to all required areas to satisfy OSHA requirements.
- C. All metering and temporary electrical service charges and / or costs of utilities shall be paid by the Contractor.
- D. The Drawings are not to be construed as shop drawings but indicate the extent, general locations, arrangement, etc., of conduit systems and equipment. Electrical drawings are diagrammatic and shall not be scaled for exact size. If the contractor has any questions regarding the layout of a particular device or equipment item, he shall contact the Owner's Representative for clarification. This Contractor shall, in laying out their work, refer to other sections of the specifications and other drawings such as air conditioning, structural, plumbing, architectural, civil, etc., to eliminate conflicts and undue delays in the progress of the work. Where items are furnished by other trades require connections by this Contractor, they shall be held responsible for providing rough-in drawings and assistance upon request.
- E. In the event of interferences, piping or equipment requiring set grades or elevations shall have precedence over conduit, luminaires, outlet boxes, etc.

- F. Plans, specifications, and other documents have been prepared and developed with reasonable professional care and coordination. It is the intent that all documents are supportive and complimentary, one to the other; and as such what is required by one shall be considered as required and binding as if indicated by all. Work indicated shall include, regardless of whether or not specifically stated, such supportive or required items or work as consistent with what is indicated, is reasonably inferable from what is indicated, and / or is common construction procedure or knowledge with regard to what is indicated.
- G. In the event of a conflict between manufacturer's installation instructions and the Drawings, the manufacturer's installation instructions shall govern.
- H. Should discrepancies be found among the Contract Documents and / or an interpretation is required, and a decision or interpretation to the contractor is not rendered by the Owner's Representative, it shall be assumed the contractor has reviewed all the documents to find the most costly method or items in question which then shall be required. One document does not take precedence over another when interpreting a discrepancy.

1.6 SUBMITTALS

- A. The submittals required in this Division shall conform to and be submitted in accordance with the General Conditions, Instructions to Bidders, Division 1 and requirements listed in all sections of Division 26.
- B. Provide submittals in PDF format. Paper submittals shall be rejected.
- C. Shop drawings, manufacturer's data materials lists, etc., are required for all equipment and material where submittals are required.
- D. Each submittal shall contain data relevant to the particular equipment (including options). The data shall be identified by "highlighting", arrows, underlining, etc. Do not submit pages of non-relevant information. Broad general data is not acceptable. If equipment submitted is not as specified in the Contract Documents, then the submittal shall contain specific details prominently identifying any differences in form, fit or function. If the equipment submitted is not as specified, then the Contractor shall be responsible for any additional costs necessary to install and connect the equipment. This includes, but is not limited to, increased panelboard size, circuit breaker size, disconnect size or circuit size.
- E. Submit warranty information on all equipment specified in this division. Warranty shall start at the time of substantial completion, unless otherwise indicated in subsequent sections.
- F. Submit dimensional layout of all electrical equipment locations, drawn to scale, with equipment locations shown. Clearances shall be in accordance with NEC and local codes. Panelboard and switchgear submittals will be rejected without dimensioned room or equipment location layouts.
- G. Some products require that a color selection be coordinated with the Owner's Representative. Information regarding such products shall be submitted to the Owner's Representative for review.
- H. If materials or equipment are installed before being reviewed without comment by the engineer, the contractor shall be liable for the removal and replacement of such unapproved materials and equipment, at no additional expense to the owner. Additionally, if the removal and replacement of unapproved materials or equipment necessitates the removal and replacement of other related materials or equipment, then the contractor shall be liable for the removal and replacement of the related materials and equipment at no additional expense to the owner.
- I. Failure to submit items that meet the requirements of the contract documents in ample time for review shall not entitle the contractor to an extension of contract time, and no claim for extension by reason of such default shall be allowed. The contractor may be held liable for delays so occasioned.

1.7 CLOSEOUT SUBMITTALS

- A. This Contractor shall accumulate during the job's progress the below list of data and shall keep it updated during construction as a set of Record Documents:
 - 1. Exact dimensioned locations of all new and existing switchgear, devices, luminaires, controls, all other equipment and new or existing site utilities.
 - 2. All warranties, as described in this section and in each subsequent specification section.
 - 3. All shop drawings.
 - 4. Submittals.
 - 5. Set of operation and maintenance manuals.
 - a. Each operating and maintenance manual shall apply specifically to the equipment installed. In those cases where one manual covers a general class of equipment, the contractor shall be required to identify (highlighting, underlining, etc.) those portions which apply to the installed equipment.
 - 6. Repair parts lists of all major items and equipment.
 - 7. Additional items that may be required in Divisions 00 and 01.
- B. Upon submitting their request for final payment, this contractor shall turn over to the Owner's Representative, all data mentioned above in the form of a PDF file.
- C. Organize all information by specification section and put them in the O&M manual.
- D. Training Documentation: Provide a letter in the closeout submittals documenting that the end user (determined by the Owner) received training as required in any section in this division. Documentation to include name of person, date, duration, and content of training.

1.8 QUALIFICATIONS

- A. For a product or manufacturer to be considered, all products shall be submitted ONLY from manufacturers that:
 - 1. Specialize in the manufacturing of the products specified for a minimum of five (5) consecutive years.
 - 2. Has been producing this product for at least two (2) years.

1.9 ADDITIONAL MATERIALS

- A. Additional materials to be a dollar cost in the base bid. At the end of the project the contractor shall generate a dollar amount credited back to the owner for any unused items.
- B. Include the following cost on a dollar basis in the base bid:
 - 1. All costs to provide five (5) additional or signal locations, all required boxes, labor and conduit as directed by the Owner's Representative. Devices, plates, and wiring by Communications Contractor(s).
 - 2. All costs to provide one (1) additional electrical circuit as required for fire alarm system signal power expanders or fire safety control circuits including all required circuit breakers, wiring, conduit, labor, and devices as specified and directed by the Owner's Representative.
 - 3. All costs to provide three (3) additional electrical circuits, all required circuit breakers, wiring, conduit, labor, and devices as specified and directed by the Owner's Representative. Each circuit to be priced with a rating of 20 amps and a distance of 100 feet to furthestmost device. Each circuit to include eight (8) duplex receptacles.
- C. See "Additional Materials" section throughout the rest of Division 26 for additional materials requirements.

1.10 ATTIC STOCK

- A. Furnish attic stock to the owner at substantial completion as a part of the base bid.
- B. See "Attic Stock" section throughout the rest of Division 26 for additional attic stock requirements.

1.11 QUALITY ASSURANCE

- A. Certification: This contractor shall be certified / licensed to install the products and equipment they are providing.
- B. Regulatory Requirements: All products provided under this division shall be manufactured and listed for the intended use and environment installed.
- C. See Manufacturers section below for more information.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. For additional requirements, see Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. For additional requirements, see Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- C. Storage and Protection: Material shall be stored in a clean and dry location until installation.
- D. Contractor shall handle in accordance with manufacturer's recommendations to avoid damaging equipment, installed devices, and finish.

1.13 EXISTING FIELD CONDITIONS

- A. The drawings are prepared from the best information available and reflect all conditions commensurate with this information. However, the contractor should visit the site prior to submitting a proposal and should verify the locations, sizes, depths, pressures, etc., of all existing utilities and familiarize themselves with working conditions, hazards, existing grades, soil conditions, obstructions, etc. If it becomes evident that existing site conditions will impair the proper operation of the utilities, the Owner's Representative shall be notified in writing.
- B. All proposals shall take these existing conditions and any revisions required into consideration, and the lack of specific site information on the drawings shall not relieve the contractor of any responsibility.
- C. This Contractor shall familiarize themselves with working conditions to the extent that they shall be responsible for damage to concealed piping, wiring and other equipment meant to remain, and shall repair any damage caused by their negligence at no cost to the owner.

1.14 WARRANTY

- A. This Contractor shall guaranty fully all workmanship, material, equipment, systems, etc., provided by them for a period of one (1) year after substantial completion of the project, unless otherwise indicated in other specification sections. The use of building equipment for temporary service and testing does not constitute the beginning of the warranty. This guaranty means that this Contractor shall make good to the owner, at no cost, any defects that become apparent during the year following substantial completion. This guaranty is in addition to any other guaranties or warranties and is not intended to limit such other guaranties or warranties.
- B. Neither the final payment nor any provisions in the Contract Documents shall relieve this Contractor, or the Contractor, of the responsibility for faulty materials or workmanship.
- C. The contractor shall remedy any defects due thereto, and pay for any damage to other work resulting there from, which shall appear.
- D. This Warranty shall not be construed to include the normal maintenance of the various components of the system covered by these specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Unless otherwise noted, products shall be only from manufacturers that have been in business for at least five (5) consecutive years.
- B. The listing of specific manufacturers does not guarantee acceptance of their products. All manufacturers, whether specified or listed as an equal, shall meet the specified ratings, features, and functions as outlined in these specifications.

2.2 SUBSTITUTION OF PRODUCTS

- A. Substitutions: Shall meet any Division 01 requirements in addition to the substitution requirements listed here.
- B. All proposed substitutions are subject to PRIOR APPROVAL and must be received by the Engineer and / or Owner's Representative no less than ten business days prior to the schedule date for opening of bids.
- C. Items noted as "No Substitutes" or "No Alternates" shall be as specified only. No substitutions will be accepted.
- D. Only such items as specified or approved as acceptable will be installed on this project.
- E. Substitution of products specified herein will be considered only when a complete list of proposed alternative equipment is submitted to the Engineer and / or Owner's Representative in writing, supported by adequate technical and cost data. This includes a complete description of the proposed substitution, drawings, catalog cut sheets, performance data, test data, or any other data or information necessary for proper evaluation.
- F. Manufacturers' names are listed herein and on the plans to establish a standard of quality and design. Where a manufacturer's name is mentioned, products of other manufacturers may be considered if, in the opinion of the Engineer and / or Owner's Representative, the substitution is of equivalent quality or better than that of the material specified.
- G. The Contractor's Bid represents that the bid price is based solely upon the materials and equipment described in the Contract Documents and that he contemplates no substitutions or extras.
- H. Requests for substitution are understood to mean that the Contractor:
 - 1. Has personally investigated the proposed substitution and determined that it is equivalent or superior in all respects to that specified.
 - 2. Will provide the same guarantee for the substitution that they would for that specified.
 - 3. Will, at no cost to the Owner, replace the substitute item with the specified product if the substitute item fails to perform satisfactorily.
- I. After Award of the Contract, substitutions will be considered only under one or more of the following circumstances:
 - 1. The substitution is required for compliance with subsequent interpretations of code or insurance requirements.
 - 2. The specified product is unavailable through no fault of the Contractor.
 - 3. The manufacturer refuses to warranty the specified products as required.
 - 4. Subsequent information that the specified product is unable to perform properly or to fit in the designated space.
- J. Revisions to the electrical system caused by substitutions shall be under the supervision of the Engineer at a standard hourly rate charged by the Engineer and shall be paid by the Contractor originating the changes.

2.3 PERFORMANCE REQUIREMENTS

- A. All materials, components, products, assemblies, equipment, etc. shall be new, free from defects, listed (by an NEC accepted listing agency), and approved / rated for the environment and purpose.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. For additional requirements, see Section 01 30 00 - Administrative Requirements (Coordination and verification of existing project / site conditions before starting work).

3.2 INSTALLATION

- A. The Contractor shall obtain all permits required to commence work and, upon completion of the Work, obtain and deliver to the Owner's Representative a Certificate of Inspection by an AHJ in the project city and state. The Contractor shall pay required permit fees.
- B. All work shall be done by experienced craftsmen skilled in the applicable trade.
- C. All equipment shall be installed in strict compliance with manufacturer's installation instructions and properly torqued using a calibrated torque tool.
- D. All panels, enclosures, devices, equipment and associated conduits, whether provided by this Contractor or any other, shall be flush-mounted and cleanly recessed in all finished spaces unless otherwise noted on the Drawings.
- E. Unprofessional and incomplete work shall be rejected and corrected at no additional expense. The judgement of professionalism and completeness of work shall be made by the Engineer and / or Owner's Representative and shall be final.
- F. All electrical connections shall be made per NEC 110.14 and torqued per manufacturer's instructions.
- G. Where existing utilities already exist or where renovation / addition work is to be done, maintain all utility services during construction to existing structures and / or portions of a project that are to remain in place and operational.
- H. This Contractor assumes all responsibility for the safety of their personnel on the project during construction. The Contract Documents do not include materials, procedures, components, etc., required to ensure construction safety. Refer to General Conditions for additional information.
- I. This Contractor shall be responsible for damage to the project caused by this Contractor's failure to recognize hazards associated with items such as lack of power, scheduling of work (tardiness), inexperienced workmen, excessive cutting, etc. This Contractor shall repair at no expense to the owner any such damage.
- J. Contract Documents do not show exact location and elevations of lines. Deviate from drawings as required to conform to the general construction, provide proper grading and installation.

3.3 INTERFACE WITH OTHER WORK

- A. Cooperation with trades of adjacent, related or affected materials or operations, and / or trades performing continuations of this work under subsequent contracts is considered a part of this work in order to affect timely and accurate placing of work and to bring together, in proper and correct sequence, the work of such trades, including under the general contractor Division 1 and Division 23.
- B. The Electrical Contractor shall coordinate installation of the electrical system with the General Contractor, Mechanical, Plumbing, and Communications Contractors to insure a complete working system for the Owner.
- C. The Electrical plans are based on the equipment and device schedules shown on the drawings or as called for in the specifications. Should any mechanical equipment or device associated devices be changed or accepted from those which are shown or noted, all electrical and / or mechanical changes shall be made at the expense of the trade or contractor initiating the change with no expense to the Owner's Representative, Engineer, etc.

- D. Coordinate all utility services and / or revisions with utility companies.
- E. Make permanent connection to new utilities or existing lines. Determine depth and location, and bid accordingly. Relocate and repair any existing lines cut by general construction work.
- F. Provide all lighting contactors with control relay. Coordinate required coil voltage with controls system.

3.4 CONTRACTOR COORDINATION - ELECTRICAL / MECHANICAL (DIV 23)

- A. Electrical Contractor to provide the following:
 - 1. All line voltage wiring, conduits, back boxes and hook-up to all HVAC equipment including required fused or non-fused safety switches.
 - 2. All boxes and conduit into accessible attic space for all thermostats and sensors. Coordinate with Mechanical Drawings for exact locations and requirements.
 - 3. All contactors and relays shown on the Electrical Drawings only.
 - 4. All conduit and back boxes for control wiring in all mechanical spaces to protect control wiring from damage. Conduit and back boxes to be required from 6" above each piece of equipment or control to a common 12" square NEMA 1 enclosure provided by Electrical Contractor and mounted directly above the EMCS / BMS controls in that space. Coordinate all required conduit paths with mechanical contractor before bidding and again before installing. Mechanical contractor to provide Electrical Contractor with conduit paths required for controls wiring on a drawing with adequate dimensions for bidding.
- B. Mechanical Contractor to provide the following:
 - 1. All contactors and relays for mechanical equipment control. Coordinate control voltage between trades as required.
 - 2. All HVAC motor starters (with heaters as required) and / or VFDs.
 - 3. All associated HVAC equipment, thermostats, controls, control wiring, etc.
 - 4. All HVAC related relays, contactors, and switches required to start / stop mechanical equipment other than switches shown on and required by Division 26.

3.5 CONTRACTOR COORDINATION - ELECTRICAL / PLUMBING (DIV 22)

- A. Electrical Contractor to provide the following:
 - 1. All line voltage wiring, conduits, back boxes and hook-up to all plumbing equipment including required fused or non-fused safety switches.
- B. Plumbing Contractor to provide the following:
 - 1. All plumbing equipment.
 - 2. All relays, contactors, and switches required to control plumbing equipment other than switches shown on and required by Division 26.

3.6 CONTRACTOR COORDINATION - ELECTRICAL / CONTROLS (DIV 23, 25)

- A. Electrical Contractor to provide the following:
 - 1. All junction boxes (standard one or multi-gang) required for controls contractor. Coordinate with controls contractor for exact locations.
 - 2. Various relays, devices, wiring and other equipment for control equipment as indicated or required per details on Electrical Drawings.
- B. Controls Contractor to provide the following:
 - 1. All required relays associated with controls in specifications.
 - 2. All hardware, software and sensors related to controls.
 - 3. All conduit required above ceiling.
 - 4. All control wiring.

3.7 CONTRACTOR COORDINATION - ELECTRICAL / COMMUNICATIONS (DIV 27)

- A. Electrical Contractor to provide the following:
 - 1. All receptacles and direct connection to all communications systems and equipment as shown and as required.

2. All building interconnect and service entry conduits as indicated on drawings. Unless otherwise noted, provide two (2) schedule 40 PVC 4" conduits buried at a depth of 24". Provide concrete or fiberglass pull boxes as shown or as required and rated for the location and traffic. Provide intermediate pull boxes for every 500 feet of conduit run or for every pair of 90 deg radius bends.
 3. All ground conductors and bonding to the building grounding system for all communications equipment panels and racks. See Section 26 05 26 - Grounding and Bonding, notes on drawings and details for more information.
 4. All required standard back boxes as required for wall-mounted devices furnished by Communications Contractor.
 5. All raceway / conduit as required for accessibility of all communications systems cabling as listed below and as indicated on the drawings and details (whether furnished under a Division 01 allowance, by the Owner, Division 26 and / or Division 27).
 - a. Provide raceway / conduit for cabling in above-ceiling spaces at the following locations:
 - 1) All wall penetrations.
 - 2) All HVAC duct penetrations (Per NEC 800).
 - 3) All cabling travelling through a plenum or other environmental air space (Per NEC 800).
 - b. Provide raceway / conduit for all cabling from wall-mounted back boxes to accessible spaces per Communications Device Backboxes detail. Coordinate exact size and locations with communications contractor before installation.
 - c. Provide full raceway / conduit for all cabling in exposed ceilings or when cabling is to be exposed on walls. Coordinate exact size and locations with communications contractor before installation.
 6. Installation of all special boxes and equipment cabinets furnished by Owner or Communications, Security, and Safety Contractor(s).
- B. Communications Contractor to provide the following:
1. All communications systems complete with equipment, cabling, special backboxes, hardware, and all other required devices.
 2. Furnish all special boxes in timely manner to the electrical contractor for installation as required.
 3. All attachments for all communications cable above accessible ceilings to be supported from the building structure and bundled.

3.8 CONTRACTOR COORDINATION - ELECTRICAL / ELECTRONIC SAFETY & SECURITY (DIV 28)

- A. Electrical Contractor to provide the following:
1. All receptacles and direct connection to all security and safety equipment as shown and as required.
 2. All ground conductors and bonding to the building grounding system for all security and safety equipment panels. See Section 26 05 26 - Grounding and Bonding and details for more information.
 3. All required standard back boxes as required for wall-mounted devices furnished by security and safety contractors.
 4. All raceway / conduit as required for accessibility of all security and safety systems cabling (whether furnished under a Division 01 allowance, by the Owner, Division 26 and / or Division 28) as listed below and as indicated on the drawings and details.
 - a. Provide raceway / conduit for all cabling in above-ceiling spaces at the following locations:
 - 1) All wall penetrations.
 - 2) All HVAC duct penetrations (Per NEC 800).
 - 3) All cabling travelling through a plenum or other environmental air space (Per NEC 800).
 - b. Provide raceway / conduit for all cabling from wall-mounted back boxes to accessible spaces per Communications Device Backboxes detail. Coordinate exact size and locations with security and safety contractor before installation.
 - c. Provide full raceway / conduit for all cabling in exposed ceilings and when cabling is to be exposed on walls. Coordinate exact size and locations with security and safety contractor before installation.
 5. A dedicated circuit for the Fire Alarm Control Panel (FACP). Provide power to all Fire Safety Control Function devices as shown on the drawings. Each circuit breaker shall be labelled as "FIRE ALARM CIRCUIT" in the panel directory and labelled "FIRE ALARM" at the lockout clip on the circuit breaker.

6. All fire safety control circuits shall be of "fail safe" operation and shall not have backup power. These circuits shall be controlled by a power relay located within three (3) feet of the breaker panel. These circuits shall be switched by a power relay controlled by the fire alarm system and wired by the Electrical Contractor.

- B. Fire Alarm Contractor to provide the following:
 1. All security and safety systems complete with equipment, cabling, special backboxes, hardware, and all other required devices.
 2. Final connection of all duct-mounted smoke detectors to the fire alarm system. Detector housings and control relays are to be mounted by the Division 23 Contractor.

3.9 CONTRACTOR COORDINATION - ELECTRICAL / OTHER

- A. Electrical Contractor to provide required hook-up to line voltage at all electromagnetic door holder / release, fire / smoke dampers, smoke dampers, etc. Provide required relays and wiring to fire alarm panels and coordinate with other specified work.
- B. Line voltage and hook-up to all building automation equipment (Division 25) including required manual safety switches with fuses / heaters of required size.

3.10 EQUIPMENT CONNECTIONS

- A. This Contractor shall bring all required electrical service to all equipment items furnished under other sections of these specifications or by the Owner, make final connections, and leave equipment ready for operation. This Contractor shall coordinate with any affected trade to assure correct operation of the equipment item, i.e., phase rotation, switching, control location, accessibility, etc.
- B. When the contractor is uncertain about the method of installation, proper location, etc., they shall ask for further instructions or details. Failure to request such information will not excuse non-compliance.
- C. All roof mounted mechanical equipment shall be served through and concealed in curb. Penetration through side of curb is not permitted. If not possible, then contractor shall notify the Owner's Representative in writing providing a no cost alternative.

3.11 INSTALLATION - OTHER WORK

- A. Cutting and Patching:
 1. All cutting required by the installation of sleeves, conduit, equipment, etc., shall be coordinated with the General Contractor, but performed by this Contractor. Patching shall be by General Contractor. This Contractor shall not cut any structural element or any finished work without written permission from the Owner's Representative.
 2. This Contractor shall cut and patch all paving as required by the installation of buried conduit or wire.
- B. Concrete Work:
 1. This Contractor shall provide all forming, reinforcing and concrete as indicated or required for equipment bases, transformer pads, etc. Work shall conform to the applicable portion of Division 03 - Concrete.
- C. Painting:
 1. All painting except "touch-up" shall be provided under Division 09 - Painting unless otherwise noted on Drawings. All exposed conduit, equipment, etc., shall be left clean and free from rust or grease and ready for the painter.
 2. Where equipment finishes are damaged, this Contractor shall obtain touch-up paint in matching colors from the equipment manufacturer and paint as required.
- D. Trenching and Backfill:
 1. This Contractor shall perform all trenching, excavation, shoring, pumping and backfill required in the installation of their work. All trenches shall be maintained dry until all circuits have been satisfactorily tested and then filled in tamped 6" layers immediately after approval of tests by the Owner's Representative. All backfill shall be free of construction debris and any other foreign material which might damage any circuit runs. Stability of backfilled soil shall match adjacent

- undisturbed soil.
 - 2. All exterior raceway or cable shall be laid with at least a minimum cover as indicated in the NEC.
 - 3. The contractor shall exercise all possible care to avoid damage to trees and roots in excavation. Where possible, the contractor shall excavate beyond the drip line of trees. If it is necessary to cut roots 1" to 2 1/2" in diameter, the contractor shall excavate around, cut clean and paint severed ends of roots with a tree wound sealer. Do not cut roots 2 1/2" and larger.
- E. Flashing and Waterproofing:
- 1. All building penetrations to the outside shall be flashed and counter-flashed as required to eliminate leaks. Provide link-seal fitting on all below grade conduit penetrations greater than 2".

3.12 PROTECTION

- A. The Contractor shall continuously maintain adequate protection of stored materials and installed equipment. Fixtures and equipment, whether located inside or outside, shall be tightly covered with sheet polyethylene or waterproof tarpaulin as protection against dirt, rust, moisture and abuse from other trades. Adequate air circulation shall be provided under any protective sheet to prevent condensation build-up. Materials and equipment shall not be stored where it can come into direct contact with the ground. Conduit, conduit hangars, cable tray and equipment shall not be used by other trades as supports for their equipment, scaffolds or personnel. At the completion of the work, equipment, luminaires, exposed supports and piping shall be cleaned of loose dirt, construction debris, overspray, etc., to the satisfaction of the Owner's Representative. Repairs made necessary by damage shall be paid for by the Contractor.

3.13 QUALITY CONTROL

- A. For additional requirements, see Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. For additional requirements, see Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

3.14 SYSTEM STARTUP

- A. All circuit and operational tests of the electrical systems shall be made by this Contractor and repeated until equipment meets or exceeds testing requirements.

3.15 CLEANING

- A. For additional requirements, see Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Where all work has been finally tested, this Contractor shall clean all work installed by them, including all luminaires, equipment, and all exposed work.

END OF SECTION

SECTION 26 05 05

SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Selective demolition of electrical and lighting systems and equipment and the off-site removal of the portions of those systems and equipment not reused, in a code-compliant and lawful manner.

1.2 RELATED REQUIREMENTS

- A. Section 26 00 00 - Electrical
- B. Section 26 05 53 - Identification for Electrical Systems

PART 2 - PRODUCTS

2.1 NOT APPLICABLE.

PART 3 - EXECUTION

3.1 ELECTRICAL EXAMINATION

- A. Verify existing field measurements, circuiting arrangements, wiring and equipment served in areas as shown on the Drawings. Adjust all circuiting, wiring and materials to be provided as required by job conditions.
- B. Verify abandoned wiring and existing equipment.
- C. Drawings are based on casual field observation and existing record documents. Report discrepancies to the Engineer before disturbing existing installation.
- D. The Contractor accepts all existing conditions when beginning demolition, whether or not those conditions are reflected in the Contract Documents.

3.2 LIGHTING EXAMINATION

- A. Where new lighting is being added to an existing installation, the new luminaires shall match the input voltage, style, finish, CCT, mounting height, etc. unless otherwise indicated on the Drawings.
- B. When new luminaires or replacement LED lamps or retrofit kits are replacing existing lighting, field verify the input voltage, lamp pin requirements, switching arrangement and dimming technology before submitting to ensure a complete and working system.
- C. For exterior lighting replacement, field verify existing conditions to determine pole quantities, bolt patterns, styles, finish, location, orientation, mounting height, etc. to install.
- D. Emergency interior and exterior lighting: If the unswitched phase conductor needed for proper operation does not exist, provide a new unswitched phase conductor to each luminaire as needed for proper operation. The unswitched phase conductor must come from the same branch circuit that powers the luminaire.

3.3 PREPARATION

- A. Disconnect electrical systems in walls, floors and ceilings as shown or required.

- B. Coordinate utility service outage with the respective utility company and the Owner.
- C. Provide temporary wiring and connections to maintain required existing systems that must remain operational during construction.
- D. When work must be performed on energized equipment or circuits, use personnel experienced in such operations. Verify phasing on existing equipment and coordinate new phasing before energizing revised service.
- E. Disconnect and remove abandoned wiring, devices, conduits, panels and distribution equipment unless otherwise specified in the drawings.
- F. Clean and repair existing raceway, boxes, wiring devices, etc. that are to remain in place or are to be reinstalled.

3.4 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Demolish and extend existing electrical work under provision of Division 01 and this section.
- B. Remove, relocate and extend existing installations to accommodate new construction as required.
- C. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floor, and patch surfaces.
- D. Remove concealed abandoned raceway to its source.
- E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
- F. Remove abandoned wiring to the source of the supply.
- G. Mark all unused breakers as spares and turn them off.
- H. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls, floors and patch surfaces.
- I. Disconnect and remove electrical devices and equipment serving equipment that has been removed.
- J. Disconnect and remove abandoned luminaires, lighting controls, contactors, time clocks, etc. Remove brackets, stems, hangers and other accessories.
- K. Extend existing conduit, raceway and box installations using materials and methods compatible with existing electrical installations or as specified.
- L. Confirm with Owner's Representative regarding the handling and disposal/reuse of removed material, equipment, devices, luminaires, etc.
- M. Where demolition of equipment or materials is required, this Contractor shall minimize cutting and exercise all due caution to leave undamaged surfaces, material and equipment meant to remain.
- N. All existing items that are to be removed shall remain property of the owner unless declared as salvage. Salvage materials shall become property of the contractor and be removed from the site. Items declared as the owner's property shall be neatly stored on the site as directed by the owner.
- O. Existing electrical equipment (except cast-in-place conduit) such as panelboards, wiring devices, luminaires, junction boxes, etc., shall be removed from the job unless otherwise noted.
- P. Please note that demolition of the HVAC system will require electrical work and coordination. Refer to the complete set of construction documents for additional information regarding the phasing of the demolition and construction.

3.5 MAINTAIN EXISTING ELECTRICAL

- A. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.
- B. Maintain access to existing wiring, devices, boxes, panels, distribution equipment, etc. to remain in place, operational and accessible. Modify installation or provide access panels as required.
- C. Where a circuit is interrupted by removal of a device or luminaire from that circuit, install wire and conduit as required to restore service to the remaining devices and luminaires on that circuit.
- D. Repair adjacent construction and finishes damaged during demolition and extension work.

3.6 REPAIR / RESTORATION

- A. Clean and repair existing materials and equipment, in areas of revision, which remain or which are to be reused.
- B. Panelboards:
 - 1. Clean exposed surfaces and check tightness of all electrical connections.
 - 2. Replace damaged circuit breakers and provide closure plates for vacant positions.
 - 3. Provide typed circuit directory showing revised circuiting arrangement as specified, on all existing panelboards and switchboards.
 - 4. Verify room names and numbers with Owner's Representative and indicate correct room names and numbers that are permanent for the facility.
- C. Labelling Requirements:
 - 1. Install identification on all existing unmarked equipment to remain in accordance with Section 26 05 53 - Identification for Electrical Systems. Replace all lost nameplates, labels or markers.

3.7 RE-INSTALLATION

- A. Install all relocated materials and equipment under the provisions of Divisions 01 and 26.

END OF SECTION

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SECTION 26 05 19

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. This section includes conductors for power circuits, including terminations and connectors.

1.2 RELATED REQUIREMENTS

- A. Section 26 00 00 - Electrical
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems

1.3 REFERENCES AND STANDARDS

- A. ICEA S-61-402 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
- B. NECA 1 - Standard Practices for Good Workmanship in Electrical Construction
- C. UL 44 - Thermoset-Insulated Wires and Cables
- D. UL 83 - Thermoplastic-Insulated Wires
- E. UL 493 - Thermoplastic Insulated Underground Feeder and Branch Circuit Cables
- F. UL 1569 - Conductor properties

1.4 SUBMITTALS

- A. Submit product data for the following:
 - 1. Building wiring and all conductors on this project.
 - 2. Conductor terminations.
 - 3. Connectors.

1.5 CLOSEOUT SUBMITTALS

- A. Submit per Closeout Submittals requirements in 26 00 00 - Electrical and any additional requirements listed below:
 - 1. Record of all actual locations of components and circuits.

1.6 QUALITY ASSURANCE

- A. General work practices for electrical construction shall be in accordance with NECA 1.
- B. Regulatory Requirements: All products provided under this section shall be listed for the intended use.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Storage and Protection: Material shall be stored in a clean and dry location until installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Conductors shall be manufactured in the United States. Acceptable manufacturers are:

1. Alan Wire (Sikeston, MO)
2. Cerrowire (Hartselle, AL)
3. Encore Wire (McKinney, TX)
4. General Cable (Highland Heights, KY)
5. Southwire (Carrollton, GA)

B. All other manufacturers shall require pre-approval in accordance with Section 26 00 00 - Electrical.

2.2 MATERIALS

A. Feeder conductors:

1. CTE Addition: Aluminum, where allowed by the NEC.
2. Existing High School Renovation: Soft-drawn annealed copper.

B. All branch circuit conductors shall be soft-drawn annealed copper.

C. Aluminum is permissible ONLY where specifically indicated on the Drawings. Aluminum used shall be AA-8xxx rated and compact stranding is preferred.

2.3 MANUFACTURED UNITS

A. Manufactured Power Circuit Conductors:

1. Conductors shall be rated for at least 600 volts and 90°C. No exceptions.
2. Conductor insulation shall be type THHN / THWN-2 or XHHW-2.
3. Conductors shall be #12 AWG or larger.
4. Conductors that are #8 AWG and larger shall be stranded. Conductors that are #12 AWG and #10 AWG may be stranded if crimp on fork terminals are used for device terminations. Otherwise, #12 AWG and #10 AWG shall be solid conductors. Never place bare stranded conductors directly under device screws.
5. Conductors sized #6 AWG and smaller shall have factory colored insulation.

B. MC Cable: Unless otherwise noted on the Drawings, MC cable is allowed ONLY for luminaire whips. Total length not to exceed six (6) feet. MC cable must meet all requirements listed in this section including (but not limited to) separate full-size neutrals, conductor material, isolated ground, installation per NEC, etc.

1. Conductor Insulation: The insulation over the conductors shall be type THHN 90°C dry with an extruded polypropylene protective covering.
2. Armor: A zinc coated galvanized steel armor shall be applied over the cabled wire assembly with an interlock in compliance with UL 1569 Section 13. Armor shall be colored to identify the voltage and number of conductors.
3. Fittings: Fittings shall be listed and identified as MCI-A for such use with metal clad interlocking armor ground. Connectors shall be of steel or malleable iron and shall have saddle clamp to insure a tight termination of MC or MCI-A cable to box.

C. NM-B (Romex): Romex may only be used in walls, above hard ceilings, and between j-box and the devices they serve.

D. Manufactured Conductor Terminations and Connectors:

1. All accessory materials such as connectors, splice and tap fittings, and terminations shall be of a type designed or intended and suitable for the use. They shall be compatible with the conductor material. Installation, compression, and torque settings shall be per manufacturer's recommendations.
2. Conductors shall be connected and terminated using suitable clamps, pressure connectors, compression terminals or lugs and hardware of the proper size and listed for the application.
3. Only connection devices that require the complete removal of the conductor jacket or insulation and result in a connection to the complete conductor surface area are suitable for use. Insulation piercing type connectors, press in type connectors or Wago style connectors shall NOT be used.
4. Splices and taps shall have a mechanical strength and insulation rating at least as that of the conductors.
5. Compression systems shall include crimped die index and company logo for purposes of inspection.

PART 3 - EXECUTION

3.1 EXAMINATION (SITE VERIFICATION)

- A. Do not install the conductors until conduit / raceway system is complete.
- B. Before installing the conductors for any branch circuit or feeder, verify that the conductor ampacity is at least as large as the rating of the overcurrent device protecting it, except where approved for use and correctly sized for motor loads per NEC. In the event that the conductors would not be adequately protected, notify the Engineer before installation.

3.2 INSTALLATION

- A. More than one conductor shall not be installed in any termination unless the termination is marked as suitable for more than one conductor.
- B. Wire Sizing: Provide conductors sized as indicated on Drawings unless modified as described below. Where conductor sizes have been omitted from Drawings, bid shall include conductors with ampacity as least as large as the overcurrent protection device protecting the conductors, or at least as large as the amp rating of the load being served, whichever is greater. In such cases, notify the Engineer before installation for size verification.
- C. Voltage Drop: The intent of the drawings is to limit the voltage drop from the service entrance conductors to each branch circuit to less than 5%. The electrician is responsible to ensure proper voltage drop values are maintained as mentioned here and as required per the NEC.
- D. Wire Lengths: For 120v branch circuits, #12 AWG wire shall not be run more than 90', #10 AWG wire shall not be run more than 120', #8 AWG wire shall not be run more than 150', etc.
- E. Neutral Conductors: Provide a separate neutral conductor for each feeder or branch circuit. Multiple circuits shall not share a common neutral. Neutral conductors shall be sized as large as the phase conductors. Neutral conductors shall not be of a reduced size.
- F. Equipment Grounding Conductors: Provide equipment grounding conductors in accordance with Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- G. Number of Current Carrying Conductors (CCC) per conduit:
 - 1. #12 AWG Wire - no more than six (6) CCCs in a single conduit.
 - 2. #10 AWG Wire - no more than nine (9) CCCs in a single conduit.
 - 3. ELSE - no more than three (3) CCCs in a single conduit.
 - 4. When more than three (3) CCCs are in a single conduit, the electrician is responsible for derating the available ampacity to current carrying conductors per NEC requirements and provide calculations to the Engineer, when requested.
 - 5. The equipment grounding conductor shall not be counted for the preceding statements.
- H. Installation in Raceways:
 - 1. All conductors shall be installed in a raceway.
 - 2. All conductors installed in a raceway shall be pulled together. Use an approved wire pulling compound when pulling large conductors.
 - 3. Do not bend any conductor either permanently or temporarily during installation to radii less than four times the outer diameter of conductors.
 - 4. Do not exceed manufacturer's recommended values for maximum pulling tension.
 - 5. When installing conductors in existing conduit, the interior of the existing conduit shall be cleaned and inspected for damage prior to the installation of the new conductors to insure that there is nothing that will damage the conductor insulation.
 - 6. The pulling device used shall be per manufacturer's installation instructions and shall be suitable to prevent damage to the conductors and the raceway.
- I. Terminations:

1. Use pressure type lugs or connectors for terminations or splices of all stranded conductors. Use ring tongue type terminators on all control wiring. More than one conductor shall not be installed in any termination unless the termination is marked as suitable for more than one conductor. With the written approval of the Engineer, an exception to this may be allowed for the installation of the surge protective devices required in Section 26 43 00 - Surge Protective Devices.
2. Conductors shall not be supported solely by their terminations.
3. Terminations shall be made such that the stripped length of the conductor is no longer than required for the terminal, lug, or connector. Excessive stripped length shall be trimmed prior to installation.
4. Conductive antioxidant shall be applied on all connections per manufacturer's instructions, regardless of conductor material.

J. Splices:

1. Conductor splices shall be kept to a minimum.
2. Where splices are required, they shall be in a box or enclosure. Splices within a conduit run are not acceptable.

K. Color Coding:

1. Provide factory colored insulated conductors for #6 AWG and smaller.
2. Color code larger insulated conductors with an approved field-applied tape 2" wide on each end of conductors.
3. If existing wiring in renovation or addition work has a consistent color coding, then match the existing and note in record documents. Otherwise, colors shall be as follows:

Line	208/120V	240/208V 1ph	240/120V	480/277V
A	Black	Black	Black	BROWN
B	Red	n/a	Orange	ORANGE
C	Blue	Red	Blue	Yellow
Neutral	White	White	White	Gray
Ground	Green	Green	Green	Green
Isol Grnd	Green +Yellow	Green + Yellow	Green + Yellow	Green + Yellow

4. Switch leg shall be the same color as the un-switched phase wiring. Travelers, and special systems as selected by the Contractor. Note in record drawings.

L. Identification: All conductors in a panelboard shall be identified by means of tags or tape.

M. MC Cable: Where allowed, install MC cable to meet all NEC requirements.

1. Support: All MC cable shall be supported by dedicated J-cable hangers or cable tray. Where suspended from the ceiling or roof structure, use split-ring hangers or wrought-iron hanger rods.
2. Fittings: Follow manufacturer's instructions for cable preparation for installation of fittings. Cleanly cut the cable end with metal clad cable rotary cutting tool to ensure flush seating of the cable into the fitting. Properly torque fitting securement screws. Provide anti-shortening bushings at both ends of each length of cable.
3. Conductors in Enclosures: Provide neat and workmanlike installation with conductors tied with nylon wire ties in terminal cabinets, gutters, and similar locations.

3.3 SITE TESTS

- A. Perform in accordance with manufacturer's printed testing procedures, applicable industry standards, ANSI standards, IEEE standards, and NEMA standards. Provide calibrated testing equipment in good working order and which complies with the above requirements. The below test shall be performed after the conductors have been pulled into the conduit and after terminations have been added, but before final connections are made. Document all readings and testing and make documentation available to Owner upon request.
- B. Feeder Insulation Test: The insulation of new service entrance conductors and each new feeder run shall be tested using a megger. Readings must indicate not less than one (1) megohm to be acceptable.
- C. Branch Circuit Insulation Test: The insulation of each new branch circuit shall be tested using an ohm meter. Readings must indicate not less than one (1) megohm to be acceptable.

END OF SECTION

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SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Grounding and bonding shall include the solid grounding of the various electrical systems and equipment and the proper bonding of all electrical system components and equipment to meet NEC 250 and all other applicable codes and ordinances. These systems shall be provided for the proper protection of life, equipment, circuits, and systems.
- B. Permanently ground entire lighting and power systems in accordance with the latest adopted version of the NEC, including service equipment, distribution, panelboards, switch and starter enclosures, motor frames, devices, transformers, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.
- C. Grounding and bonding requirements specified in this section may be supplemented in other sections of these Specifications.

1.2 RELATED REQUIREMENTS

- A. Section 26 00 00 - Electrical

1.3 REFERENCES AND STANDARDS

- A. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
- B. IEEE 1100 (Green book) - Recommended Practice for Powering and Grounding Electronic Equipment.
- C. NFPA 54 - National Fuel Gas Code
- D. NFPA 78 - Lightning Protection Code
- E. NFPA 99 - Health Care Facilities Code
- F. UL 467 - Safety Standard for Grounding and Bonding Equipment.
- G. UL 486 A & B - Wire Connectors

1.4 SUBMITTALS

- A. Product Data: Submit data on grounding electrodes and connections.

1.5 CLOSEOUT SUBMITTALS

- A. Submit per Closeout Submittals requirements in 26 00 00 - Electrical and any additional requirements listed below.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging and with plastic sheathing.

1.7 COORDINATION

- A. Complete grounding and bonding of building reinforcing steel (rebar) to the satisfaction of the local AHJ prior to concrete placement.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer List
 - 1. Apache Grounding
 - 2. Copperweld, Inc.
 - 3. ILSCO Corporation
 - 4. nVent (Cadweld, Critec, Erico)
 - 5. O-Z Gedney Co.
 - 6. Thermoweld
 - 7. Thomas & Betts

2.2 PERFORMANCE REQUIREMENTS

- A. General:
 - 1. All materials used for grounding and bonding and all work performed shall conform to requirements of NEC, IEEE 142, and be listed for the application and environment.
 - 2. All grounding and bonding shall be in strict accordance with NEC 250, 517, etc.
 - 3. Grounding electrode system shall have a resistance to earth of five (5) ohms or less. Where this cannot be met, provide two additional ground rods to form a "triple ground rod" installation. Under no conditions shall the system have a resistance greater than twenty-five (25) ohms to ground, per NEC 250, at any location in the system.
- B. Ground Rods:
 - 1. Copper cladding permanently bonded to a high-strength steel core.
 - 2. 3/4 inch by 10 feet (19mm by 3m) straight, conform to UL 467.
- C. Conductors:
 - 1. Grounding Conductor: Copper, insulated (green) where required or uninsulated where allowed in the Specifications or by code, sized per drawings or NEC Table 250.95.
 - 2. Bonding Jumpers - Insulated conductor, sized to be minimum cross-sectional area greater than or equal to that of the equivalent grounding conductor as determined from NEC Table 250.95.
 - a. Where braided bonding jumpers are indicated or otherwise required, provide copper tape, braided #3/0 AWG bare copper wire, terminated with copper ferrules.
 - 3. Grounding Ring around a building - #2 AWG uninsulated copper, otherwise sized per NEC.
 - 4. Grounding Ring around a utility transformer - #2 AWG uninsulated copper (unless sized per drawings), otherwise sized per NEC or by utility requirements.
- D. Connections:
 - 1. General: All connectors shall be listed and labeled as grounding connectors for the materials used.
 - 2. Welded Bond - Exothermic welded connection or bond such as "Cadweld". No phosphorous or any other caustic, toxic or explosive substance may be used.
 - a. Provide exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.
 - 3. Clamps - Listed bronze connectors, suitable for grounding and bonding applications, in configurations required for a particular installation.
- E. Buss Bars:
 - 1. Bare annealed copper bars, 1/4" x 4" x 20" unless otherwise noted on the drawings.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove paint, rust, mill oils, and all surface contaminants at connection points.

3.2 APPLICATION

- A. Unless otherwise indicated, the below list of connection styles shall be followed.
- B. Outdoor Below Grade Grounding Connections:
 - 1. Welded bond only, no exception.
- C. Outdoor Above Grade Grounding Connections:
 - 1. Clamps may be used. Use welded bond where clamping is not accessible or practical.
- D. Indoor Grounding and Power Connections:
 - 1. Clamps may be used. Use low-smoke/low emission welded bond where clamping is not accessible or practical.

3.3 INSTALLATION

- A. General:
 - 1. Ground and bond electrical systems and equipment in accordance with NEC requirements except where the Drawings or Specifications exceed NEC requirements, then follow the Drawings or Specifications.
 - 2. Bond all ground electrodes together to form the grounding electrode system including metal underground water pipe, metal frame of the building or structure, concrete encased electrodes, ground ring, rod and pipe electrodes and plate electrodes.
 - 3. At all electrical system components, assemblies, circuits, etc. that are over 120v to ground, provide locknuts and / or listed fittings per NEC 250.97 for bonding of metal raceways. In case of oversized, concentric or eccentric knockouts, comply with NEC 250.92(B). The use of snap-in, wedge-type, or pivot-type connectors is prohibited.
 - 4. Permanently attach equipment and grounding conductors prior to energizing equipment.
 - 5. Refer to Drawings for additional special grounding systems or grounding requirements not mentioned here.
- B. Concrete Encased Electrode:
 - 1. Fabricate with twenty (20) feet (6m) of conductor laid lengthwise in excavation for foundation or footings. Install so conductor is within two (2) inches (50mm) of the bottom of the concrete. Where base of foundation is less than twenty (20) feet (6m) in length, coil excess conductor at base of foundation. Bond conductor to reinforcing steel at four (4) locations, minimum. Extend conductor below grade and connect to building grounding electrode.
- C. Main Electrode:
 - 1. Provide a building ground rod and bond it to the grounding electrode system. Where ohmic values exceed 5 ohms to ground, the building ground rod shall consist of three ground rods, arranged in an equilateral triangular pattern located at least five (5) feet outside an exterior building wall or as otherwise directed. Space fifteen (15) feet apart and drive into the earth to a point two (2) feet below finished grade to top of rods. Grounding electrode conductor shall form a continuous loop around rods, and conductor shall be properly bonded to each rod by a fusion weld similar to "Cadweld".
 - 2. Extend grounding electrode conductor from this ground rod(s) to the grounded service conductor (neutral) in the building main switchboard at an accessible point on the ground bus per NEC 250.24.
 - 3. Install grounding electrode conductor of #3/0 AWG copper.
- D. Main Bonding Jumper: Shall be sized in accordance with NEC 250.66, if not indicated on the Drawings, and installed within the same enclosure as the point of bonding of the system neutral service entrance.
- E. Water Pipe Electrode: A ten (10) foot minimum length of electrically-continuous underground metal water pipe. Bond around insulating joints or sections, insulating pipe, and water meters to make pipe electrically continuous.
- F. Fuel Gas Piping:
 - 1. Each above ground portion of a gas piping system upstream from the equipment shutoff valve shall be made electrical continuous and bonded to the building grounding electrode system, as required in NFPA 54.
 - 2. Gas piping shall not be used as a grounding electrode.

- G. Transformers: Ground as a separately derived source.
 - 1. Where transformer secondary includes a neutral, the neutral shall be bonded to the equipment enclosure and connected to the system ground conductor.
 - 2. Size bonding jumper per NEC Table 250.66.
 - 3. Grounding conductor shall be in raceway and shall be bonded to nearest available point of interior metal water piping system.

- H. Equipment Grounding Conductor (EGC):
 - 1. Comply with NEC 250 for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated.
 - 2. All power circuits shall be provided with a separate copper insulated EGC run in the raceway with the power conductors. The conduit shall not be used as the sole means of grounding. The insulation of the EGC shall be green.
 - 3. Bonding to the EGC shall be provided at each end of metallic conduit runs and at all boxes and enclosures.
 - 4. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.

- I. Isolated Ground (IG) Equipment Grounding Conductor:
 - 1. All branch circuits and feeders that require an IG equipment grounding conductor shall be provided with a separate copper insulated IG equipment grounding conductor run in the raceway with the power conductors. The IG equipment grounding conductor shall be provided in addition to the normal EGC. The insulation of the IG equipment grounding conductor shall be green with a yellow stripe.
 - 2. Conduits and boxes of IG circuits shall be bonded to the normal EGC as stated above. At outlet locations, the IG equipment grounding conductor shall connect only to the isolated ground terminal of an isolated ground outlet. There shall be no connection, either directly or indirectly, between the normal EGC and the IG equipment grounding conductor at any point other than at the source of a separately derived system (transformer) or at the service entrance.
 - 3. The following circuits shall be provided with an IG equipment grounding conductor:
 - a. Feeders providing power to panels equipped with an IG buss.
 - b. All branch circuits originating at a panel with an IG buss.

- J. Exterior Lighting:
 - 1. All metallic outdoor poles and luminaries on metallic or non-metallic lighting poles shall be grounded by bonding in an approved manner to the circuit grounding conductor. In addition to this, bond pole to a #6 AWG bare copper wire which shall also be bonded to a ground rod. Install the ground rod adjacent to the pole base with the top driven at least two (2) feet below grade.

- K. Grounding Busses:
 - 1. Provide a copper buss bar where indicated on Drawings or in rooms containing any of the below list. Provide a #2 AWG insulated grounding electrode conductor from the grounding electrode system to each grounding buss.
 - 2. Provide in each IDF and MDF room.
 - 3. Provide at each CATV / MATV head-end mounting board.
 - 4. Provide at each building communications rack.
 - 5. Provide at each sound reinforcement equipment rack.

- L. Communications Systems:
 - 1. Bond each server, patch panel, data and other communications equipment ground (buss type or grounding conductor type) at each piece of equipment and each equipment rack back to the copper grounding buss installed in the room with a bare #6 AWG ground wire.

- M. Engine Generator Neutral:
 - 1. Ground the generator neutral as a separately derived system per NEC 250.20(D), unless noted otherwise on Drawings.
 - 2. Sign: Provide a sign at the service entrance equipment indicating type and location of on-site generator. See Section 26 05 53 - Identification of Electrical Systems for more information.

- N. Lightning Protection System:

1. Bond grounding conductors or grounding conductor conduits to lightning protection down conductors or grounding conductors in compliance with NFPA 78.
 2. Bond electric power system ground directly to lightning protection system grounding conductor at closest point to electric service grounding electrode. Use bonding conductor sized same as system ground conductor and installed in conduit.
- O. Other Grounding Systems:
1. Other buildings served from common service:
 - a. The main building service is the source for electric service.
 - b. Bond grounding conductor of building main feeder to grounding electrode system.

3.4 CONNECTIONS

- A. General:
1. Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 2. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series. Make connections with clean bare metal at points of contact.
 3. Aluminum to steel connections shall be with stainless steel separators and mechanical clamps. Aluminum to galvanized steel connections will be with tin-plated copper jumpers and mechanical clamps.
 4. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.
 5. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B.
- B. Exothermic Welded Connections:
1. Use for connections to structural steel and for underground connections except those at test wells. Install at connections to ground rods and plate electrodes. Comply with manufacturer's written recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
 2. Terminate insulated EGCs for feeders and branch circuits with pressure-type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground buss in the housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushing and bare grounding conductors.
- C. Compression Type Connections:
1. Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.
- D. Moisture Protection:
1. Where insulated ground conductors are connected to ground rods or ground busses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.

3.5 SITE TESTING

- A. Testing:
1. Test the electrical system after installation is complete. Inspect and test for stray currents, unintended ground shorts, and proper physical condition of grounding system. Correct any deficiencies and re-test to verify satisfactory installation.
 2. Document all readings and testing and make documentation available to Owner upon request.
 3. Perform ground resistance and continuity testing in accordance with IEEE 142.
 4. Perform leakage current tests in accordance with NFPA 99.
 5. Use true-RMS meters for all voltage and current measurements.

6. Test telecommunications grounding riser to verify continuity.
7. Check all isolated ground receptacles for correct polarity.
8. Test all subpanels of separately derives systems to verify subpanel neutral is isolated from ground.
9. Test isolated power systems for the sound reinforcement system to verify isolation of ground system from other building systems.
10. Verify continuity and isolation of audio system ground buss and grounding riser.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Provide all raceway and conduits, outlet boxes, pull and splice boxes, floor boxes, poke-thru boxes, wireways, gutters, and associated fittings as indicated on the Drawings and as required for feeders, branch circuits, splices, taps, equipment connections, and for compliance with regulatory requirements. All locations shown on the Drawings are approximate unless dimensioned.
- B. Provide complete, separate conduit systems for all electrical systems on this project to include, but not limited to service entrance, feeders, branch circuit, control wiring furnished by this contractor, emergency and standby power and lighting circuits, critical power, communication systems, and other electrical systems as required.
- C. Provide outlet wiring boxes of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with knockouts or threaded hubs in back and sides, and with threaded holes with screws for securing box covers or wiring devices. Provide outlets as shown, as required and per NEC.

1.2 RELATED REQUIREMENTS

- A. Section 26 00 00 - Electrical
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems
- C. Section 26 05 53 - Identification for Electrical Systems
- D. Section 26 20 00 - Low-Voltage Electrical Distribution
- E. Divisions 27 and 28 - Communications and Security

1.3 REFERENCES AND STANDARDS

- A. ANSI C80.1 - Zinc-Coated Rigid Steel Conduit
- B. ANSI C80.4 - Zinc Coated Electrical Metallic Tubing
- C. ANSI C80.4 - Fittings for Rigid Metal Conduit and Electrical Metallic Tubing
- D. ANSI / NEMA Publication No. OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers and Box Supports, and Cast Aluminum Covers.
- E. ANSI / NEMA Publication No. OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.
- F. ANSI 77 - Load Ratings for Underground Boxes
- G. ETL PVC-001 - PVC-Coated Rigid Steel Conduit
- H. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80) and Fittings
- I. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing
- J. NEMA FB 1 - Metallic Fittings, Cast Metal Boxes and Conduit Bodies
- K. NEMA RN 1 - PVC Externally Coated Galvanized Rigid Steel Conduit and IMT

- L. NEMA 250 - Enclosure Ingress Protection Testing
- M. UL 1 - Flexible Metal Conduit
- N. UL 5 - Surface Metal Raceways and Fittings
- O. UL 6 - Rigid Metal Electrical Conduit
- P. UL 360 - Liquid tight Flexible Steel Conduit
- Q. UL 467 - Electrical Grounding and Bonding Equipment
- R. UL 514 - Electrical Outlet Boxes and Fittings
- S. UL 651 - Rigid Nonmetallic Conduit
- T. UL 797 - Electrical Metallic Tubing
- U. UL 870 - Safety Standard for Wireways, Auxiliary Gutters and Associated Fittings

1.4 ABBREVIATIONS AND ACRONYMS

- A. This specification uses the acronyms and abbreviations from the NEC unless otherwise noted.

1.5 DEFINITIONS

- A. Back Box - junction box (j-box), back box, pull box and similar.
- B. Raceway - Conduit, raceway, tubing, wireway and similar.
- C. See NEC 100 for additional definitions used in these specifications, unless otherwise noted.

1.6 DESIGN REQUIREMENTS

- A. All conduit, wireway, raceways, boxes, fittings, installation hardware, accessories, and similar products whether directly or indirectly referenced in the Specifications or Drawings shall be:
 - 1. Suitable and listed for the space / area / environment where they are installed.
 - 2. Installed / mounted / suspended per latest adopted version of the NEC, NECA "Standard of Installation" and manufacturer's installation instructions. This work includes but is not limited to clamping, cutting, threading, bending, assembly, supporting, patch coating, etc.
- B. Boxes and fittings shall be made of the same material as the conduit material they are installed with, unless modified below or otherwise noted on the Drawings.

1.7 SUBMITTALS

- A. Submit from the following list, all items used on this project: Rigid metal and non-metallic conduit, flexible metal and nonmetallic conduit, liquid-tight flexible metal and non-metallic conduit, tubing, all fittings, surface raceways, wireways, pull boxes, back boxes, hand holes, mounting hardware, accessories, etc.
- B. Submit on all cover plates, extension rings, fittings, labeling, and supports for conduits inside and on roof.

1.8 CLOSEOUT SUBMITTALS

- A. Submit per Closeout Submittals requirements in Section 26 00 00 - Electrical and any additional requirements listed below:
 - 1. Record on as-built actual routing of all conduits larger than 3/4".

1.9 DELIVERY, STORAGE AND HANDLING

- A. Protect all conduit from corrosion, entrance of debris, moisture and sunlight, prior to and after installation.

1.10 COORDINATION

- A. Coordinate mounting heights, orientation and locations of back boxes for outlets mounted above counters, benches, back splashes, etc.
- B. Conduit systems shall not be covered or otherwise concealed until review has been made and approvals obtained from the AHJ.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Raceways, Wireways, Gutters and Conduits: Aflex, Atkore (AFC, Allied, FRE, Power Strut, TJ Cope), American Conduit, Calbond, Cantex, Carlon, Champion, Hoffman, Hubbell, KorKap, Nepco, Nucor, Omega, Plasti-Bond, Perma-Cote, Pittsburgh, Sedco, Spang, Square-D, Thomas & Betts, Western Tube and Wheatland, Walker and Wiremold.
- B. Surface-mount Raceways: Hubbell, Mono-Systems, Panduit, Tehalit and Wiremold.
- C. Boxes and Fittings: Appleton, Atkore (AFC, Allied, Power Strut, TJ Cope), Cantex, Eaton, ECN Korns, Hoffman, Hubbell, Keystone, Lew, Madison, nVent Caddy, Orbit Industries, Raco, Regal, Stahlin, Steel City, Thomas & Betts and Walker.
- D. Others: Where specifically listed on Drawings.

2.2 GENERAL PERFORMANCE REQUIREMENTS

- A. Minimum conduit / raceway size shall be 1/2" for all circuits.
- B. Fittings may be set-screw or compression style fittings.
- C. All fittings shall have an insulated throat bushing, no exceptions.
- D. See Section 26 05 19 - Low Voltage Conductors for information on where MC cable is allowed. Where and when allowed, it shall be installed per manufacturers instructions and NEC requirements.

2.3 RIGID METAL CONDUIT - STEEL (RMC)(IMC) - PER ANSI C80

- A. Steel: Hot-dipped galvanized rigid steel (GRC) and galvanized intermediate metallic conduit (IMC) with zinc-coated threads and an outer coating of zinc chromate.
- B. Fittings: Per NEMA FB 1.
 - 1. Malleable iron, either cadmium plated or hot-dipped galvanized. Die cast zinc.
 - 2. Clamps shall be steel.
 - 3. Use deflection and expansion couplings with bonding jumpers at all expansion joints where required.

2.4 RIGID METAL CONDUIT - ALUMINUM (RAC) - PER ANSI C80

- A. Aluminum: Rigid aluminum conduit shall be threaded only.
- B. Fittings: Per NEMA FB 1
 - 1. Aluminum fittings required.
 - 2. Use deflection and expansion couplings with bonding jumpers at all expansion joints where required.
- C. Conditions: Aluminum conduit shall not be installed in direct contact with concrete or masonry construction.

2.5 PVC COATED RIGID METAL CONDUIT - NEMA RN 1

- A. Steel: Galvanized rigid steel conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6 and ETL PVC-001.
- B. Fittings: Per NEMA FB 1.
 - 1. Malleable iron or steel, PVC coated (40 mils) exterior, urethane coated (2 mils) interior.
 - 2. Use fittings listed and labeled as complying with UL 514B.
- C. Conditions: The installer shall be certified by a manufacturer to install coated conduit.

2.6 ELECTRICAL METALLIC TUBING (EMT) - ANSI C80.3

- A. Galvanized thin wall steel or aluminum tubing.
- B. Fittings: Per NEMA FB 1.
 - 1. Die cast zinc, pressure cast, malleable iron or steel. Clamps shall be steel. Where aluminum tubing is allowed, aluminum fittings are required unless otherwise noted.
- C. Conditions: Aluminum conduit shall not be installed in direct contact with concrete or masonry construction.

2.7 RIGID NONMETALLIC CONDUIT (RNC)

- A. PVC: Schedule 40 PVC, NEMA TC 2, high impact resistant.
- B. RTRC: Fiberglass, NEMA TC 14, standard wall.
- C. Fittings: Per NEMA TC 3 & 14, solvent weld socket type.
- D. Conditions: Do NOT use PVC for elbows in sizes 1-1/2" and larger.

2.8 FLEXIBLE METAL CONDUIT (FMC)

- A. Steel: Spiral-wound, square interlocked, hot-dipped galvanized steel.
- B. Aluminum: Spiral-wound, square interlocked aluminum.
- C. Fittings: Per NEMA FB 1.
 - 1. Cadmium plated two-screw, double-clamp malleable iron. Hot-dipped galvanized two-screw, double-clamp malleable iron. Pressure cast. Steel cast. Zinc coated, aluminum.

2.9 LIQUID-TIGHT FLEXIBLE METAL CONDUIT (LFC)

- A. Steel: Spiral-wound, square interlocked, hot-dipped galvanized steel strip with a bonded outer jacket of PVC.
- B. Fittings: Per NEMA FB 1.
 - 1. Cadmium plated, compression type, malleable iron. Hot-dipped galvanized, compression type, malleable iron. Terminations shall be insulated throat type.
 - 2. Aluminum: Copper free (1% or less).

2.10 WIREWAYS / GUTTERS

- A. Steel: Not less than 16-gauge sheet steel. Size and length shall be as indicated on drawings. Otherwise, provide dimensions per NEC 366 and NEC 376, but never smaller than four (4) inches by four (4) inches. Construction shall be oil-tight, dust-tight and rain-tight with hinged fully gasketed cover. Finish shall be ANSI gray epoxy paint over rust-inhibiting prime coat.
- B. Fittings: Lay-in type with removable top, bottom and sides, captive screw drip shield.

2.11 SURFACE RACEWAYS - SINGLE CHANNEL

- A. Steel: Not less than 0.04" thickness sheet steel. One piece for up to seven (7) - #12 AWG wire capacity. Two (2) piece for eight (8) or more - #12 AWG wire capacity. In unfinished spaces, finish shall be enamel over rust-inhibiting prime coat, not less than 0.25 square inch cross section.
- B. PVC: Rigid PVC, not less than 0.20 square inch cross section. Two (2) piece construction, minimum five (5) - #12 AWG wire capacity.
- C. Finish: In all spaces, coordinate color with Owner's Representative.
- D. Fittings: Provide all required manufacturer's standard accessories and fittings for a complete installation.

2.12 SURFACE RACEWAYS - DUAL CHANNEL

- A. Aluminum: Two compartment, with receptacles and data devices as noted on electrical and technology drawings.
- B. PVC: Wiremold 4320, Panduit T-70 non-metallic raceway or similar, two compartment, with receptacles and data devices as noted on electrical and technology drawings.
- C. Finish: In all spaces, all faceplates and coverings should be white. Coordinate color with Owner's Representative.
- D. Fittings: Provide all required manufacturer's standard accessories and fittings for a complete installation.

2.13 GENERAL OUTLET / BACK BOX / JUNCTION BOX

- A. All boxes shall meet NEMA OS 1 (metallic) and NEMA OS 2 (nonmetallic).
- B. Cast Boxes: NEMA FB 1, Type FS or FD malleable iron or aluminum. Furnish gasketed cover by box manufacturer and provide threaded hubs.
- C. Masonry Boxes: Shall have gang capacity and extension ring covers to match the number of devices installed.
- D. Floor-mounted Back Boxes: Shall be adjustable and gasketed.
- E. Outlet and Pull Boxes: Single or ganged back boxes.
 - 1. Interior: Standard box shall be 2-1/8" deep or better. Use 3-1/2" deep boxes as needed and 1-1/2" shallow boxes as required for wall depth.
 - 2. Exterior: Standard box shall be 3-1/2" deep NEMA 3R or better.
 - 3. In Ground or Concrete: NEMA 4 cast iron box with external recessed flanged cover. Depth as required.
- F. Box Ganging: Gang type boxes shall be used where multiple devices are located adjacent to one another, including ceiling, wall and cast in floor boxes.
- G. Box Barriers: In boxes with multiple switches, where the voltage between adjacent switches exceeds 150 volts to ground, provide an enclosure equipped with identified, securely installed barriers between adjacent devices.
- H. Wall Plates: As specified in Section 26 27 26 - Wiring Devices.

2.14 PULL / SPLICE BOXES AND HAND HOLES

- A. Surface Mounted Cast Metal Box: NEMA 250, Cast aluminum with ground flange, neoprene gasket and stainless steel cover screws.
- B. In-Ground Cast Metal Box: NEMA 250, Type 6, cast aluminum with flanged (smooth/nonskid) cover, recessed cover box for flush mounting.
- C. Handholes: Fiberglass with weatherproof nonskid cover with pre-cut 6 inch x 6 inch (150 mm x 150 mm) cable entrance at center bottom of each side.

2.15 POWER AND COMMUNICATIONS FLOOR BOXES AND POKE-THRUS:

- A. Shallow Floor Boxes: Lid to be square, color to be white
 - 1. Provide 2-gang and 4-gang: RFBA series by Walker, CFB series by Hubbell.
- B. Standard Floor Boxes: Lid to be square, color to be ____
 - 1. Provide 2-gang, 4-gang, and 6-gang: RFBx by Walker, CFBx by Hubbell.
- C. Poke-Thru Devices: Provide all telecommunications and data plates in each poke-thru as noted on the Communications Specifications and Drawings. Lid / top color to be white.
 - 1. Provide 4" and 6" with matching lid: Wiremold Evolution series, Hubbell S1Rx series.

2.16 ROOFTOP CONDUIT SUPPORTS

- A. Supports shall be adjustable height. Metal parts to be stainless steel or galvanized steel.
- B. This product shall be used ONLY when conduits are indicated on the drawings to be run on the roof.
- C. Approved Products:
 - 1. Miro Industries model #24-R-AH, 48-R-AH, 24AH and 48AH.
 - 2. PHP Systems model #PP10.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Place conduit sleeves in the cavities of walls and floor slabs for the free passage of conduits.
- B. Set all conduit sleeves in place a sufficient time ahead of concrete placement so as not to delay the work.
- C. Apply caulking for all conduit sleeves through floors and through exterior walls.
- D. Plugs or caps shall be installed before concrete placement begins.

3.2 GENERAL INSTALLATION

- A. The Drawings indicate an approximate location of boxes for switches, lighting outlets, power outlets, raceways, etc. The Drawings may not give complete and accurate information in regard to locations of such items. The exact locations shall be determined by reference to the Drawings and by actual measurements during construction of the building, subject to approval by the Owner's Representative.
- B. The Owner's Representative reserves the right to adjust locations of raceway and boxes up to six (6) feet in any direction prior to rough-in to accommodate intended purpose at no additional cost.
- C. Ground and bond all raceway and boxes in accordance with Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- D. Identify all raceway and boxes in accordance with Section 26 05 53 - Identification for Electrical Systems.
- E. All installations shall meet NEC requirements for acceptable fill ratings. NO exceptions. No derating shall be allowed without explicit permission from the EOR. Listed partitions are acceptable in gutters or similar for proper partitioning.

3.3 CONDUIT AND RACEWAY APPLICATION

- A. General Application:
 - 1. Raceway Systems: All raceway shall be verified with the AHJ before use. In the case of questionable or denied use, the contractor shall be required to use a raceway system permitted by the AHJ at no additional cost.

2. Conduit Sleeves: Provide RMC sleeves at all locations where conduits pass through beams, outside walls, fire rated walls, or structural members. The size of these sleeves shall be such as to permit readily the subsequent insertion of conduit of the proper size with adequate clearance for movement due to expansion and contraction. Where conduits pass through outside walls, the inside diameter of each pipe sleeve shall be at least 1/2" greater than the outside diameter of the service pipe. After the conduits are installed, fill the annular space between the conduit and its sleeve with a mastic or caulk. Use packing as required to accomplish this. At fire rated wall penetrations, use fire barrier.
 3. Surface-mount Raceway: Not permitted except as noted on the Drawings or in locations where concealing conduit is not possible.
 4. Wireway / Raceway: Where required or shown on the Drawings. It shall be solid, without knockouts, with hinged cover, placed so that cover is gravity closed.
 5. Branch Circuits: Shall not be installed in or under the ground floor slab unless specifically required on the Drawings or pre-approved by the EOR. No exceptions.
- B. Underground:
1. Acceptable Conduit: RMC and PVC.
 2. Fittings: All elbows shall be galvanized steel or fiberglass, no PVC. Other fittings shall match conduit material.
 3. Boxes: Shall be cast metal, concrete or fiberglass. Shall be ANSI 77 traffic rated for the location.
 - a. Street / Drive: Vehicle Tier 22 rated.
 - b. Sidewalk: Personnel or vehicle Tier 8 rated.
 - c. Grass: Personnel Light Duty rated.
 4. Conditions: Conduit risers from elbow to above grade shall be RMC.
- C. Imbedded in / Passing through concrete:
1. Acceptable Conduit: RMC.
 2. Fittings: Shall match the conduit material.
 3. Masonry Boxes: Galvanized steel masonry rated box.
 4. Conditions:
 - a. PVC allowed only where required by utility provider.
 - b. Where allowed, conduit imbedded in concrete shall not be larger than 3/4". Verify with project Structural Engineer prior to placing.
- D. Crawlspace:
1. Acceptable Conduit: PVC.
 2. Fittings: Shall match the conduit material.
 3. Boxes: Shall match the conduit material.
- E. Wet and Damp Locations:
1. Acceptable Conduit: RMC.
 2. Fittings: Shall be rated for the space and shall match the material of the conduit they are installed with.
 3. Boxes: Recessed shall match conduit material. Surface-mount shall be stainless steel.
- F. Concealed / Exposed Dry Locations:
1. Acceptable Conduit - EMT.
 2. Fittings: Shall match the conduit material.
 3. Boxes: Malleable iron or cast aluminum (type FS / FD), with threaded hubs and gasketed covers.
 4. Conditions: Do not use aluminum in cinder-fill walls.
- G. Existing Walls:
1. Acceptable Conduit:
 - a. Concealed: FMC and EMT.
 - b. Surface-Mount: Surface-Mount Raceway and EMT.
 2. Fittings: Shall match the conduit material.
 3. Conditions: Surface-mount raceway shall be used in finished spaces. EMT may be used only in unfinished spaces, unless otherwise directed on the Drawings.
- H. Indoor Equipment Connections:
1. Acceptable Conduit: FMC and LFC (Liquid-Tight FMC).

2. Fittings: Shall match the conduit material.
 3. Boxes: Shall match the conduit material.
 4. Conditions:
 - a. Where FMC or FNC are used, total length not to exceed 72" above ceiling, 48" exposed below ceiling.
 - b. In kitchen or similar spaces, use LFC unless otherwise directed on the Drawings.
 - c. Install flexible conduit to all recessed luminaires in accessible ceilings. Do not use more than four (4) flexible metal conduits per junction box to supply luminaires in a location. Do not supply a luminaire from another with any raceway or FMC. Suspend junction boxes and conduits from high roofs with hangers and trapeze.
- I. Outdoor Above Grade:
1. Acceptable Conduit: RMC.
 2. Fittings: Shall match the conduit material.
 3. Boxes: Weatherproof cast steel or cast aluminum.
 4. Conditions: Conduits may be used on a roof ONLY where indicated on the Drawings and shall be supported per the Specifications.
- J. Outdoor Equipment Connections:
1. Acceptable Conduit: LFC (Liquid-Tight FMC).
 2. Fittings: Shall be rated for the space or environment.
 3. Boxes: Shall be rated for the space or environment.
 4. Conditions: Flexible conduit types shall not exceed 72" in length.
- K. Corrosive Environments:
1. Acceptable Conduit: PVC and LFNC.
 2. Fittings & Boxes: Shall be rated for the space or environment.
 3. Conditions: Flexible conduit for equipment connections only unless otherwise noted on the Drawings.
- L. Hazardous Locations:
1. Acceptable Conduit: RMC.
 2. Conditions: All conduit, boxes, fittings, hardware, etc. shall be rated for hazardous location.
- M. Passing Through a Firewall:
1. Acceptable Conduit: EMT and RMC.
 2. Conditions: Provide fire caulking at all penetrations.

3.4 CONDUITS AND RACEWAY INSTALLATION

- A. General:
1. Unless otherwise indicated on the Drawings, conduits shall be concealed in walls, partitions and above the ceiling. In rooms where ceilings are not present or scheduled, orient conduit parallel or perpendicular to structure.
 2. Completely install each entire conduit system before pulling in any conductors. Clean the interior of every run of conduit before pulling in conductors. See Section 26 05 19 - Low Voltage Power Conductors for additional requirements for installation of conductors in raceways.
 3. Conduits shall be continuous between enclosures such as outlet, junction and pull boxes, panels, cabinets, motor control centers, etc. The conduit must enter and be secured to enclosures so that each system is electrically continuous throughout. Where knockouts are used, provide double locknuts, one on each side. At conduit terminations, provide insulated throat fittings. Where conduits terminate in equipment having a ground buss, such as in switchgear, and panelboards, provide conduit with an insulated grounding bushing.
 4. In mechanical spaces, install final equipment connections down from overhead where possible.
 5. Capping
 - a. Cap open ends of raceways until conductors are installed to prevent ingress of dirt and moisture.
 - b. Cap or close ends and unused openings in wireways and gutters.
 6. Sealing
 - a. Seal both ends of all conduits that serve as a passageway for control wiring, data, etc. through a rated wall to prevent air / gasses / contaminants from moving from one space to

- another.
 - b. Seal both ends of underground conduits as required to prevent ingress of water and other contaminants from outside.
 - c. All Sealant shall be fire caulk, putty packs, etc. to maintain the rating of the wall.
 - 7. RNC shall be adequately solvent welded at joints to form a tight, waterproof connection. Provide insulated ground wire in all PVC conduit and extend to ground buss.
 - 8. Provide two (2) spare 1 inch conduits stubbed into attic space at flush mounted electrical cabinets.
 - 9. Moisture traps: Provide junction box with drain fitting at low points in conduit system to avoid moisture traps.
 - 10. Grounding: The installation shall comply with all NEC grounding requirements. See Section 26 05 26 - Grounding and Bonding for Electrical Systems for additional grounding requirements.
 - 11. Use expansion-deflection fittings on conduits two (2) inches and larger crossing structural expansion joints and on exposed conduit runs where necessary. Provide bonding jumpers across fittings in metal raceway systems. Provide fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.
- B. Support:
- 1. Install conduits parallel and supported on unistrut or equal trapezes and anchored with split ring hangers, conduit straps or other devices specifically designed for the purpose. Wire ties are not permitted. Do not attach raceway to ceiling support wires or other piping systems.
 - 2. Securely fasten and support all conduit runs. Provide required clamps, straps, clips, hangers and brackets. Raceways installed in joists shall be secured to joists with clamps at 20'-0" maximum spacing. Raceways installed parallel to joists shall be supported by caddy clips (1 inch or smaller) or in unistrut / threaded rods / beam clamps trapeze at 15'-0" centers. Raceways installed perpendicular to bottom of joists shall be secured with individual conduit hangers at 10'-0" maximum spacing or unistrut / threaded rods / beam clamps at 15'-0" maximum centers. Raceways supported by straps at walls shall be supported per NEC. Support all raceways within one (1) foot of each box, cabinet, disconnect, bend or other raceway termination.
 - 3. Raceways shall be supported with 2-hole straps. Single hole straps are not acceptable.
 - 4. Support raceway using coated steel or malleable iron straps, clevis hangers, and split hangers.
 - 5. Support group related raceway using conduit rack system made of steel channel. Provide space on each for 25 percent additional raceways.
 - 6. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports.
- C. Raceway Spacing:
- 1. Maintain clearance between raceway and piping for maintenance purposes.
 - 2. Maintain twelve (12) inch (300 mm) clearance between raceway and surfaces with temperatures exceeding 104°F (40°C). (Excluding roof mounted conduits.)
- D. Raceway Bends:
- 1. Make bends with standard ells or conduit bent in accordance with the NEC. Make field bends using equipment designed for the particular conduit material and size involved. Bends must be free from dents or flattening. Use no more than the equivalent of three (3) 90-degree bends in any run between terminals and cabinets, or between outlets and junction boxes or pull boxes. Provide conduit bodies to make sharp changes in direction, as around beams. Provide factory elbows for bends in metal conduit larger than two (2) inch (50 mm) size.
- E. Concealed Locations:
- 1. Install concealed conduit as directly and with the largest radius bends as possible. Conceal conduit in finished areas.
- F. Pull String:
- 1. Provide a Greenlee #431 or equal (240 lbs.) nylon pulling line in conduits where wiring is not installed under Division 26 work, such as controls, signal, and similar systems. Identify both ends of the line by means of labels or tags reading "Pulling Line".
- G. Fire Rated Walls:
- 1. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping to comply with the latest applicable edition of the UL Fire Resistance Directory, Volumes I and II.

- H. Raceway Routing:
 - 1. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- I. Rooftop Installation:
 - 1. RMC installed on the roof shall be securely fastened in place and supported on approved supports at least every ten (10) feet. Additionally, conduit shall be securely fastened and supported within three (3) feet of each outlet box, junction box, device box, cabinet, conduit body, or other conduit termination.
 - 2. LFC on the roof shall be securely fastened in place by an approved means within twelve (12) inches of each box, cabinet, conduit body, or other conduit termination, and shall be supported and secured at intervals not to exceed 4.5 feet. Flexible conduit shall not lay on roof.
- J. Raceway Assemblies:
 - 1. Bring conduit to shoulder of fittings; fasten securely.
 - 2. Provide conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- K. Surface Raceway:
 - 1. Provide flat-head screws, clips, and straps to fasten raceway channel to surfaces. Mount plumb and level.
 - 2. Provide insulating bushings and inserts at connections to outlets and corner fittings.

3.5 WIREWAY AND GUTTER INSTALLATION

- A. Install wireways and surface raceways where noted or as required. Field apply a 90% grey zinc paint coating over cuts or scratches before any other finish is applied.
- B. Serve surface-mount raceways from flush outlet boxes mounted behind raceway where possible and as directed.

3.6 COMMUNICATION SYSTEMS CONDUIT INSTALLATION

- A. This Contractor shall provide all raceways and conduits for all communication systems shown and / or required per Specifications and as shown on the Electrical and Communications Drawings. Communication systems may include but are not limited to fire alarms, intercoms, data, security, antenna and media management.
- B. This contractor shall provide a conduit pathway (minimum 12" long) above ceiling for fire alarm, data, AV systems, etc. between all spaces and the corridor, where walls go to deck. Coordinate exact conduit sizes and quantities (range from one (1x) 1" to two (2x) 4" conduits) with low voltage Contractors and Installers.
- C. Raceways and conduit requirements shall be coordinated by this Contractor with each communication systems Contractor and the General Contractor.
- D. See Divisions 25, 27 and 28 for additional requirements.

3.7 BACK BOXES, OUTLETS AND FITTINGS APPLICATION

- A. Back Boxes: Sizes and configuration shall be as required for the intended service and shall conform to and be applied in accordance with NEC Table 314.16(A). Provide extension rings, expandable bars sets, supports, gaskets for weatherproof type etc., where required.
- B. Ceiling-mounted Boxes: Provide supports and attachments to properly support ceiling and bracket-type devices or luminaires. Where the box shall support the device, the box shall be rated for the weight of the device / luminaire supported.
- C. Voice & Data Outlet: Provide back boxes at each voice and data outlet. Communications wiring, device and plate to be provided by communications Contractor. See Divisions 27 and 28 for additional requirements.

3.8 BACK BOXES, OUTLETS AND FITTINGS INSTALLATION

- A. Do not connect or install outlet boxes back-to-back.
- B. Mounting height of a wall-mounted outlet box means the height from finished floor to bottom of box.
- C. Unless otherwise shown or specified, install boxes for switches at 44" and receptacles at 18" AFF. Verify door swings with Drawings and schedules and locate switches and pull stations on the strike side of the door unless otherwise noted.
- D. Where back boxes are required for switches, receptacles, data jacks, thermostats, CO₂ sensors, etc. and are shown next to each other, all devices shall be installed at the same height and, where possible, provide a gang back box and cover them with a multi-gang cover plate.
- E. Where boxes are indicated adjacent to each other, mount these boxes in a symmetrical pattern with all tops at the same elevation.
- F. Install boxes as required to facilitate cable installation in raceway systems.
- G. Provide boxes in conduit runs of more than 100 feet or as required in Division 26.
- H. Protect boxes in such a manner as to prevent foreign material, such as plaster, from entering boxes. Boxes shall be thoroughly cleaned of foreign materials before pulling conductors.
- I. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26 - Wiring Devices, as indicated on the Drawings or as indicated in the details.
- J. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- K. Accessible Ceilings: Install outlet and junction boxes no more than six (6) inches (150 mm) from ceiling access panel or from removable recessed luminaire. Provide suitable access doors for all boxes mounted above gypsum / hard or otherwise inaccessible ceilings.
- L. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- M. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- N. Install adjustable steel channel fasteners for hung ceiling outlet box.
- O. Do not fasten boxes to ceiling support wires or other piping systems.
- P. Support boxes independently of conduit.
- Q. Install gang box where more than one device is mounted together. Do not use sectional box.
- R. Provide plaster rings for all boxes in plastered walls and ceilings.
- S. Install gang box with plaster ring for single device outlets.
- T. Provide boxes so that covers are readily accessible and easily removable after completion of the installation.
- U. Provide all standard boxes, pull junction, wiring device and / or splice boxes for all systems in ceilings, walls and slabs.
- V. All low voltage systems in attic or crawl spaces specified in Division 23 / 25 are not included.
- W. At all ceiling-mounted receptacle and luminaire locations (exit light, pendants, linear direct / indirect, etc.), provide a heavy-duty dual bar hanger with ceiling ties to support the back box. Provide Cooper Industries BA50F or approved equal with appropriate back box for the application.

- X. All outlet boxes shall be mounted between joists / studs and supported by both adjacent joists / studs, not just one. All outlet boxes shall be supported by a rigid box support or mounting bracket that stretches the entire length between the joists / studs and is mechanically fastened to joists / studs at each end. Outlet boxes shall not be supported from only one side or by only one joist / stud regardless of stud material.
- Y. Plates shall cover any cracks between box and tile. Use oversize plates where necessary.
- Z. At all exit lights installed in grid ceilings (T-grid), provide a Cooper Industries BA50F or approved equal.

3.9 FLUSH BOXES

- A. Mount all outlet boxes such that finished installation with mud ring is within 1/4 inch of the finished wall or ceiling line unless otherwise indicated. Provide knockout closures to cap unused knock out holes where knock out holes have been removed. Install outlets flush with finish walls or ceiling surfaces for concealed wiring.
- B. Provide galvanized steel extension rings where required to extend the box forward in conformance to NEC requirements. Attach ring with at least two machine screws. Install electrical boxes and fittings in compliance with NEC requirements and in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that the boxes and fittings serve the intended purposes. Under no circumstances shall a conduit enter/exit an extension ring. Conduits shall enter / exit the electrical box only.
- C. Locate boxes and conduit bodies to ensure accessibility of electrical wiring. Install blank cover plates, painted to match surrounding, at pull boxes, junction boxes and all others to which no luminaire or device is to be attached.
- D. Securely fasten outlet boxes in position using clips or other suitable means. Secure boxes rigidly to the substrate upon which they are being mounted. Solidly embed boxes in concrete or masonry. Boxes shall not be permitted to move laterally, or to be supported only by EMT or conduit.

3.10 POWER AND COMMUNICATIONS FLOOR BOXES AND POKE-THRU DEVICES

- A. Provide and install all wiring, devices, back boxes, covers, plates, conduit and hardware as required for a complete installation. Do not daisy-chain floor boxes or poke-thru devices with conduits unless otherwise noted on the Drawings. See Section 26 27 26 - Wiring Devices for wiring devices to go in floor boxes.
- B. Provide duplex receptacles and associated wiring per table below unless otherwise noted on the Drawings. Provide circuits as shown on the Drawings. If powered by an isolated ground circuit, all receptacles shall be isolated ground. Provide conduits indicated in the table below from each box to nearest wall and then up to accessible attic space for power, data, A/V and other wiring.

SIZE	Recept. Qty.	Power Conduit	Data Conduits
2-gang	1x duplex	1x - 1"	1x - 1-1/4"
4-gang	2x duplex	*1x - 1"	2x - 1-1/4"
6-gang	3x duplex	*2x - 1"	3x - 1-1/4"
8-gang	4x duplex	*2x - 1"	See Plans
10-gang	5x duplex	*2x - 1"	See Plans

* or as required.

3.11 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with Section 07 84 00 - Firestopping.
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation.
- C. Locate outlet boxes to allow luminaires positioned as indicated on the Drawings.

- D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.12 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closures in unused openings in boxes.

3.13 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

3.14 EXISTING WORK

- A. For any renovation, it is intended to reuse the existing conduits if they prove to be adequate in size and integrity, unless otherwise noted on the Drawings.

END OF SECTION

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SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Identification required for electrical equipment and systems.
- B. All identification required by code or ordinance shall be provided, whether or not shown on Drawings or specified herein.

1.2 RELATED REQUIREMENTS

- A. Section 26 00 00 - Electrical
- B. Section 26 20 00 - Low-Voltage Electrical Distribution

1.3 REFERENCES AND STANDARDS

- A. ANSI Z535.4 - Safety labels and signs
- B. Federal Specification (L-P-387) - labelling, materials and color standards

1.4 SUBMITTALS

- A. Product Data:
 - 1. Submit product data for sign materials. Refer to Electrical Identification detail on the Drawings for additional information.
 - 2. Submit manufacturer's catalog literature for each product required.
 - 3. Submit Electrical Identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.

1.5 CLOSEOUT SUBMITTALS

- A. Submit per Closeout Submittals requirements in 26 00 00 - Electrical and any additional requirements listed below:
 - 1. After the owner's room number list is finalized, submit a list of all electrical identification tags. The list shall include the actual text that will appear on each tag. Include the owner's and architect's room numbers on all tags. Upon request, this list shall be submitted to the Owner's Representative for review.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of three (3) years experience.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Accept identification products on site in original containers. Inspect for damage.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General Requirements:
 - 1. Lettering shall be Arial font.
 - 2. All means of identification referenced in this section shall be of sufficient durability to withstand the environment per NEC 110.21. Where plastic is used outdoors, it shall be UV rated or treated.
 - 3. Colors shall conform to FS L-P-387.
 - 4. Thickness for signs and engraved labels shall be 1/16" thick minimum.
- B. Signs: For identifying multiple electrical services.
 - 1. Outdoors: Aluminum.
 - 2. Indoors: Plastic.
 - 3. Appearance: White with black lettering, lettering to be 1/4" tall minimum.
- C. Equipment Labels: For panelboards, switchboards, switchgear, disconnects, equipment, etc.
 - 1. Outdoors: UV rated engravable plastic (L-P-387).
 - 2. Indoors: Engravable plastic (L-P-387).
 - 3. Appearance:
 - a. Non-Emergency - White with black lettering, lettering to be 1/4" tall minimum.
 - b. Emergency - Red with black lettering, lettering to be 1/4" tall minimum.
- D. Electrical Safety Labels: For arc flash labelling.
 - 1. Inside building or enclosure to be self-adhesive vinyl.
 - 2. Appearance: Industry standard colors and layout.
- E. Marker Labels / Sleeves: For circuit identification and other labelling.
 - 1. Marker Label - 2" or wider write-on marker label with white writing portion and clear laminating portion for protection.
 - 2. Marker Sleeves - 2" or wider sleeve colored to identify electrical systems per requirements in Part 3.
- F. Wire Markers: For circuit or voltage identification.
 - 1. Conductor Marking: Electrical tape.
 - 2. Circuit Marking: Tubing type, cloth tape, split sleeve.
 - 3. Appearance: Colors to match requirements in Part 3.
- G. Underground Warning Tape:
 - 1. Four (4) inch wide plastic tape.
 - 2. Appearance: Colored red and yellow with suitable warning legend describing buried electrical lines.
- H. Mechanical Fasteners: Stainless steel screws, non-corroding pop rivets.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate with the Owner's Representative to obtain a list of the finalized owner's room number list before ordering identification tags.
- B. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 APPLICATION OF EQUIPMENT LABELLING

- A. Main Service Disconnecting Means:
 - 1. Mark the label on the main service disconnecting means with the calculated fault current listed on the panel schedule along with the issue date of the Drawings per NEC 110.24(A). The calculated fault current shall be labelled "Maximum Fault Current" and the date shall be labelled "Date Calculations Performed".
 - 2. Provide a sign at each service at each structure per NEC 230.2(E).
- B. Panelboards, Switchboards, Switchgear:

1. Circuit directory shall be frame mounted inside the door with heat-resistant transparent face and a directory card that is type written and completely filled out.
 2. Circuit directory shall coordinate each breaker with the proper load served. Each circuit shall be uniquely identifiable per NEC 408.4(A) including room numbers. Room numbers shall be as directed by Owner.
 3. Circuit directory shall indicate all spares and spaces in erasable pencil.
 4. Equipment Label shall indicate the high leg per NEC 408.3.
- C. Instantaneous Fault Current (AIC): Electrician to field-mark the equipment labels with the calculated instantaneous fault current (as shown on panel boards) per NEC 110.24(A) and use the issue date of the drawings as the calculation date.
- D. When series rated panels are specifically allowed, provide a label affixed by the manufacturer indicating the tested and approved series rating combinations per NEC 240.86. Provide an additional label affixed behind the panel door to be field marked in accordance with NEC 110.22(C).

3.3 INSTALLATION OF EQUIPMENT IDENTIFICATION

- A. General:
1. Install all identification per manufacturer's installation instructions, NEC and NECA standards.
 2. Install all labels in an easily visible location and parallel to equipment lines.
 3. Provide signs and tags for equipment requiring identification as shown on Drawings and for equipment as required by the NEC.
 4. All signs and tags to be mechanically fastened. Double-sided tape or other fastening methods are not acceptable.
 5. Provide for each main disconnect not grouped together.
 6. Install signs on outside of cover for safety switches and time clocks.
 7. Install signs on outside top, not on door, and at each circuit for panelboards, switchboards and motor control centers.
 8. All labeling identification shall contain both the owner's and architect's room names and numbers. Coordinate with General Contractor to secure construction room numbers.
 9. Provide all additional signage required by the AHJ at no cost to the Owner.
 10. Install identification only when ambient temperature and humidity conditions are within range recommended by the manufacturer.
- B. Conduit Identification:
1. When any of the below systems are required to be run in conduits (per Drawings, Div. 27, Div. 28, AHJ or Owner Requirements), conduits shall be colored with painted band, marker labels or marker sleeves every ten feet (10') maximum and at back box locations using paint or marker labels. All colors shall be by system per the below list:
 - a. Fire Alarm System: Red
 - b. Voice / Data cabling: Blue
 - c. Security System: Green
 - d. Intercom, A/V, etc. (Media Mgmt.): Yellow
 - e. CATV / MATV: Black
 - f. Lighting Controls: Orange
- C. Back Box Cover Identification:
1. When any of the below systems are required to be run in conduits (per Drawings, Div. 27, Div. 28, AHJ or Owner Requirements), identify the back box covers per system. by painting the entire cover or by using marker labels. Marker labels not acceptable for back box covers for Fire Alarm. See below for colors.
 2. Cover Identification: Paint the entire cover or use marker labels. Marker labels not acceptable for back box covers for Fire Alarm. See below for colors.
 3. Back Box Cover Information: Label the back box with the source panel and circuiting using Marker Labels or Sharpie. Label as "Future Use" if there are no conductors pulled.
 4. Back Box Cover Color:
 - a. Fire Alarm System: Red
 - b. Voice / Data cabling: Blue
 - c. Security System: Green

- d. Intercom, A/V, etc. (Media Mgmt.): Yellow
 - e. CATV / MATV: Black
 - f. Lighting Controls: Orange
 - g. Other (unless otherwise specified herein): White
- D. Electrical Distribution Nameplates:
- 1. Application: Panelboards, Switchboards, Switchgear, Transformers, MCCs, etc.
 - 2. Identification: Sign or Equipment Label with mechanical fasteners, per NEC 408.4(B).
 - 3. Information shall include (Example in parenthesis):
 - a. Panel designation (CHAC).
 - b. Voltage, phase and wires (277/480v 3ph 4w).
 - c. Source of service (Fed from MSB).
- E. Electrical Equipment Nameplates:
- 1. Application: Safety switches, disconnects for HVAC, motors, time clocks, water heaters, etc. and enclosure for controls, relays, contactors, solenoids, other electrical assemblies.
 - 2. Identification: Sign or Equipment Label with mechanical fasteners.
 - 3. Information shall include (Example in parenthesis):
 - a. Load served (A/H #C206) or (Parking Lot Lighting).
 - b. Voltage and phase (480v 3ph).
 - c. Circuits used (CHAC-15,17,19).

END OF SECTION

SECTION 26 05 73
POWER SYSTEM STUDIES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Provide calculation of various parameters of the new and / or existing electrical system along with feedback to the Electrical Contractor to ensure:
 - 1. Proper adjustment of all adjustable breakers for efficient operation.
 - 2. Proper labelling for equipment and personnel safety.
- B. Provide Protective Device Coordination Studies.
- C. Provide Arc Flash analysis with proper equipment labelling.

1.2 RELATED REQUIREMENTS

- A. Section 26 00 00 - Electrical

1.3 REFERENCES AND STANDARDS

- A. ANSI / IEEE Standard 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
- B. NFPA 99 – Health Care Facilities Code.

1.4 COORDINATION

- A. Coordinate special tests and / or equipment start-up as specified or implied in related sections.

1.5 CLOSEOUT SUBMITTALS

- A. Submit per Closeout Submittals requirements in 26 00 00 - Electrical and any additional requirements listed below:

PART 2 - PRODUCTS

2.1 PERFORMANCE / DESIGN CRITERIA

- A. Submit studies in accordance with ANSI / IEEE Standard 242.
- B. Submit one-line diagram for each electrical service. Key all equipment and components on diagram to items in the studies.

PART 3 - EXECUTION

3.1 GENERAL

- A. This Contractor shall coordinate with the submitted equipment manufacturer to provide the below studies per the requirements in the Specifications. This Contractor shall coordinate all wire and conduit sizes and feeder lengths to the equipment manufacturer for the purposes of conducting the studies.
- B. The submitted equipment manufacturer shall provide the below studies, complete with a report including any cautionary items, equipment adjustments and proper equipment labels.

3.2 APPLICATION

- A. Short-Circuit Current Study (SCCS):
1. Provide a short-circuit current analysis for each main switchboard and all downstream distribution as required to complete the breaker coordination study and arc flash study requirements below. Short-circuit analysis shall calculate short-circuit levels at service transformer secondary, switchboard main breaker, each feeder breaker and all levels of downstream distribution equipment. Assume infinite source buss at the utility transformer primary if the primary short-circuit current information cannot be obtained from the utility company.
 2. Coordinate the Short Circuit Current Ratings (SCCR / Withstand Rating) of mechanical equipment with the available short circuit current. The SCCR of all electrical and mechanical equipment shall exceed the available short circuit current.
 3. Label each switchboard and panelboard with the Instantaneous Fault Current per Section 26 05 53 - Identification for Electrical Systems.
- B. Overcurrent Protective Device Coordination Study (Breaker Coordination) (BCS):
1. Provide a time-current coordination study for each system. Coordination study shall compare the operating levels and times of the protective devices to the withstand levels and times that the equipment can sustain without damage or failure. Determine electronic trip unit settings necessary to achieve optimal selective coordination throughout the entire electrical distribution system. Determine setting for all adjustments of trip units of all electronic circuit breakers that are linked by zone-selective interlocking.
 2. Provide a breaker coordination study for the entire electrical distribution system when any of the following happen:
 - a. Where service entrance equipment is added or changed.
 - b. Where distribution panels or sub-panels are added or changed.
 - c. Where feeders are changed.
 - d. Where the utility transformer is changed.
 3. Provide a breaker coordination study for all affected electrical distribution equipment including switchboards, panelboards, MCCs, disconnects, safety switches, etc. when any of the following happen:
 - a. Where electrical panels are added or changed but the service entrance equipment is not changed.
 - b. Where any mechanical equipment is changed including chillers, cooling towers, air handlers, condensers, pumps, or rooftop units.
 4. Submit the short circuit and OCPD coordination to the AHJ / city upon request. The level of detail and format shall conform to city requirements.
 5. Adjust settings of adjustable circuit breakers to achieve selective coordination of the system. Notify the Engineer if selective coordination cannot be achieved.
 6. Overcurrent Protective Device Coordination Study shall be performed in accordance with NEC and NFPA 99.
- C. Arc Flash Hazard Study (AFHS):
1. This contractor required to provide, as a part of this project, an arc flash and fault study with all required labels for the service entrance equipment and all downstream electrical panelboards and switchboards per NEC 110.16 and 110.21(B).
 2. This requirement may be met by one of the following methods:
 - a. Coordinate this requirement with the equipment manufacturer to provide both the study and the required labels. (usually less expensive)
 - b. Hire a qualified firm to provide the study and labels.

END OF SECTION

SECTION 26 08 00

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Commissioning:
1. Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent and the owner's operational needs. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:
 - a. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
 - b. Verify and document proper performance of equipment and systems.
 - c. Verify that O&M documentation is complete.
 - d. Verify that the Owner's operating personnel are adequately trained
 2. The systems to be commissioned include: electrical switchgear and panels, emergency power systems (if included), UPS Systems (if included), electrical and lighting controls, fire alarm system, and life safety systems and controls.
 3. Commissioning requires the participation of affected Division contractors to ensure that all systems are operating in a manner consistent with the Contract Documents. All affected Division contractors shall be familiar with all parts of the commissioning plan issued by the CA (Commissioning Authority) and shall execute all commissioning responsibilities assigned to them in the Contract Documents.
 4. Commissioning Team:
 - a. The members of the commissioning team consist of the Commissioning Authority (CA), the designated representative of the owner, the General Contractor (GC or Contractor), the Architect and Design Engineers, the Mechanical Contractor (MC), the Electrical Contractor (EC), the Controls Contractor (CC), the Fire Alarm Contractor, and any other installing subcontractors or suppliers of equipment. The Owner's building or plant operator/engineer is also a member of the commissioning team.

1.2 COMMISSIONING AUTHORITY

- A. The commissioning authority and/or agency shall be selected and employed by the building owner. The commissioning agent shall be a licensed professional engineer in the State where the work will be performed, and shall be experienced in the commissioning of mechanical and electrical systems of the type installed in this project. Experience in construction process, direct digital control systems, test and balance and ASHRAE Guideline 1 - 1998 is mandatory. The commissioning agent shall not be associated with or employed by a mechanical contractor, or equipment supplier.

1.3 COMMISSIONING PLAN

- A. Commissioning Plan:
1. The commissioning plan provides guidance in the execution of the commissioning process. Just after the initial commissioning scoping meeting the CA will provide the plan, which will continue to evolve and expand as the project progresses. The Specifications will take precedence over the Commissioning Plan.
- B. Commissioning Process:
1. The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur.
 2. Commissioning during construction begins with a scoping meeting conducted by the CA where the commissioning process is reviewed with the commissioning team members.

3. Additional meetings will be required throughout construction, scheduled by the CA with necessary parties attending, to plan, scope, coordinate, schedule future activities and resolve problems. Generally, these meetings will be included with or will be sequential with regular subcontractor meetings.
4. Equipment documentation is submitted to the CA during normal submittals, including detailed start-up procedures.
5. The CA works with the Subs in developing startup plans and startup documentation formats, including prefunctional checklists to be completed, during the startup process.
6. In general, the checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels with prefunctional checklists being completed before functional testing.
7. The Subcontractors, under their own direction, execute and document the prefunctional checklists and perform startup and initial checkout. The CA documents that the checklists and startup were completed according to the approved plans. This may include the CA witnessing start-up of selected equipment and systems.
8. The installing contractors, suppliers and manufacturers, develops specific equipment and system functional performance test procedures with the assistance of the CA.
9. The procedures are executed by the Subcontractors, under the direction of, and documented by the CA.
10. Items of non-compliance in material, installation or setup are corrected at the Subcontractor's expense and the system retested.
11. The CA reviews the O&M documentation for completeness. All O&M documentation must be submitted and approved before the start of training.
12. Commissioning shall be completed before Substantial Completion.
13. The CA reviews, pre-approves and coordinates the training provided by the Subs and verifies that it was completed.
14. Deferred testing is conducted, as specified or required.

1.4 RESPONSIBILITIES

- A. General Contractor (GC):
 1. Facilitate the coordination of the commissioning work by the CA, and with the CA ensure that commissioning activities are being scheduled into the master schedule.
 2. Include the cost of commissioning in the contract price.
 3. Furnish a copy of all construction documents, addenda, change orders and approved submittals and shop drawings related to commissioned equipment to the CA.
 4. In each purchase order or subcontract written, include requirements for submittal data, Systems/O&M data, commissioning tasks and training.
 5. Ensure that all Subs execute their commissioning responsibilities according to the Contract Documents and schedule.
 6. A representative shall attend a commissioning scoping meeting and other necessary meetings scheduled by the CA to facilitate the Commissioning process.
 7. Coordinate the training of owner personnel.
 8. Prepare Systems/O&M manuals and Systems manuals, according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
- B. Warranty Period:
 1. Ensure that Subcontractors execute seasonal or deferred functional performance testing, witnessed by the CA, according to the specifications.
 2. Ensure that Subs correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.
- C. Electrical Contractors and Sub-Contractors:
 1. The commissioning responsibilities applicable to each of the subcontractors are generally as follows (all references apply to commissioned equipment only). Specific requirements are shown in the appropriate Divisions.
 2. Construction and Acceptance Phases
 - a. Include the cost of commissioning in the contract price.
 - b. In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, Systems/O&M data and training.

- c. Attend a commissioning scoping meeting and other meetings necessary to facilitate the Commissioning process.
 - d. Contractors shall provide the CA with normal cut sheets and shop drawing submittals of commissioned equipment as part of the normal submittal process.
 - e. Provide additional requested documentation, prior to normal O&M manual submittals, to the CA for development of start-up and functional testing procedures.
 - 1) Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Authority.
 - 2) The Commissioning Authority may request further documentation necessary for the commissioning process.
 - f. Provide a copy of the Systems/O&M manuals and submittals of commissioned equipment, through normal channels, to the CA for review and approval.
 - g. Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
 - h. Provide assistance to the CA in preparing the specific functional performance test procedures. Subs shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
 - i. Develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the prefunctional checklists from the CA for all commissioned equipment. Submit to CA for review and approval prior to startup.
 - j. During the startup and initial checkout process, execute the prefunctional checklists for all commissioned equipment.
 - k. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CA.
 - l. Address current A/E punch list items before functional testing
 - m. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem solving.
 - n. Perform functional performance testing under the direction of the CA for specified equipment. Assist the CA in interpreting the monitoring data, as necessary.
 - o. Correct deficiencies (differences between specified and observed performance) as interpreted by the CA, and A/E and retest the equipment.
 - p. Prepare Systems/O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
 - q. Prepare redline as-built drawings for all drawings and final as-builds for contractor-generated coordination drawings.
 - r. Provide training of the Owner's operating personnel as specified.
 - s. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
- D. Warranty Period:
- 1. Execute seasonal or deferred functional performance testing, witnessed by the CA, according to the specifications.
 - 2. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.
- E. Equipment Suppliers:
- 1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
 - 2. Assist in equipment testing per agreements with Subs.
 - 3. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid

- price to the Contractor, except for stand-alone data logging equipment that may be used by the CA.
4. Provide information requested by CA regarding equipment sequence of operation and testing procedures.
 5. Review test procedures for equipment installed by factory representatives.
- F. Commissioning Authority (CA):
1. The CA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CA may assist with problem-solving non-conformance or deficiencies, but ultimately that responsibility resides with the general contractor and the A/E. The primary role of the CA is to develop and coordinate the execution of a testing plan, observe and document performance - that systems are functioning in accordance with the documented design intent and in accordance with the Contract Documents. The Contractors will provide all tools or the use of tools to start, checkout and functionally test equipment and systems, except for specified testing equipment supplied and installed by the CA.
 - a. Coordinates and directs the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.
 - b. Coordinate the commissioning work and, with the GC, ensure that commissioning activities are being scheduled into the master schedule.
 - c. Revise, as necessary, Commissioning Plan-Construction Phase.
 - d. Plan and conduct a commissioning scoping meeting.
 - e. Request and review additional information required to perform commissioning tasks, including Systems/O&M materials, contractor start-up and checkout procedures.
 - f. Before startup, gather and review the current control sequences and interlocks and work with contractors and design engineers until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.
 - g. Review and approve normal Contractor submittals applicable to systems being commissioned for compliance with commissioning needs, along with A/E reviews.
 - h. Perform site visits, as necessary, to observe component and system installations. Attend selected planning and job-site meetings to obtain information on construction progress. Review construction meeting minutes for revisions/substitutions relating to the commissioning process. Assist in resolving any discrepancies.
 - i. Approve pre-functional tests and checklist completion by reviewing prefunctional checklist reports and by selected site observation and spot checking.
 - j. Approve systems startup by reviewing start-up reports and by selected site observation.
 - k. Review the functional performance test procedures for equipment and systems developed by the subcontractors and suppliers. This may include energy management control system trending, or manual functional testing.
 - l. Coordinate, witness and approve manual functional performance tests performed by installing contractors. Coordinate retesting as necessary until satisfactory performance is achieved.
 - m. Review equipment warranties to ensure that the Owner's responsibilities are clearly defined.
 - n. Oversee and approve the training of the Owner's operating personnel.
 - o. Compile and maintain a commissioning record.
 - p. Review and approve the preparation of the Systems/O&M manuals.
 - q. Provide a final commissioning report.

1.5 WARRANTY PERIOD

- A. Coordinate and supervise required seasonal or deferred testing and deficiency corrections.
1. Return to the site at 10 months into the 12-month warranty period and review with facility staff the current building operation and the condition of outstanding issues. Also interview facility staff and identify problems or concerns they have operating the building as originally intended. Make suggestions for improvements and for recording these changes in the Systems/O&M manuals. Identify areas that may come under warranty or under the original construction contract. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.
- B. Scheduling:

1. The CA will work with the GC according to established protocols to schedule the commissioning activities. The CA will provide sufficient notice to the CM and GC for scheduling commissioning activities. The GC will integrate all commissioning activities into the master schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Division contractor for the equipment being tested.
- B. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and left on site.
- C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications.

PART 3 - EXECUTION

3.1 MEETINGS

- A. Scoping Meeting:
 1. Within 90 days of commencement of construction, the CA will schedule, plan and conduct a commissioning scoping meeting with the entire commissioning team in attendance. Meeting minutes will be distributed to all parties by the GC. Information gathered from this meeting will allow the CA to revise the Commissioning Plan to its "final" version, which will also be distributed to all parties.
- B. Miscellaneous Meetings:
 1. Other meetings will be planned and conducted by the CA as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with particular subs. The CA will plan these meetings and will minimize unnecessary time being spent by Subs.

3.2 REPORTING

- A. The CA will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through memos, progress reports, etc.
- B. Testing or review approvals and non-conformance and deficiency reports are made regularly with the review and testing as described in later sections.
- C. A final summary report by the CA will be provided focusing on evaluating commissioning process issues and identifying areas where the process could be improved. All acquired documentation, logs, minutes, reports, deficiency lists, communications, findings, unresolved issues, etc., will be compiled in appendices and provided with the summary report.

3.3 SUBMITTALS

- A. The CA will provide appropriate contractors with a specific request for the type of submittal documentation the CA requires to facilitate the commissioning work. These requests will be integrated into the normal submittal process and protocol of the construction team. At minimum, the request will include the manufacturer and model number, the manufacturer's printed installation and detailed start-up procedures, full sequences of operation, Systems/O&M data, performance data, any performance test procedures, control drawings and details of owner contracted tests. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Authority. All documentation requested by the CA will be included by the Subs in their Systems/O&M manual

contributions.

- B. The Commissioning Authority will review and approve submittals related to the commissioned equipment for conformance to the Contract Documents as it relates to the commissioning process, to the functional performance of the equipment and adequacy for developing test procedures. This review is intended primarily to aid in the development of functional testing procedures and only secondarily to verify compliance with equipment specifications. The Commissioning Agent will notify the appropriate persons as requested, of items missing or areas that are not in conformance with Contract Documents and which require resubmission.
- C. The CA may request additional design narrative from the A/E and Controls Contractor, depending on the completeness of the design intent documentation and sequences provided with the Specifications.

3.4 START-UP, PREFUNCTIONAL CHECKLISTS AND INITIAL CHECKOUT

- A. The following procedures apply to all equipment to be commissioned. Some systems that are not comprised so much of actual dynamic machinery may have very simplified PCs and startup.
- B. General:
 - 1. Prefunctional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are used. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
- C. Start-up and Initial Checkout Plan:
 - 1. The CA shall assist the commissioning team members responsible for start-up of any equipment in developing detailed start-up plans for all equipment. The primary role of the CA in this process is to ensure that there is written documentation that each of the manufacturer-recommended procedures have been completed. Parties responsible for prefunctional checklists and start-up are identified in the commissioning scoping meeting and in the checklist forms. Parties responsible for executing functional performance tests are identified in the testing requirements.
 - a. The CA assist in the development of checklists that indicate required procedures to be executed as part of start-up and initial checkout of the systems and the party responsible for their execution.
 - b. The Contractor determines which trade is responsible for executing and documenting each of the line item tasks and notes that trade on the form. Each form may have more than one trade responsible for its execution.
 - c. The subcontractor responsible for the purchase of the equipment develops the full start-up plan by combining (or adding to) the CA's checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.
 - d. The full start-up plan could consist of something as simple as:
 - 1) The contractor and CA prefunctional checklists.
 - 2) The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
 - 3) The manufacturer's normally used field checkout sheets.
 - e. The subcontractor submits the full startup plan to the CA for review and approval.
 - f. The CA reviews and approves the procedures and the format for documenting them, noting any procedures that need to be added.
 - g. The full start-up procedures and the approval form may be provided to the CM for review and approval, depending on management protocol.
- D. Execution of Prefunctional Checklists and Startup:
 - 1. Four weeks prior to startup, the Subs and vendors schedule startup and checkout with the GC and CA. The performance of the prefunctional checklists, startup and checkout are directed and

- executed by the Sub or vendor. When checking off prefunctional checklists, signatures may be required of other Subs for verification of completion of their work.
2. The CA shall observe, at minimum, the procedures for each piece of primary equipment, unless there are multiple units, (in which case a sampling strategy may be used as approved).
 3. For lower-level components of equipment the CA shall observe a sampling of the prefunctional and start-up procedures.
 4. The Subs and vendors shall execute startup and provide the CA with a signed and dated copy of the completed start-up and prefunctional tests and checklists.
 5. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item off.
- E. Deficiencies, Non-Conformance and Approval in Checklists and Startup:
1. The Subcontractors shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the CA within two days of test completion.
 2. The CA shall work with the Subcontractors and vendors to correct and retest deficiencies or uncompleted items. The CA will involve the CM or GC and others as necessary. The installing Subcontractors or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CA as soon as outstanding items have been corrected and resubmit an updated start-up report and a Statement of Correction on the original non-compliance report. When satisfactorily completed, the CA recommends approval of the execution of the checklists and startup of each system using a standard form.

3.5 FUNCTIONAL TESTING

- A. This sub-section applies to all commissioning functional testing for all divisions.
1. Objectives and Scope:
 - a. The objective of functional testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems.
 - b. In general, each system should be operated through all modes of operation where there is a specified system response. Verifying each sequence in the sequences of operation is required.
 2. Development of Test Procedures:
 - a. Before test procedures are written, the CA shall obtain all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. Each Sub or vendor responsible to execute a test, shall provide assistance to the CA in developing the procedures review (answering questions about equipment, operation, sequences, etc.). Prior to execution, the CA shall provide a copy of the test procedures to the Sub(s) who shall review the tests for feasibility, safety, equipment and warranty protection. The CA may submit the tests to the A/E for review, if requested.
 - b. The purpose of any given specific test is to verify and document compliance with the stated criteria of acceptance given on the test form.
 3. Test Methods:
 - a. Functional testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results. The CA will determine which method is most appropriate for tests that do not have a method specified.
 4. Coordination and Scheduling:
 - a. The Subs shall provide sufficient notice to the CA regarding their completion schedule for the prefunctional checklists and startup of all equipment and systems. The CA will schedule functional tests through the GC and affected Subcontractors. The CA shall direct, witness and document the functional testing of all equipment and systems. The Subs shall execute the tests.
 - b. In general, functional testing is conducted after prefunctional testing and startup has been satisfactorily completed. Testing proceeds from components to subsystems to systems. When

the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.

3.6 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

- A. Documentation:
1. The CA shall witness and document the results of all functional tests using the specific procedural forms developed for that purpose. Prior to testing, these forms are provided to the GC for review and approval and to the Subs for review. The CA will include the filled out forms in the Commissioning Report.
- B. Non-Conformance:
1. The CA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported on a standard non-compliance form.
 2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CA. In such cases the deficiency and resolution will be documented on the procedure form.
 3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures.
 4. As tests progress and a deficiency is identified, the CA discusses the issue with the executing contractor.
 - a. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:
 - 1) The CA documents the deficiency and the Sub's response and intentions and they go on to another test or sequence
 - b. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
 - 1) The deficiency shall be documented on the non-compliance form with the Sub's response and a copy given to the GC and to the Subcontractor representative assumed to be responsible.
 - 2) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the Owner.
 - 3) Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the CA. The CA reschedules the test and the test is repeated until satisfactory performance is achieved.
- C. Cost of Retesting:
1. The cost for the Subcontractor to retest a prefunctional or functional test, if they are responsible for the deficiency, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the GC.
 2. The Contractor shall respond in writing to the CA at least as often as commissioning meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.
 3. The CA retains the original non-conformance forms until the end of the project.
- D. Failure Due to Manufacturer Defect:
1. If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable. In such case, the Contractor shall provide the Owner with the following:
 - a. Within one week of notification, the Contractor or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided within two weeks of the original notice.
 - b. Within two weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.

- c. The Owner will determine whether a replacement of all identical units or a repair is acceptable.
 - d. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.
- E. Approval:
- 1. The CA notes each satisfactorily demonstrated function on the test form. The CA recommends acceptance of each test using a standard form. The Owner gives final approval on each test using the same form, providing a signed copy to the CA and the Contractor.

3.7 SYSTEMS/OPERATION AND MAINTENANCE (O&M) MANUALS

- A. The following Systems/O&M manual requirements do not replace O&M manual documentation requirements elsewhere in these specifications.
- B. Each Division shall compile and prepare documentation for all equipment and systems covered in that Division and deliver this documentation to the GC for inclusion in the Systems/O&M manuals, according to this section, prior to the training of owner personnel.
- C. The CA shall receive a copy of the O&M manuals for review.
- D. Field checkout sheets and logs should be provided to the CA for inclusion in the Commissioning Record Book.
- E. Review and Approvals:
 - 1. Review of the commissioning related sections of the Systems/O&M manuals shall be made by the A/E and by the CA.

3.8 TRAINING OF OWNER PERSONNEL

- A. The GC shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed.
- B. The CA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment.

3.9 WRITTEN WORK PRODUCTS

- A. Written work products of Contractors will consist of the start-up and initial checkout plan described and the filled out start-up, initial checkout and prefunctional checklists, manufacturer's factory and field testing and inspection forms, contractors' inspection and functional testing forms, Systems/O&M Manuals, training plans and training records.
- B. These work products will be supplied to the CA to be included in the final commissioning report.

END OF SECTION

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SECTION 26 09 13

ELECTRICAL POWER MONITORING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Provide all metering, CTs, software and connectivity required to meter the panelboard, switchboard, switchgear or complete electrical system as described herein and on the Drawings. This system is a separate requirement from the utility metering used for billing.
- B. Metering and monitoring parameters shall include voltage, current, power, power factor, and other various metrics and store minimum, maximum and average values for each. Parameters are to be measured at 15 minute intervals and records shall be kept internally for 36 months.

1.2 RELATED REQUIREMENTS

- A. Section 26 00 00 - Electrical
- B. Section 26 20 00 - Low Voltage Electrical Distribution

1.3 SUBMITTALS

- A. Submit complete product information for the following:
 - 1. Metering
 - 2. CT's
 - 3. Software
 - 4. Statement of accuracy for all equipment.

1.4 CLOSEOUT SUBMITTALS

- A. Submit per Closeout Submittals requirements in Section 26 00 00 - Electrical and any additional requirements listed below:
 - 1. Wiring diagram of meters and current transformers.
 - 2. Topology of monitoring system if multiple meters are required including location of each meter on an overall plan or on the electrical riser diagram.

1.5 WARRANTY

- A. Provide a five (5) year manufacturer's warranty covering parts and labor for all metering and monitoring equipment. The warranty shall include all components including, but not limited to, metering, storage, CTs, software, software updates / upgrades, etc.

1.6 SPECIAL TOOLS AND SOFTWARE

- A. Provide PC-based configuration software tools and / or monitoring software tools.
- B. Provide a minimum of one communication interface cable for each type of cable required to connect to PC for configuration and monitoring.

PART 2 - PRODUCTS

2.1 ACCEPTABLE METERING MANUFACTURERS

- A. Metering and Transformers:
 - 1. Square-D
 - 2. ABB (formerly GE)
 - 3. Eaton (formerly Cutler-Hammer)

4. Siemens
5. Sonomec (Diris Digiware)
6. Leviton (or any other brand with a cloud based solution) is NOT ACCEPTABLE

2.2 GENERAL REQUIREMENTS

- A. Metering:
1. Metering may be internally or externally mounted. If externally mounted, it shall be adjacent to the buss being measured.
 2. Microprocessor based with communication port to provide monitoring functions as well as deliver inputs to EMCS (or other HVAC controller).
 3. Accuracy of ampacity, voltage and frequency shall be $\pm 0.5\%$
 4. Accuracy of watts, PF, kW demand, WH and all other properties shall be $\pm 1.0\%$
 5. Shall work for 50/60hz systems with 3 or 4 wire as project dictates.
 6. Shall be UL listed and self-protected from fault.
- B. Transformers:
1. CTs - 100/5 through 5,000/5, accuracy within $\pm 2\%$
 2. PTs - Up to 600v to be self-contained, above 600v inputs to meet project requirements
- C. Data Storage and Reporting: Shall meet below performance requirements.

2.3 PERFORMANCE REQUIREMENTS

- A. Monitoring & Alarm Requirements for the system:
1. Voltage Properties:
 - a. Phase Loss: Occurs if less than 50% of nominal line voltage is detected.
 - b. Phase Imbalance: Occurs if the maximum deviation between any two phases exceeds the amount of unbalance as a percent of nominal line voltage. Range - 5 to 40% (5% increments)
 - c. Phase Reversal: Occurs if any two phases become reversed. Range - more than one second.
 - d. Overvoltage: Occurs if incoming voltage exceeds allowed nominal line voltage range. Range - 105% to 140% (5% increments)
 - e. Undervoltage: Occurs if incoming voltage drops below allowed nominal line voltage range. Range - 95% to 60% (5% increments)
 2. Current Properties:
 - a. Phase Loss: Monitor and alarm if smallest phase current is less than 1/16 of the largest phase current.
 3. Delay: Allows existence of overvoltage, undervoltage, or voltage unbalance before an alarm or trip occurs. Range - 0-8 sec. (1 sec. increment)
 4. Percent Trip Level and Trip Time Interval: owner adjustable
 5. Alarm: Audible or visual alarm at the metering equipment or on the PC monitoring software. Ability to send an email or SMS to one or multiple recipients with alarm code.
- B. Main Service Metering:
1. Provide metering for the main service disconnecting means or Main Service Board (MSB / MDP) or group of mains with data storage and reporting on all properties listed herein.
 2. Each main service panelboard 600A to 1200A, provide base model - Square D EasyLogic PM 2200 series or approved equal.
 3. Each main service switchboard larger than 1200A, provide Base Model - Square D Power Logic PM 5563 with integrated display & Ethernet or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install meters so as to be easily removed.
- B. Provide all fuse blocks and terminal strips as required.

- C. Provide a 3/4 inch conduit to energy management control system (EMCS) panel. Engineer to decide final location. Provide 120V connection to EMCS panel. All control wiring shall be provided in accordance with other Divisions 1, 23, 25, and 27.
- D. Coordinate with owner final location of PC / software used, network connection, etc. for data reporting and energy monitoring.

END OF SECTION

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SECTION 26 09 16
ELECTRICAL CONTROL COMPONENTS

PART 1 - GENERAL

1.1 SUMMARY

1.2 SECTION INCLUDES

- A. Time switches for circulating pumps.

1.3 RELATED SECTIONS

- A. Section 26 00 00 - Electrical
- B. Section 26 05 53 - Identification For Electrical Systems
- C. Section 26 20 00 - Low Voltage Electrical Distribution

1.4 SUBMITTALS

- A. Product Data: Submit product data for time switches.
- B. Samples: Provide a non-returnable sample when requested.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Water Heater Time Clocks & Batteries:
 - 1. Tork Model EH10/20 Digital Control Clock
 - 2. Intermatic ET2725C
 - 3. Battery Backup - 9V lithium or super capacitor good for at least 100hrs.
- B. All other manufacturers shall require pre-approval in accordance with specification section 26 00 90 - Electrical Submittal Procedures.

2.2 MATERIALS

- A. Case:
 - 1. Indoor/outdoor Nema 3R enclosure made of self-extinguishing high impact plastic or steel with corrosion resistant paint.
- B. Type:
 - 1. Seven day, 24 hour, with skip a day capability. Solid state electronic type. Fully automatic with manual capability.
- C. Features:
 - 1. Contacts:
 - a. Minimum 20 amps at 120 VAC resistive.
 - 2. Backup System:
 - a. Maintain program functions for up to 7 days. Provide a new lithium battery per manufacturer's requirements.
 - 3. Events and Holiday Schedule:
 - a. Daily Minimum: 8 events (on or off) in any order
 - b. Weekly minimum: 56 events
- D. Photoelectric Control Interface:

1. Heavy duty photo control with zero cross technology
2. Mount on conduit and locate on roof where directed by Engineer.
3. Photo control to bring lights on, timer to turn off.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install near the panelboard supplying service to load per manufacturer`s direction.
- B. Mount time switch not more than 12" above top of switchgear and so that the time switch is readily accessible.
- C. Programming:
 1. Program the time switches as directed. Include programming and operating instructions in "Records for Owner" as outlined in Section 26 00 00.
 2. Instruct the Engineer in setting the switches before final inspection.
- D. Label Time Clock.

3.2 WATER HEATER TIME CLOCKS

- A. Provide a Digital Control Clock for each water heater. Located time clock in electrical room and label "Water Heater - (Location)".
- B. Provide power to each water heater time clock from the same circuit as the general purpose receptacle in the electrical room or from the same circuit as the circulation pump or from the nearest acceptable 120v circuit using a 20A breaker and #12 wire or greater.
- C. Set to Operate:
 1. On: 7:00 a.m.
 2. Off: 11:00 a.m.
 3. On: 2:00 p.m.
 4. Off: 6:00 p.m.
 5. Off: Saturdays and Sundays
- D. Timer to control both the water heater and any circulating pump. Circulating pump to run continuously as long as water heater is operational. When the water heater is intentionally turned off to conserve energy, then turn off the circulating pump.
- E. Provide mechanically held contactor for each water heater circulating pump.
- F. Provide a non-fused disconnect at each water heater. Refer to Section 26 28 16 for Enclosed Switches and Circuit Breakers.

END OF SECTION

SECTION 26 09 18

LABORATORY UTILITY SHUT-OFF SYSTEM

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Where indicated on the drawings, provide a Laboratory Utility Shut-Off System with a utility control panel and all associated equipment and accessories to operate independent of other spaces. This system shall manage the student laboratory workstation and the teachers' laboratory demonstration station utilities within the room as detailed below and as shown in the detail and drawings.
- B. The utility shut-off system shall allow the instructor to control when utilities (power, water, gas, compressed air, etc.) are available for use in a classroom, lab or prep room per applicable State Requirements. There shall be separate control for each of the following:
 - 1. Electricity, water and/or gas at student lab stations in the space.
 - 2. Additional area outlets (general purpose outlets and computer outlets around the space).
 - 3. Purge fan in the space.
 - 4. Single control for utilities (as a group) at demonstration station.
- C. This Laboratory Utility Shut-Off system shall have an emergency shut-off (EPO) feature that allows pressing a single mushroom / push-button switch in the event of an emergency to activate the purge fan (programmed for a specific duration) and shut-off all utilities in the space including additional area outlets before evacuating the room. Power for lighting shall not be controlled by this system. The EPO shall be located such that it is quickly accessible to the instructor.
- D. Provide and install all hardware, software, wiring, programming, etc. necessary to meet all features, functions, requirements, etc. as outlined in these specifications and as required by the manufacturers instructions.
- E. See Science Lab and Prep Room details in the electrical drawings and plumbing drawings for exact utilities to be controlled by this system. Provide all necessary enclosures, contactors, solenoids, wiring, etc. for a complete and working system per space.
- F. Documentation and training shall be provided to the owner as outlined in these specifications.

1.2 RELATED REQUIREMENTS

- A. Section 26 00 00 - Electrical

1.3 REFERENCES AND STANDARDS

- A. UL 429 - Electrically Operated Valves
- B. UL 508-A - Safety Standard for Industrial Control Equipment.
- C. Guide YIOZ, File MP618, Safety Valves.
- D. FM Approved to Class 7400 "Liquid and Gas Safety Shutoff Valves".
- E. Americans with Disabilities Act.

1.4 COORDINATION

- A. PRE-INSTALLATION MEETINGS
 - 1. Meet with the manufacturer of the controls on-site to review installation, wiring methods and exact equipment locations of all components prior to starting installation. At this meeting Contractor shall be trained by the manufacturer or vendor on the installation, setup and functionality of the system.

Failure to have this meeting will result in Contractor assuming full responsibility of all costs incurred to move controls and sensors, replace equipment due to product damage, costs due to installation errors or failure to meet the full intent of the design.

2. The location of switch panels, control panels, solenoid enclosures, and other components shall be coordinated between the mechanical, electrical, plumbing contractors and the fixture providers prior to the installation of conduit or piping.

1.5 SUBMITTALS

A. Product Data:

1. Drawing locating all components of the laboratory utility shut-off systems and a copy of the system schematic drawing with all associated part numbers.
2. Product data including special boxes, cable, and other material as requested by the Architect as follows:
 - a. A cover sheet with the name and location of the project, the name, address, and telephone number of the Contractor, and the name, address, and telephone number of the submitting sub-contractor. Include on or after the cover sheet sufficient space for review stamps.
 - b. Indicate any deviations from Contract Document requirements, including variations and limitations. Show any revisions to equipment layout required by use of selected equipment.
 - c. A product data index and complete equipment list including for each product submitted for approval the manufactures name and part number, including options and selections.
 - d. Cut-sheets or catalog data illustrating the physical appearance, size, function, compatibility, standards compliance, and other relevant characteristics of each product on the equipment list. Indicate by prominent notation (an arrow, circle, or other means) on each sheet the exact product and options being submitted.
 - e. Any resubmittal shall include a complete revised equipment list and any product data that is revised.

B. Equipment is not to be ordered without approval. Partial submittals are not acceptable for review.

1.6 CLOSEOUT SUBMITTALS

- A. Submit per Closeout Submittals requirements in Section 26 00 00 - Electrical and any additional requirements listed below:

1.7 WARRANTY

- A. All components shall have a 2 year factory warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The device manufacturer/model numbers indicated in this specification establish a standard of quality, function, and design.
- B. Factory configured systems with comparable layout and functions, are acceptable as equivalent as manufactured by the following:
 1. ISIMET, LLC
 2. Lab Automation Controls Systems – Dan Ursery (E&I)
 3. American Gas Safety
 4. Basic Lab Controls (BLC)

2.2 COMPONENTS

- A. Provide components below to control all utilities listed in the Science Lab or Prep Room detail and as shown on electrical, mechanical, and plumbing drawings. Lighting is not to be controlled by this system.
- B. Utility Control Cabinet with required switching and controls
 1. Classroom or lab cabinet
 - a. ISIMET 620xR series

- b. LACS Model LCP series
 - c. Approved alternative
 2. Prep room Utility Control Cabinet with required switching and controls
 - a. ISIMET LA unit with LAIP
 - b. LACS RO series
 - c. Approved alternative
 3. Custom configured panel with each control function listed above.
 4. Provide a flush mount (preferred) or surface mount control panel enclosure as required per room (class / lab / prep), factory labeled. Enclosure shall be NEMA Type 1 enclosure with a stainless-steel brushed finish or white powder coat paint finish.
 5. Provide utility control circuit outputs as required.
 6. Label each control panel shown on the plans and herein specified as "CLASSROOM" or "STUDENT LAB" or "STUDENT LAB / DEMONSTRATION" or "DEMONSTRATION ONLY" or "PREP ROOM", whatever the control panel will serve.
- C. Emergency Shut-Off (EPO) switches
 1. Manufacturers
 - a. ISIMET IP-O-C series
 - b. LACS REO series
 - c. Approved alternative
 2. Provide a stainless-steel mushroom EPO switch as shown on the plans and in the Science Lab or Prep Room details.
 3. Where mounted at exits, each switch shall have a clear hinged cover to protect them from accidental activation.
 4. Provide wiring from each switch to control cabinet.
 5. Label each EPO as "EMERGENCY SHUT-OFF".
- D. Keyed "ENABLE" / OFF / RESET switch
 1. A keyed reset switch shall be provided to control this system.
 2. Label this switch so each position is clearly identified as "ENABLE", "OFF" and "RESET"
- E. Utility and Purge Fan switches
 1. Provide switches for each function and each utility listed in the Science Lab or Prep Room detail.
 2. Each switch shall be a LED illuminated toggle switch or standard toggle switch with LED indicator lights, one light for on and another light for off. A touch screen can be used in place of the utility and purge fan switches.
 3. Label each switch according to the utility served such as – "ELECTRIC", "WATER", "FUEL GAS", "DEMO UTILITIES", "PURGE FAN", "COMP. AIR", etc.
- F. Solenoids - For Water
 1. Refer to the plumbing sheets in the project documents for solenoid valve pipe sizes. Coordinate exact size of each solenoid with plumbing contractor before ordering.
 2. $\frac{3}{4}$ " Cold water solenoids to be ISIMET S-202 or ASCO Red Hat series Buna seal general service or equivalent.
 3. 1" Cold water solenoids to be ISIMET S-203 or ASCO Red Hat series Buna seal general service or equivalent.
 4. $\frac{3}{4}$ " Hot water solenoids to be ISIMET S-502 HW or ASCO Red Hat series ethylene propylene seal hot water service or equivalent.
 5. 1" Hot water solenoids to be ISIMET S-503 HW or ASCO Red Hat series ethylene propylene seal hot water service or equivalent.
 6. Provide solenoids for hot water, cold water, gas, compressed air, etc. as required for each system and as shown on the Science Lab or Prep Room detail.
 7. Solenoids to feature a 24 VAC coil (120 VAC or 12 VAC pre-engineered systems are acceptable if controller will correctly operate them), two-wire control, normally closed. 2-3 psi differential.
 8. Solenoid valves must be mounted with solenoid shaft vertical and upright.
 9. Provide solenoid assemblies for the intended use as required (hot and cold shut-off) and pipe size construction as scheduled.
 10. All solenoids are to be located within an enclosure and factory assembled and tested.
 11. Provide water hammer arrestor in the flow stream at each domestic water service assembly.
 12. Provide a ball valve service shut-off up-stream from each solenoid and a wye-strainer.

13. Provide each solenoid with a reset fuse/switch.
- G. Solenoids - For Air
1. Refer to the plumbing sheets in the project documents for solenoid valve pipe sizes. Coordinate exact size of each solenoid with plumbing contractor before ordering.
 2. 3-way compressed air solenoids to be ASCO Red Hat Buna seal for air service up to 125 PSI catalog number 8316G064 ($\frac{1}{2}$ ") or 8316G074 ($\frac{3}{4}$ ") with 24 VAC coil, or equivalent.
 3. Provide 3-way solenoid assemblies for the intended use and pipe size construction as scheduled.
 4. Solenoids are to be located within an enclosure and factory assembled and tested.
 5. Solenoid valves must be mounted with solenoid shaft vertical and upright for proper operation.
 6. Provide each solenoid with a reset fuse/switch.
 7. Utilize only Normally Closed type solenoids designed for compressed air to ensure fail-safe operation.
 8. Solenoid to feature a 24 VAC coil (120 VAC or 12 VAC pre-engineered systems are acceptable if controller will correctly operate them), two wire control, normally closed. 2-3 psi differential.
 9. Provide a ball valve service shut-off and particulate air filter up-stream from each compressed air each solenoid.
 10. Particulate air filters to be PneumaticPlus SAF4000M-N04B (1/2" NPT) or SAF4000M-N06B (3/4" NPT) SAF4000 series particulate air filter with bracket, or equivalent.
 11. Provide on the exhaust port a quiet flow muffler/filter, designed to diffuse air and muffle noise from the exhausted port of the release valve to acceptable levels within OSHA noise requirements, utilizing a porous sintered bronze muffler directly bonded to nickel plated steel pipe thread fitting. Air muffler to be an Arrow Pneumatics ASP-4 ($\frac{1}{2}$ ") or ASP-6 ($\frac{3}{4}$ ") Pneumatic Exhaust Muffler.
 12. Install with port-P (Pressure) to compressor, port-E to exhaust muffler, and port-A (cylinder line) to the workstation distribution manifold.
 13. Refer to the plumbing sheets in the project documents for solenoid valve pipe sizes.
- H. Solenoids - For Fuel Gas
1. Refer to the plumbing sheets in the project documents for solenoid valve pipe sizes. Coordinate exact size of each solenoid with plumbing contractor before ordering.
 2. $\frac{1}{2}$ " piping - ISIMET model S-301 or ASCO model 8210G075, aluminum body with 24 VAC coil and Buna seal for gas service.
 3. $\frac{3}{4}$ " piping - ISIMET model S-302 or ASCO model 8210G076, aluminum body with 24 VAC coil and Buna seal for gas service.
 4. Provide 24VAC solenoid assemblies designed for control of commercial and industrial gas burners and for the pipe size and construction as scheduled.
 5. Fuel gas solenoid valves for adjacent areas may be combined in a single vented enclosure if convenient for installation.
 6. Each fuel gas solenoid installation shall include a ball valve service shut-off up-stream from the solenoid and a union on each side of the solenoid.
 7. Utilize only Normally Closed type solenoids with a reset fuse/switch for fuel gas shut-off to ensure fail-safe operation.
- I. Contactors
1. Provide multi-pole electrically held 24VAC normally open or normally closed contactors as required to control power to receptacle groups, exhaust, etc. as required for each system, as indicated on the plans and as shown on the Science Lab or Prep Room detail.
 2. Provide top and/or side auxiliary contacts at contactors as required.
 3. Provide separate shut-off contactors/enclosures as required.
 4. Power to the designated laboratory use student lab station/demonstration station or preparation room electrical outlets only, shall feature Normally Open operation, controlled by the system panel switches, and for the system programmed durations, in the same manner as the other utilities.
 5. All other electrical outlets in the same room, including computer and general purpose outlets (Additional Area Receptacles); shall be Normally Closed operation, shut down only by the EPO switch. The computer and general purpose outlets shall not be shut-off by the utility switches or any system programmed durations.
- J. Enclosures - For Contactors
1. Manufacturers
 - a. ISIMET E-31xx-S-F series
 - b. LACS ECP-FC series

- c. Approved alternative
 - 2. Provide 24 VAC operation with normally-open for -L circuits and normally-closed for -A circuits.
 - 3. Provide NEMA Type 1 General purpose indoor enclosures, powder coated (white color), for all contactors. Size enclosures as required.
 - 4. Enclosures must be mounted in a service accessible location, concealed above a drop ceiling when possible.
- K. Enclosures - For Water and Air Solenoids
- 1. Manufacturers
 - a. Approved alternative
 - 2. Provide as required NEMA Type 1 General purpose indoor enclosures of steel construction and powder coated (white color). Size enclosures as required
 - 3. Enclosures must be mounted in a service accessible location, concealed above a drop ceiling when possible.
- L. Enclosures - For Fuel Gas Solenoids
- 1. Manufacturers
 - a. Approved alternative
 - 2. Provide as required NEMA Type 4 liquid tight indoor enclosures of steel construction and powder coated (white color). Enclosures shall include air tight strain relief fittings at pipe entry/exit points, and a penetration with fitting/lock nut for an enclosure secondary vent pipe connection. Vent piping is to extend to an outdoor roof penetration.
 - 3. Each fuel gas pipe entry/exit into a vented enclosure is to be sealed outside the pipe or sleeve, as required, with an air tight strain relief fitting - U.S. Plastic Corp. stock 32324 1/2" Uniseal made of DuPont Alcryln, or equivalent (available for pipe sizes 3/16" to 6").
 - 4. Enclosures must be mounted in a service accessible location, concealed above a drop ceiling when possible.
- M. Other System Components
- 1. Step down low voltage transformers shall be mounted in a suitable location within a metal enclosure as described above and shall accept 120 VAC primary input and output low voltage at the amperage required by the system.
- N. Labelling
- 1. Each switch label shall feature 1/8" high engraved letters as indicated on plan details.
 - 2. See Science Lab or Prep Room detail for what goes on each label.

2.3 PERFORMANCE REQUIREMENTS

- A. Utility Control Panel
- 1. The Utility Control Panel shall be the central location for control of the utilities for the room. It shall house each of the following:
 - a. A separate switch (or touch screen function) for each utility provided at the student stations
 - b. A single switch (or touch screen function) to control all utilities at the teacher station
 - c. A single switch (or touch screen function) to control the purge fans.
 - d. An EPO switch. The EPO shall not be a touch screen function.
 - e. A keyed enable/off/reset switch.
 - 2. The contactors and solenoids in the enclosures shall be powered and controlled by the Utility Control Cabinet.
 - 3. The utility control cabinet shall operate on 120v and shall provide power to all contactors and solenoids.
- B. Emergency shut-off (EPO) switches
- 1. (Additional Area Receptacles) shall be shut down and restored only by an Emergency Shut-Off mushroom switch.
 - 2. Shall shut off all controlled utilities in the space per TEA requirements, including the designated lab use electrical outlets in the area.
 - 3. Shall shut off the general purpose and computer electrical outlets (additional area receptacles).
 - 4. Shall run the area purge fan for the programmed the duration of 1-hour, regardless of keyed reset switch position.

- C. Keyed "ENABLE" / OFF / RESET switch
 1. The keyed reset switch shall have three positions.
 2. The first position shall be "ENABLE". Each day of laboratory utility use, the teacher may turn the switch panel keyed switch momentarily to the ENABLE position, let it spring back, and remove the key, which allows for selectively switched use of laboratory utilities for a programmed duration of 10-hours.
 3. The second position shall be "OFF" and shall turn all controls off, except for purge fan.
 4. The third position shall be "RESET". It shall be a momentary position for the purpose of resetting the time period allowed to operate the utilities. It shall also be used to allow the controls to resume normal operation after operation of any emergency shut-off mushroom switch.
 5. Operation of any EPO shall require the system to be reset with the key at the switch panel before utilities can be restored. The teacher shall be able to remain in the room to do so and no electric breakers shall require switching.
 6. The non-lab station use electrical outlets (additional area receptacles) in the room shall not be shut-off by a system timer or by the utility control switches, only the EPO.
- D. Utility switches (toggle or touch screen)
 1. Individual utility switches shall be provided at the Utility Controller main panel to be utilized by the teacher to control individual utilities at the student stations.
- E. Purge Fan switch (toggle or touch screen)
 1. The purge fan switch shall be provided to operate the purge fan (hi/lo fan) for evacuation of the space. The purge fan shall remain active until the system is switched off or times out. If the system was left enabled and the time has expired, the system must be reset to re-enable the fan switch. However, the purge fan shall run for the listed duration if the EPO is pressed, regardless of reset switch condition (off or enabled).
 2. Switch shall be a LED toggle switch or standard toggle switch with LED indicator lights.
- F. Solenoids
 1. Provide solenoids for hot water, cold water, gas, compressed air, etc. as required for each system and as shown on the detail.
- G. Contactors
 1. Provide contactors to control power to outlets, exhaust, etc. as required for each utility system including (student receptacles, demonstration receptacles, additional area receptacles, exhaust, etc.)
- H. Enclosures
 1. Provide enclosures as required for each set of control circuits, relays, solenoids, or contractors. Size enclosures as required, with hinged door. Mount enclosures in a service accessible area located above drop ceilings as indicated on plans, or as required.
 2. Enclosures shall be broken into groups and serve only a means of control for the listed utility.
 - a. Contactors shall be grouped into separate enclosures from other utilities.
 - b. Gas solenoids shall be grouped into separate vented enclosures from other utilities.
 - c. Water (hot and cold) and compressed air solenoids shall be grouped into separate enclosures from other utilities.
- I. Where systems include domestic hot and cold water shut-off, a single output circuit shall control these systems simultaneously.
- J. Each utility service and purge fan system shall be independently controlled by area and shall not be combined with other areas.

PART 3 - EXECUTION

3.1 EXAMINATION, COORDINATION, AND SCOPE OF WORK

- A. Do not begin installation until submittal / coordination drawings have been properly reviewed.

- B. It shall be the responsibility of the Plumbing Contractor (Refer to Division 22) to install the system devices provided, make final connections to all utility piping systems where indicated, and make other provisions for the Laboratory Utility Shut-off System as required and outlined in the Drawings and Specifications. In addition, the plumbing contractor shall provide shock arrestors upstream at each domestic water service valve assembly.
- C. It shall be the responsibility of the Mechanical Contractor to provide equipment, devices, and other provisions for the Laboratory Utility Shut-off System to control the area purge exhaust fan as outlined in the Drawings and Specifications.
- D. It shall be the responsibility of the Electrical Contractor to provide in his base proposal all equipment, devices, and other provisions for the laboratory safety system as outlined in the drawings and specifications.
- E. The electrical contractor shall install all panels, controls, and devices not requiring connection to utility piping systems.
- F. The electrical contractor shall also provide all conduit systems, standard electrical boxes, 120 VAC operating power and wiring for the laboratory safety system as outlined in the drawings and specifications.
- G. Each Utility Controller shown on the drawings and herein specified shall operate as an independent control system.
- H. The electrical contractor shall coordinate system testing of all utility piping and devices with the plumbing contractor.
- I. The Electrical Contractor shall be responsible for all system configuration, integration, testing, and start-up.

3.2 INSTALLATION

- A. Install all equipment in accordance with manufacturer's recommendations and instructions.
- B. Exposed conduit or piping will not be permitted in the finished job.
- C. Verify that the mounting heights of all control switches comply with ADA and TAS standards.
- D. Furnish and install all devices as shown on drawings and as specified herein. Where device is to be installed by other trades, furnish, and turn over to appropriate trade for installation.
- E. Furnish, install, and make final connections to all switches, solenoids, and relays as indicated on Drawings and specified herein.
- F. Provide conduits for wiring from point of connection to each device to a service accessible point above ceiling.
- G. A copy of the system schematic drawing with all associated part numbers shall be attached to the inside cover of each control panel enclosure for service purposes.

3.3 TESTING

- A. A qualified representative of the contractor shall supervise the final connections and testing of the system and it shall be subject to the final acceptance of the Architect / Engineer and Owner.
- B. Testing for all requirements shall be performed with all wiring and devices in place.
- C. The System Contractor shall make a thorough inspection of the complete installation to ensure the following:
 - 1. All components and control devices are installed to comply with manufacturer's requirements and recommendations and that all devices and installations conform to Drawings and Specification

- requirements.
- 2. Each system is complete and functional.
- 3. All wiring shall test free from all grounds, crosses, and shorts.
- 4. Leak testing for all pipe systems.
- 5. Verify that all controlled piping systems have been thoroughly cleaned.
- 6. Verify that all controlled devices and circuit breakers are ON.
- 7. Verify that all switches perform the specified functions.
- 8. A representative of the Owner shall be present for all testing. Testing shall verify design and performance requirements as specified.

3.4 SYSTEM START-UP

- A. After system startup and prior to substantial completion of the project, require the manufacturer to test the operation of the complete system (all pieces, every space) to ensure the proper operation of the system throughout the range of building operating conditions. Provide documentation of such functional testing in the closeout submittals. Do this functional testing on all projects, regardless of other additional commissioning or testing requirements.

3.5 OWNER TRAINING

- A. After functional testing is complete, manufacturer or manufacturer rep shall provide a minimum of 4 hours of on-site training to Owner's personnel in the operation, adjustment, and maintenance of the system. Do this training in a location where it can be recorded by Owner. Coordinate date, time and location of training one week prior to meeting and provide documentation of such training in the closeout submittals.
- B. Provide reset keys to the Owner's representative.

END OF SECTION

SECTION 26 09 23
LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Provide a lighting control system for the proper operation of interior and interior and exterior lighting, except for lighting intended for 24-hour operation.
- B. This section does not include controls for theater and stage equipment.
- C. This section does not include controls for outdoor sports lighting.

1.2 RELATED REQUIREMENTS

- A. Section 26 00 00 - Electrical
- B. Section 26 05 19 - Low Voltage Electrical Power Conductors and Cables
- C. Section 26 05 33 - Raceways and Boxes for Electrical Systems
- D. Section 26 05 53 - Identification for Electrical Systems
- E. Section 26 08 00 - Commissioning of Electrical Systems
- F. Section 26 27 26 - Wiring Devices
- G. Section 26 50 00 - Lighting

1.3 REFERENCES AND STANDARDS

- A. NEMA Guide Publication WD 7 Occupancy Motion Sensors Standard
- B. NFPA 101 - Life Safety Code (latest adopted version)
- C. International Energy Conservation Code (IECC) (latest adopted version)
- D. ANSI / ASHRAE / IES Standard 90.1: Energy Standard for Buildings Except Low-Rise Residential Buildings (ASHRAE 90.1) (latest adopted version)
- E. Electronic Industries Association (EIA)

1.4 DEFINITIONS

- A. Energy Code - The latest state or city adopted version of the IECC or ANSI / ASHRAE / IES Standard 90.1.
- B. Motion Sensor - A sensor that detects when an occupant is in a space. This sensor can be wired or configured to be an occupancy sensor or vacancy sensor.
- C. Occupancy Sensor - A motion sensor designed or programmed to automatically turn the lighting in a space "on" when an occupant enters the space (based on major motion) and automatically turn the lighting in a space "off" after the occupant is no longer present or detected (based on minor motion) for a predetermined length of time.
- D. Vacancy Sensor - A motion sensor designed or programmed to require an occupant to manually turn the lighting in a space "on" and automatically turn the lighting in a space "off" after the occupant is no longer present or detected (based on minor motion) for a predetermined length of time.

- E. Dual Technology Sensor - A motion sensor with both infrared and ultrasonic technologies or both infrared and microphonic technologies.
- F. Photocell - A light sensitive sensor used to communicate with a room controller to dim the lighting in a daylight zone according to the ambient lighting entering a space via any method other than electric lighting.
- G. Room Controller - The local space lighting controller that interfaces with the luminaires, motion sensors, photocells, smart switches, etc. in each space to control on / off, "scenes", dimming, and daylight harvesting. This may include manufacturer verbiage such as power pack, distributed controller, driver interface modules, interface components, etc. Some or all of this function may be an integral part of the luminaires in the space.
- H. Smart Switch - Intelligent programmable switch capable of communicating with the lighting control system in the space to trigger on / off, "scenes", dimming, etc.
- I. Network Controller - The building-wide controller that connects room controllers together into a central network.
- J. Daylight Zone - Area in a space around / about a window, skylight or other fenestration measuring how far exterior natural lighting can reach into a space. Not all daylight zones can be combined. Luminaires in a daylight zone are to be controlled separately from the luminaires in other daylight zones and separately from the rest of the space. Some daylight zones, after they are identified in a space, will not require any change to the lighting controls already shown and may therefore be disregarded. Those will usually be deleted from the RCP to prevent confusion. Note, some spaces may indicate multiple daylight zones and / or both primary and secondary daylight zones depending on the Energy Code.
- K. Functional Testing - Start-up or testing performed by the manufacturer or certified representative to verify the operation of the complete lighting control system.
- L. Commissioning Agent - Third-party hired by the Owner or Owner's Representative to verify proper operation of the lighting control system as designed to meet the Energy Code commissioning requirements.

1.5 COORDINATION

- A. Coordinate motion sensor and photocell mounting and locations with architectural RCP (ceiling type, ceiling height, baffles, etc.), mechanical (HVAC duct work, grilles, etc.), plumbing (exposed piping, sprinkler heads, etc.), technology (A/V, projectors, etc.) and other trades, as required, before installation.
- B. Provide a product "tabletop" demonstration by the manufacturer of the lighting control system including a sample of each piece and part demonstrating a complete working system. If the above requirement is not acceptable by the Owner or Owner's Representative, provide a mock-up of select spaces in the building with complete controls for Owner or Owner's Representative review before installation throughout the building. Coordinate select spaces with Owner or Owner's Representative.
- C. Pre-Installation Meetings:
 - 1. Meet with the manufacturer of the lighting control system on-site to review installation, wiring methods and exact equipment locations of all components prior to starting installation. At this meeting the Contractor shall be trained by the manufacturer or vendor on the installation, setup and functionality of the system. Failure to have this meeting will result in the Contractor assuming full responsibility of all costs incurred to move controls and sensors, replace equipment due to product damage, costs due to installation errors or failure to meet the full intent of the design.

1.6 SUBMITTALS

- A. Submit from the following list, all items used on this project: Motion sensors, photocells, smart switches, time switches, room controllers, network controller, plug load controller, software, lighting contactors, low voltage wiring, intelligent luminaires, etc.

- B. Product data for motion sensors shall clearly indicate coverage areas for major motion and minor motion determined in accordance with the testing procedures of NEMA Guide Publication WD 7 Occupancy Motion Sensors Standard.

1.7 SHOP DRAWINGS

- A. Submit shop drawings of each RCP area in this project showing the specific locations of all parts of the lighting control system including motion sensors, photocells, smart switches, room controllers, network controller, plug load controller, enhanced building controls (if required), etc. Motion sensors shown shall include sensor type, sensor mounting, and other pertinent data to allow evaluation of the proposed system.
- B. Submit a complete wiring diagram for all motion sensors, photocells, smart switches, room controllers, network controllers, etc. for this project. Typical wiring diagrams will be rejected.
- C. Submit a sequence of operations for each unique space type describing the function of each button on each switch and the effects on the lighting in the space. This sequence of operations should be similar to the Lighting Control Chart with the added information describing how the lighting control system pieces / parts work together.
- D. Submit a list of switch types by unique space with a list of proposed button labels. This list should be similar to the Button Info in the Lighting Control Chart with added information showing switch button layouts and actual labels for this project.

1.8 CLOSEOUT SUBMITTALS

- A. Submit per Closeout Submittals requirements in 26 00 00 - Electrical and any additional requirements listed below.

1.9 WARRANTY

- A. Provide a five (5) year parts and one (1) year labor warranty on the entire lighting control system. Warranty coverage shall begin at the time of Project Substantial Completion.

1.10 ADDITIONAL MATERIALS

- A. Additional materials to be a dollar cost in the base bid. At the end of the project, the Contractor shall generate a dollar amount credited back to the Owner for any unused items.
- B. Include in the base bid for additional materials:
 - 1. All costs to provide 10 additional smart switches equal to the model required for switch type "LC" denoted on the Lighting Control Chart.
 - 2. All costs to provide 10 additional motion sensors equal to the model required for switch type "LC" denoted on the Lighting Control Chart.
 - 3. All costs to provide 5 additional photocells equal to the model required for switch type "LC" denoted on the Lighting Control Chart.
 - 4. All costs to provide 5 additional room controllers equal to the model required for switch type "LC" denoted on the Lighting Control Chart.
 - 5. All costs to provide 4 additional plug load controllers equal to the model required for switch type "LC" denoted on the Lighting Control Chart.
- C. See Section 26 00 00 - Electrical and Section 26 50 00 - Lighting for other additional materials to be provided by this Contractor.

1.11 ATTIC STOCK

- A. All attic stock shall be provided to the Owner at substantial completion. The base bid shall include all attic stock.
- B. Include in the base bid for attic stock:

1. Provide 4 room controllers equal to the model required for switch type "LH" denoted on the Lighting Control Chart.
 2. Provide 4 room controllers equal to the model required for switch type "LC" denoted on the Lighting Control Chart.
 3. Provide 8 motion sensors equal to the model required for switch type "LC" denoted on the Lighting Control Chart.
 4. Provide 4 photocells equal to the model required for switch type "LC" denoted on the Lighting Control Chart.
 5. Provide 2 smart switches for each switch type (LE, LK, LC, etc.) used on the Lighting Control Chart.
 6. Provide 4 plug load controllers equal to the model required for switch type "LC" denoted on the Lighting Control Chart.
- C. See Section 26 00 00 - Electrical and Section 26 50 00 - Lighting for other attic stock to be provided by this Contractor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. If they comply with these specifications, products of the following manufacturers will be acceptable:
1. Acuity Controls - Chris Sears at 214-658-9030
 2. Cooper Controls - Allen Pilgrim at 817-267-9300
 3. Current NX Controls (formerly Hubbell Controls) - Randy Schwimmer at 972-406-8700
 4. Intelligent Lighting Controls - Allen Pilgrim at 817-267-9300
 5. Leviton - Brendan Kenna at 214-247-7415
 6. Lutron - Randy Schwimmer at 972-406-8700
 7. WattStopper - Brian Ross at 501-301-8739
- B. No other manufacturers will be accepted. Submitting on any brand other than those listed here will be rejected. No exceptions.

2.2 GENERAL REQUIREMENTS

- A. Refer to the Luminaire Schedule and the Lighting Control Chart on the Drawings for additional requirements and more information.
- B. The lighting control system shall include all required devices for a complete and proper operating system to automatically control the lighting to meet the intent of the Energy Code. The system may include but not be limited to motion sensors, room controllers, network controller, plug load controller, enhanced building controls (if required), low voltage control wiring, photocells, smart switches, intelligent luminaires and all required conduit and back boxes. Not all required components are shown on the Drawings.
- C. All parts of the lighting control system shall be warranted by the same company.
- D. All parts of the lighting control system shall be from the approved list of manufacturers above.
- E. All parts of the lighting control system shall be aesthetically compatible. i.e., from the same product line or family of products.
- F. All sensors shall be from the latest release generation. Do not mix product of different releases or generations.
- G. Battery operated devices and controls are not acceptable.
- H. All lighting control system products shall be UL listed, individually and as a system, for the specific applications utilized on this project.
- I. Refer to the RCP and the Lighting Control Chart for additional information and requirements for controlling the lighting in various areas throughout the building. For projects beyond the scope of a single system, multiple systems shall be networked together to accommodate any size requirement.

- J. Color: Device color shall be coordinated with the Owner's Representative and shall reasonably match across all Divisions. Emergency devices and plates shall be red.
- K. If a FACP exists or shall be installed, then provide fire alarm integration as noted on the Lighting Control Chart. This feature shall be provided via a single contact closure at the FACP as a trigger to the lighting control system. Provide all associated hardware and wiring from the FACP to the lighting control system necessary for a complete and working system.
 - 1. Fire Alarm Activation: The lighting controls shall turn all interior and exterior building-mounted lights on to meet NFPA 101 Section 7.8.1.2.2 requirements.
 - 2. Fire Alarm Deactivation: The lighting controls shall return all interior and exterior building-mounted lights to the previous state before the fire alarm was activated.
- L. All portions of the lighting control system mounted above ceiling shall be plenum rated.
- M. If a generator or UPS provides backup / auxiliary power to any luminaires, then power shall be provided for all lighting control system components in those spaces such that all functions of the lighting control system remain operable under any power condition.
- N. If a generator or UPS provides emergency power to any emergency luminaires, all emergency luminaires shall turn on to maximum lumen output. If battery packs provide power for emergency lighting, all emergency luminaires shall turn on to maximum lumen rating of the battery pack.
- O. Wiring between sensors and control units shall be 18 AWG minimum (stranded preferred) or CAT5/5e/6. Wiring shall be plenum rated in plenum spaces and UL listed. Pre-terminated low voltage wiring from the lighting controls manufacturer is preferred.
- P. See Lighting Control Chart on the Drawings for controls by space and sequence of operation.
- Q. A networked distributed lighting control system is required. Relay panels are not acceptable unless noted in the Lighting Control Chart.

2.3 MOTION SENSORS

- A. Sensor design and layout: Provide the quantity of motion sensors required for complete and proper coverage without gaps within the range of coverage of controlled areas. Rooms shall have 100% coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room. The locations and quantities of sensors shown on the Drawings are diagrammatic and indicate only rooms that are to be provided with sensors. Provide additional sensors if required to properly and completely cover the respective room. Proper judgment must be exercised in executing the work so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.
- B. Coverage and Orientation: Select the appropriate type of sensor for complete coverage of each space. All motion sensors are to be in the best location to avoid false triggers from movement outside an open doorway.
- C. All motion sensors shall be dual technology.
- D. All motion sensors to be set to the time delay indicated in the Lighting Control Chart and adjusted to maximum sensitivity. Motion sensors must be capable of being set down to 5 minutes and 1 minute for testing.
- E. Coverage areas for major motion and minor motion shall be determined in accordance with NEMA WD 7 Guide Section 3.
- F. Ultrasonic technology shall utilize a frequency that does not interfere with other sensors, hearing aids, smartboards, etc.
- G. All motion sensors on this project shall have masking or internal shielding available to control coverage pattern in the field. Stickers or other external adhesive masking will not be accepted.

- H. Timer Switches: Where indicated on the Drawings, a timer switch control function shall have an override not exceeding the maximum time allowed by the Energy Code.

2.4 SMART SWITCHES

- A. Shall control the luminaires in the space for all on / off, dimming, "scene" controls, manual override, etc. as indicated in the Lighting Control Chart on the Drawings and as required by the Energy Code.
- B. All smart switches are to be engraved or internally labeled so that the function of each button is clearly identified. All labeling or engraving must be of high quality and be provided by the lighting control system manufacturer.

2.5 ROOM CONTROLLER

- A. Shall operate all lighting in the space based on input from the smart switch(es), motion sensors, photocells, etc. via low voltage control output and relays / contactors using zero-cross technology.
- B. In the event of a hardware, software or component failure, the lighting in the space shall default to the "ON" position.
- C. Provide room controllers, as required, for complete control of all lighting in the space to meet Energy Code requirements and design intent shown on the Drawings.

2.6 NETWORK CONTROLLER

- A. Shall be capable of being programmed / reprogrammed via PC (via software) or mobile device (via app). It shall be capable of receiving input via contact closure, user PC software, FACP, etc. and issuing building-wide commands to enable / disable a "scene" at all luminaires controlled by the lighting control system.
- B. Shall include astronomical time clock feature capable of seven (7) different day types per week, automatic holiday "shutoff" feature for 24-hours, 12-hour minimum program backup capabilities to meet the Energy Code.
- C. Shall be BTL BACNET / IP listed for use to communicate with EMCS and HVAC.

2.7 MAINTENANCE SERVICE

- A. Provide a three (3) year manufacturer's software service agreement with the lighting control system. The agreement shall cover all minor updates, bug fixes and maintenance to the software of the system to maintain all original functionality. The software service agreement shall start at the time of Project Substantial Completion.

2.8 SYSTEM SUPPORT

- A. Provide five (5) year complete system support starting from Project Substantial Completion. The entire lighting control system (hardware and software) shall be included in the support. The support shall include phone and email communication (as a minimum) for the duration of the support. The system support shall include all technical support, hardware and software questions, warranty help, etc.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Where work is to be performed in an existing facility, visit the site of the proposed work and observe its conditions so that you may be fully informed as to the materials, labor, workmanship and conditions under which the work is to be done.

3.2 INSTALLATION

- A. General

1. Provide all lighting controls, as required and where indicated, in accordance with manufacturer's written instructions and project shop drawings, applicable requirements of the NEC, and recognized industry practices to ensure that products serve the intended function.
 2. Provide the room controller, as required, located above the ceiling above the switches near the exit door. Provide a permanent label on the ceiling to identify its location. The label material shall be as described in Section 26 05 53 - Identification for Electrical Systems. The label shall say "Lighting Controller". It is acceptable for a room controller to serve more than one space.
 3. Provide the network controller, as required, located on the wall of the main electrical room near any EMCS, contactors, etc. It is acceptable for a single network controller to serve an entire building if supported by the controller.
 4. Provide conduit and wiring in accordance with Section 26 05 33 - Raceways and Boxes for Electrical Systems and Section 26 05 19 - Low Voltage Electrical Power Conductors and Cables.
 5. All motion sensors and switches located in gyms, play areas, multipurpose spaces, etc. shall have a wire guard.
 6. Exact locations of all equipment shall be based on observing good installation practice and shall be coordinated with other elements of the RCP.
- B. Lighting Control Cable Routing and Installation
1. System wiring and equipment installation shall be in accordance with good engineering practices as established by the EIA and the NEC. Wiring shall meet all state and local electrical code requirements.
 2. Cable pathways, conduit, and cable support systems shall be complete with bushings, de-burred, cleaned, and secure prior to installation of cable.
 3. All wiring shall test free from opens, grounds, or shorts. All lighting control cable shall be supported from the building structure and bundled. Do not attach any supports to joist bridging or other lightweight members.
 4. Support system shall provide a protective pathway to eliminate stress that could damage the cabling. The lighting control cable shall not be crushed, deformed, skinned, crimped, twisted, or formed into tight radius bends that could compromise the integrity of the cabling.
 5. Lighting control cable must not be fastened to electrical conduits, mechanical ductwork / piping, sprinkler pipes, or routed to obstruct access to hatches, doors, utility access panels, or service work areas. Do not route cables through fire doors, ventilation shafts, grates, or parallel with line voltage electrical conductors. Lighting control cables shall not be run loose on ceiling grid or ceiling tiles.
 6. Support shall be provided by mounting appropriate fasteners that may be loaded with multiple cables. Provided that the weight load is carried by the support rod or wire, the support assembly may attach to the ceiling grid for lateral stabilization. The required support wires for the ceiling grid or luminaires shall not be utilized. Any fastener attached to the ceiling grid shall not interfere with inserting or removing ceiling tiles. The cable pathway of supports must be positioned at least twelve (12) inches above the ceiling grid.
 7. Provide bushings to protect the cable from damage for conduit ends, box openings, and passage through metal studs.
 8. Lighting control cables shall be run in bundles above accessible ceilings and supported from building structure. Cabling shall be loosely bundled with cable hook and loop (Velcro) ties randomly spaced at 30 to 48 inches on center. Cable ties shall not be tight enough to deform cabling and shall not be used to support the cabling.
 9. Each cable run shall include a three (3) foot service loop with hook and loop (Velcro) ties located in the ceiling above each device. This is to allow for future re-termination or repair.
 10. Lighting control cable shall not be installed in the same conduit, raceway, tray, duct, or track with line voltage electrical cable without a metallic barrier meeting NEC requirements.
 11. Maximum cable pulling tension should not exceed twenty-five (25) pound-force (110 N) or the manufacturers recommendation, whichever is less.
 12. Any pulling compounds utilized must be approved by the cable manufacturer and shall not degrade the strength or electrical characteristics of the cable.
 13. No terminations or splices shall be installed in or above ceilings, other than in designated end point housings.
 14. Cable bends shall not be tighter than the manufacturer's suggested bend radius.
 15. Mount all equipment firmly in place. Route cable in a professional, neat and orderly installation.
- C. Lighting Control Cable Support
1. Conduit, duct, or track shall be used for lighting control cable in exposed areas.

2. Cable fill shall not exceed the manufacturers' instructions for each type of support.
3. All conduit, ducts, track, and raceways shall be supported from the structure at industry standard intervals for the size specified, utilizing proper anchoring devices.
4. All vertical supports shall be attached to the building support structure or concrete ceiling with anchors load rated for 100-lbs. minimum. Down rods shall be a minimum of 1/4" diameter. Steel uni-strut cross supports shall be two (2) inch minimum.

D. Bushings

1. Provide a plastic snap in bushing at each box opening, passage through a metal stud, and at the end of all open conduit stubs or sleeves prior to lighting control cable installation to protect the cabling from damage:
 - a. Box openings - Thomas & Betts Knockout Bushing Series 3210, or equivalent.
 - b. Metal stud passage - Thomas & Betts Twist It Bushing Catalog Number SB1216-SC, or equivalent.
 - c. Conduit ends - Thomas & Betts Anti-Short Bushing Series 390 or Tite-Bite Combination Couplings Series 442, or equivalent.

E. J-Hooks

1. Attachments for cabling support shall be spaced at approximately 48 to 60 inches on center. Cable bundles shall not be allowed to sag down more than twelve (12) inches mid-span between attachments.
2. All attachments shall be approved for category rated twisted pair cabling. Attachments shall be Caddy part numbers as follow, or equivalent, sized as follows:
 - a. CAT16HP, 1" diameter, Capacity 15 Category rated cables.
 - b. CAT21HP, 1.31" diameter, Capacity 40 Category rated cables.
 - c. CAT32HP, 2" diameter, Capacity 60 Category rated cables.
 - d. Split bundles greater than 2" diameter or provide cable tray.
3. Do not mix different signal strength cables on the same J-hook (i.e. fire alarm with data and telephone cable). Multiple J-hooks can be placed on the same attachment point, up to the rated weight load of the attachment device.

F. Cable Tie Wraps

1. Provide and install Panduit TAK-TY cable ties or equivalent.
2. Hook and loop (Velcro) cable ties shall be furnished and installed to attach wire bundles to supports and for appropriate wire management as required.
3. Hard plastic or metal tie wraps will not be allowed on any data grade cable (Category rated twisted pair cable).

3.3 SEQUENCES OF OPERATION

A. Lighting Controls

1. The smart switch shall be required to be pressed to turn the lights "on" in all spaces where a vacancy sensor is required. Otherwise, an occupancy sensor may automatically turn the luminaires "on". Two minutes prior to turning the lights "off", the lighting control system shall dim the luminaires in the space to 50% of their previous output as a notification to the occupants that the controls will soon turn the lighting off. A momentary "blink" is allowed if luminaires are not dimmable. If the motion sensor is not triggered within the two minutes, the lighting in the space shall turn "off". If the motion sensor is triggered, the lighting control system shall dim the lighting back up to the previous lighting level and timeout is restarted. In spaces with timer switches, the system shall accept an override signal at any time either before or after the lighting is turned off. The occupant shall not be required to wait for the lights to go out before issuing the override.
2. Where shown on the Drawings, a photocell is to be used to measure the light level and signal to the room controller to dim the luminaires continuously (from 100% to 15% or lower, including off) in the daylight zone to maintain a consistent (within +10% and -0%) lighting level in the space.

3.4 FUNCTIONAL TESTING

A. Coordinate the below requirements with the manufacturer representatives.

1. Certified factory representative shall provide all initial field programming of the system as part of the system startup process.

2. Certified factory representative shall inspect the finished installation against the shop drawings and installation instructions.
3. Certified factory representative shall do functional testing of the finished installation. Submit documentation of the functional testing in accordance with closeout submittal requirements.

3.5 ADJUSTING

- A. Motion sensors may be affected by various conditions in the room. It may be necessary for the Contractor to make adjustments, change the location or type of sensor to obtain proper operation in a specific room. The Contractor / equipment manufacturer shall have final responsibility for proper operation and coverage of the system in each room and should therefore make labor allowance for such changes and adjustments. The Contractor is also responsible for acquiring approval from Engineer for any changes or deviations from project specifications.
- B. Contractor shall work with the manufacturer to correct all findings from manufacturer functional testing.
- C. Contractor shall work with the manufacturer to correct all findings made by the Commissioning Agent or registered design professional, whichever entity performs the commissioning service. This Contractor is responsible for the entire lighting control system and luminaires to pass the commissioning inspection and reporting.

3.6 SYSTEM STARTUP

- A. Provide the initial programming, aiming and start-up of the system.
- B. After system startup, the manufacturer or manufacturer's representative shall test the operation of the complete system (all pieces, every space) to ensure the proper operation throughout the range of building operating conditions. Provide documentation of such functional testing in the closeout submittals. Testing individual components, third-party commissioning, etc. shall not be a replacement for complete system testing.

3.7 THIRD-PARTY COMMISSIONING

- A. In addition to functional testing by the Contractor and the manufacturer, additional third-party commissioning is required to meet the Energy Code requirements. The manufacturer shall be present during the third-party commissioning process. See Section 26 08 00 - Commissioning of Electrical Systems for more information.

3.8 OWNER TRAINING

- A. After functional testing and commissioning are complete, the manufacturer shall provide a minimum of four (4) hours of on-site training to the Owner's personnel in the operation, adjustment, and maintenance of the system. The length of the training session shall be at the discretion of Owner. Do this training in a location where it can be recorded by the Owner. (With prior approval of the Owner, the Contractor can arrange to record the training and present it to the Owner.) Coordinate date, time and location of training one week prior to meeting and provide documentation of such training in the closeout submittals. The training shall cover the following items in detail:
 1. Scope of System: Review the as-built documentation with the Owner to detail extent of system. Identify locations of all wall stations, wiring, and panels that fall within the scope of the lighting control system. Define clear lines of scope between lighting control system and EMCS functions, if applicable.
 2. Operation of System: Cover normal operation of switches, push-buttons, LCD interfaces and software (if provided). Provide documentation to the Owner showing the operational zoning of controlled circuits and all time clock events programmed into the Lighting Control System. Show the Owner how to change and add / delete events.
 3. Maintenance and Troubleshooting of System: Detail any required or optional preventive maintenance actions required of the Owner. Review step-by-step procedures to troubleshoot all possible failure modes of each component type of the lighting control system. Cover procedure to get lights turned on in any space containing a lighting control system in the event the control system fails. Identify any specialized equipment necessary to support all the above actions.
 4. Service and Support of System: Identify nearest direct support contact for the manufacturer and provide both telephone and email contact details.

END OF SECTION

SECTION 26 20 00

LOW VOLTAGE ELECTRICAL DISTRIBUTION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Electrical service including underground primary requirements, transformer and secondary enclosure requirements, overhead and underground service entrance requirements, metering, and final connections.
- B. Provide and install all components of the low voltage distribution system(s) including all switchboards, panelboards, transformers, fuses, circuit breakers, disconnects, MCCs, etc. as shown on the Drawings and as required for a complete and working system. All equipment shall be sized to meet the latest adopted version of NEC 220 requirements as a minimum.

1.2 RELATED REQUIREMENTS

- A. Section 26 00 00 - Electrical
- B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables
- C. Section 26 05 26 - Grounding and Bonding for Electrical Systems
- D. Section 26 05 33 - Raceways and Boxes for Electrical Systems
- E. Section 26 05 53 - Identification of Electrical Systems
- F. Section 26 05 73 - Power System Studies
- G. Section 26 43 00 - Surge Protection Devices

1.3 REFERENCES AND STANDARDS

- A. ANSI C33.4 / C57.96 - Distribution, Power and Specialty Transformers
- B. ANSI / UL 98 - Safety Standard for Enclosed Switches
- C. IEEE 65 - Transformer Test Procedures
- D. NEMA AB1 - Molded Case Circuit Breakers
- E. NEMA AB2 - Procedures for Verifying the Performance of Molded Case Circuit Breakers
- F. NEMA ICS 2 - IC System Contactors and Overload Relays
- G. NEMA ICS 5 - IC System Control Circuits and Pilot Devices
- H. NEMA ICS 6 - IC System Enclosures
- I. NEMA KS 1 - Enclosed Switches
- J. NEMA PB1 - Panelboards
- K. NEMA ST 1 - Specialty Transformers (Except General Purpose Type)
- L. NEMA ST 20 - Dry Type Transformers for General Applications
- M. NEMA WD 1 - General Color Requirements for Wiring Devices

- N. NEMA WD 6 - Wiring Devices
- O. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems
- P. NFPA 99 - Health Care Facilities Code
- Q. Title 10 CFR Part 431 - Energy Efficiency Program for Certain Commercial and Industrial Equipment
- R. UL 50 - Cabinets and Boxes
- S. UL 67 - Electric Panelboards
- T. UL 489 - Molded Case Circuit Breakers
- U. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers
- V. UL 5085-1 - Low Voltage Transformers, Part 1: General Requirements
- W. UL 5085-2 - Low Voltage Transformers, Part 2: General Purpose Transformers
- X. UL 60947 - Low Voltage Switchgear and Controlgear

1.4 COORDINATION

- A. Prior to ordering disconnects and fuses or fuse holders, coordinate fuse ratings with the Mechanical Contractor to verify that fuses for all mechanical equipment matches the Maximum Over-Current Protection (MOCP) values of the mechanical equipment being provided. This Contractor to adjust upstream breaker sizes, branch circuit conductor sizes, whip sizes and disconnect sizes to accommodate the fuse (Over-Current Protection Device, OCPD) requirements for the supplied equipment.

1.5 SUBMITTALS

- A. Provide scaled shop drawings for each electrical equipment room showing the placement of all panelboards, transformers, and other equipment such as mechanical equipment, drawn to scale and dimensioned. Such shop drawings will be reviewed for compliance with the intent of the Drawings and the spaces available for all electrical equipment.
- B. Clearly indicate on the submittals whether equipment is fully-rated or series-rated.
- C. Arrangement: Arrange panelboard submittals in the order the panelboard schedules appear on the panelboard sheets of the Drawings as read from top to bottom, then left to right.
- D. Include the following parameters as applicable in the submittal: equipment name, description, voltage, phase, ampacity, kVA rating, K-rating, control voltage, impedance, etc.

1.6 CLOSEOUT SUBMITTALS

- A. Submit per Closeout Submittals requirements in 26 00 00 - Electrical and any additional requirements listed below:

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. All panelboards, switchboards, disconnects, OCPDs, etc. shall be from the same manufacturer to ensure proper breaker coordination.
- B. All equipment on this project shall be new. Refurbished or used equipment will not be acceptable.
- C. The following are approved manufacturers.

1. ABB (formerly GE)
2. ACT Communications
3. Asco
4. Bussman
5. Eaton (formerly Cutler-Hammer)
6. Hammond Power Solutions
7. Industrial Electric Manufacturing (IEM)
8. Jefferson
9. Littlefuse
10. Mersen (Ferraz Shawmut)
11. MGM Transformer
12. Mirus International
13. Powersmith
14. Siemens
15. Square-D (Schneider Electric)

D. All other manufacturers shall require pre-approval in accordance with Section 26 00 00 - Electrical.

2.2 GENERAL REQUIREMENTS

- A. Conductor material for switchboards, panelboards, disconnects, etc. shall be copper.
- B. Transformer coils shall be continuous wound and conductor material shall be copper.
- C. Unless otherwise indicated on the Drawings, provide the following enclosures for all panelboards, switchboards, switchgear, disconnects, transformers, etc.:
 1. NEMA 1 - All equipment located in interior dry locations.
 2. NEMA 3R - All equipment located in damp, wet or exterior locations.
 3. NEMA 4X - All equipment located in corrosive environments.
- D. All panelboards, switchboards, disconnects, etc. shall have weatherproof threaded hubs for top / bottom / side conduit entries.
- E. Unless specifically noted otherwise on the Drawings, all equipment in these Specifications shall meet the requirements outlined below.
- F. All equipment shall have a factory applied gray finish applied over a rust inhibiting treatment. Any items which have the finish marred shall be touched up or refinished to a new condition before final acceptance. This shall include, but shall not be limited to, sanding and properly removing rust or other contaminants and completely repainting equipment if damage is extensive. Overall acceptance is subject to approval of the Engineer.
- G. Provide all labelling / identification per Section 26 05 53 - Identification of Electrical Systems.
- H. Provide, at each main switchboard and all downstream distribution, a complete (time-current) coordination study and an arc flash study with all required labels. Contractor may use the equipment manufacturer to provide both the required studies and the required labels. Contractor to adjust all settings for electronic-trip circuit breakers. See Section 26 05 73 - Power System Studies for more details.

2.3 PANELBOARD / SWITCHBOARD COMMON REQUIREMENTS

- A. Construction: NEMA PB 1, interiors shall be completely factory assembled. See General Requirements above for NEMA enclosure rating requirements.
- B. Enclosure Properties: Door in door construction, standard conduit knockouts in ends and sides of cabinet. Provide flush type combination catch and key door locks on all panelboards and load centers. Key all locks alike, provide two keys with each panelboard.
- C. Buss Information:
 1. Ground Buss: Full length, 25% phase rated, bonded to each buss, additional isolated buss in computer and communication panels.

2. Neutral Buss: Full length
 - a. 200% of phase rated for all computer or isolated ground (IG) panels.
 - b. 100% of phase rated for all lighting and power panels.
- D. OCPDs: Provide bolt-on circuit breakers unless otherwise indicated on the Drawings.
- E. Fault Withstandability: Suitable for operation and able to withstand the symmetrical short circuit current as indicated on the Drawings or available at the location, whichever is larger.
- F. Spaces: Install all allotted or indicated spaces so that future OCPDs can be added without additional machining, drilling, tapping or buss extensions.
- G. Circuit Identification:
 1. Frame-mounted directory with a heat-resistant transparent face for identifying circuits. Mount inside the panelboard door. Use equipment names as reflected by panel schedules on the Drawings. Use room names and numbers selected by the Owner's Representative, which may differ from those shown on Drawings.
 2. Provide on all panelboards, revise existing panelboards per Division 26 with new information.
 3. See Section 26 05 53 - Identification for Electrical Systems for more information.
- H. Features & Accessories:
 1. Provide metering and instrumentation per Section 26 09 13 - Electrical Power Monitoring and per Division 23 Energy Management Control System requirements.
 2. Provide GFCI protection as indicated here, as shown on the Drawings and where required per NEC.
 3. Provide SPDs at the main switchgear per Section 26 43 00 - Surge Protective Devices.

2.4 PANELBOARDS

- A. Construction:
 1. Flush mounted panelboards: Trims shall fasten to permit both horizontal and vertical adjustment.
 2. Surface mounted panelboards: Trims shall fasten to insure no overhang.

2.5 SWITCHBOARDS (> 1200A AMPS)

- A. Construction:
 1. Provide the required number of sections of the required size to fit in the space provided.
 2. Connect sections with bussing. Cabled connections are not allowed.
 3. Switchboards rated 2,000 amps or greater shall have a minimum depth of 30 inches.
- B. Overcurrent Protection Devices:
 1. Circuit breakers: Shall be capable of field-installable shunt trip, all shall be capable of being locked in the OFF position.
 2. Fused switches: Provide fused switches and fuses as indicated on the Drawings.
 3. Clearly indicate size of breaker or fused switch and ON / OFF positions for all OCPDs.

2.6 TRANSFORMERS

- A. Construction:
 1. NEMA ST 1, factory-assembled, enclosed, ventilated, air-cooled, dry-type, with lifting brackets, sized as indicated on Drawings.
 2. Transformers shall be rated for continuous operation at rated kVA, 24 hours per day, 365 days per year with normal life expectancy as defined in IEEE 65.
 3. Minimum transformer efficiency shall meet Title 10 CFR Part 431.
 4. K-13 and K-20 rated transformers shall have a 200% neutral bar.
 5. See General Requirements above for NEMA enclosure rating requirements.
- B. Enclosure Properties:
 1. Enclosed, with vent openings (to meet NEC 450.21), UL 1561 listed.
 2. Audible sound levels shall be in accordance with NEMA ST-20.
 3. Capable of operating at 115% on 115°C rise, with ambient temperature rise not exceeding 40°C.

- C. Insulation: Unless otherwise noted on the Drawings, provide the following:
 - 1. Class 155 or higher, no exceptions.
 - 2. 1-15 kVA: Class 185 with 115°C rise.
 - 3. 16-500 kVA: Class 220 with 115°C rise.
- D. Tap arrangement: Use in the high voltage winding unless noted otherwise on the Drawings. Provide taps at 2.5% each, at least two (2) above and at least two (2) below nominal voltage.
- E. Mounting Options:
 - 1. 1-15 kVA: Suitable for wall mounting.
 - 2. 16-75 kVA: Suitable for wall, floor stand, or trapeze mounting.
 - 3. Larger than 75 kVA: Suitable for floor stand or trapeze mounting.
 - 4. Floor mounting shall be bolted to a four (4) inch raised concrete pad.

2.7 SAFETY SWITCHES AND ENCLOSED CIRCUIT BREAKERS

- A. Product Description:
 - 1. Provide single throw, horsepower rated, 100% load break and make rated, designed for locking in "ON" or "OFF" position, in code gauge steel cabinets, as required by the application and required per the NEC.
 - 2. Provide equipment rated for the required voltage and with the number of poles required, dependent on the equipment requirements.
 - 3. Provide SPDs at equipment in accordance with Section 26 43 00 - Surge Protection Devices.
- B. Construction:
 - 1. All safety switches and enclosed circuit breakers shall be Heavy Duty (HD) type.
 - 2. See General Requirements above for NEMA enclosure rating requirements.
- C. Disconnect / Safety Switches:
 - 1. Safety switches shall be fused, unless indicated as non-fused on the Drawings.
 - 2. All disconnects / safety switches shall be lockable in the OFF position.
 - 3. Use fuse clips which are rejecting type to accept Class RK or L fuses only.
 - 4. Size fused safety switches and upstream conductors serving motor loads at 125% to 175% of motor nameplate or per NEC values, whichever is larger, and round to the next standard size.
- D. Enclosed Circuit Breakers: Provide where indicated on Drawings, otherwise provide a disconnect / safety switch.

2.8 CIRCUIT BREAKERS

- A. Product Description: Bolt-on, quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489; ratings, configurations, and features as indicated on the Drawings.
- B. Interrupting Ratings: Provide size (ampacity) and withstand (AIC) rating as indicated on Drawings. Series rated panels are NOT allowed. All panels shall be FULLY RATED.
- C. Thermal Magnetic Circuit Breaker: Bimetallic overload elements, magnetic trip, common trip type so that an overload or fault on one pole will trip all poles simultaneously. Handle ties are not acceptable.
- D. Electronic Trip Circuit Breaker: Solid state, microprocessor-based, true RMS sensing trip units with the following field-adjustable trip response settings:
 - 1. Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
 - 2. Long time delay.
 - 3. Short time pickup and delay.
 - 4. Instantaneous pickup.
- E. Features and Accessories: Provide as required, as indicated in the Specifications and as shown on the Drawings.
 - 1. AFCI: Arc fault sensing where arc fault protection is indicated or required.

2. GFCI: Ground fault pickup and delay where ground fault protection is indicated or required by NEC.
 3. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
 4. Lock-Out Provision: For locking the circuit breaker in the off position.
- F. Provide number of poles indicated for the specified equipment or service, with common trip handle for all poles.
- G. Independently mount so that a single unit can be removed from the front of the panel without disturbing or removing main buss, other units or other branch circuit connections.
- H. All circuit breakers that have an overcurrent trip setting fixed or adjustable at 1200A or higher shall have an Energy-Reducing Maintenance Switch or similar approved method for arc energy reduction and shall meet all requirements of NEC 240.87. No exceptions.

2.9 FUSES

- A. Performance Requirements:
1. All fuses shall be from the same manufacturer.
 2. Provide ampacity rating as indicated on Drawings or required by NEC.
 3. Unless otherwise indicated on the Drawings, size fuses serving all motor loads at 175% of motor nameplate FLA or NEC motor table ampacity, whichever is larger.
- B. 600-amp and less: UL Class RK-1 dual element, time delay.
- C. 601-amp and larger: UL Class L time delay.

2.10 GFCI PROTECTION

- A. Ground Fault Protection System:
1. Ground sensor relay (GSR) system with ground break components, solid state construction, adjustable current pick-up and time delay settings.
 2. Coordinate ground sensor (CT) with integral test winding of sufficient size to encircle all phase and neutral conductors, for zero-sequence monitoring and a solid-state relay to operate the trip circuit on the main switches.
 3. Provide required transformer to supply power for tripping switches and connect phase to phase.
- B. Accessories Included:
1. Ground fault relaying system for main switches to be zero-sequence type.
 2. Ground fault current-detection range to be 100 to 1,200 amperes.
 3. Time delay range to be instantaneous to 60 cycles.
 4. Derive tripping and control power from control power transformers in switchboard.
 5. Components shall include static ground fault sensor, current monitor, and test panel.
- C. Where GFCI protection is required or indicated in the Specifications or Drawings, coordinate with the equipment manufacturer to provide proper GFCI requirements to determine whether they are intended to be for personnel (5ma) or equipment (30ma).

2.11 FRACTIONAL HORSEPOWER MOTOR-RATED SWITCH

- A. Product Description: NEMA WD-1 & WD-6, motor-rated toggle switch. For use when switch-mounted thermal overload relays are not required.
- B. Provide quality and features comparable to Leviton MS302 / MS303 series, Hubbell HBL78xx series or P&S 7802 / 7803 series.

2.12 FRACTIONAL-HORSEPOWER MANUAL MOTOR STARTER

- A. Product Description: NEMA ICS 2, AC general-purpose, Class A, manually-operated full-voltage controller for induction motors, with toggle control, manual motor starter and thermal overload relay, NEMA WD 1 & WD 6, UL 60947, NEMA ICS 6 enclosure.

- B. Control voltage shall be 120v, unless otherwise indicated on the Drawings.
- C. Provide quality and features comparable to Cutler-Hammer B100x series, Square-D KG-1/2 series, ABB CR1062Sx series or Siemens Class SMF / MMS series.

2.13 MANUAL MOTOR CONTROLLER

- A. Product Description: NEMA ICS 2, AC general-purpose, Class A, manually-operated full-voltage controller for induction motors, with push-button operation, red pilot light, manual motor starter and thermal overload relays, NEMA WD 1 & WD 6, UL 60947, NEMA ICS 6 enclosure.

2.14 AUTOMATIC MOTOR CONTROLLER

- A. Product Description: NEMA ICS 2, AC general-purpose, Class A, automatic full-voltage controller for induction motors, with push-button override, red pilot light, motor starter and thermal overload relays, NEMA WD 1 & WD 6, UL 60947, NEMA ICS 6 enclosure.
- B. Options and Features:
 - 1. Cover Mounted Pilot devices: NEMA ICS 5, standard duty type.
 - 2. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.

2.15 CONTACTORS AND RELAYS

- A. General:
 - 1. NEMA ICS 2, magnetic contactor with poles and contacts to match the circuit function and load. All contactors used for lighting shall be "lighting-rated".
 - 2. Coordinate coil voltage with controls system. 120v preferred. Provide fused control circuit transformers as required.
 - 3. Provide an enclosure to house all contactors and relays. See General Requirements above for NEMA enclosure rating requirements.
 - 4. All contactors to be rated for the load type, voltage and continuously rated current.
 - 5. Provide sufficient contactors and/or poles to accommodate quantity of circuits needing to be switched plus an additional 25% for future growth.
 - 6. Mechanically-held contactors are required except where electrically-held contactors are specifically noted on the drawings.
- B. Mechanically-held contactors:
 - 1. Mechanism electrically operated by solenoids and mechanically latched.
 - 2. Coil clearing contacts to de-energized coils when device is held closed.
 - 3. Required remote control relay and controls for proper latching and unlatching.
- C. Electrically-held contactors:
 - 1. Mechanism electrically-held by a solenoid.
 - 2. Required relays and controls for proper operation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify mounting supports are properly sized and located including concealed bracing in walls.

3.2 PREPARATION

- A. Coordinate with the power utility company to obtain information regarding the available short circuit current at the service point. Provide this information to the electrical gear manufacturer for use in the overcurrent protective device coordination study required by Section 26 05 73 - Power System Studies.
- B. Coordinate all requirements with the power utility company and include in the base bid, including but not limited to the following:
 - 1. Whether the service will be overhead or underground.

2. The extent of any underground primary.
3. The need for a secondary enclosure. Provide in bid if required.
4. Any charges from the power utility company for providing service.
5. The need for a transocket for utility metering.

3.3 APPLICATION

- A. Panelboards and Switchboards: Provide a complete isolated ground system including isolated ground panel with 200% neutral, SPD and separate isolated ground buss where indicated on the Drawings.
- B. Transformers:
 1. Provide K-1 transformers when serving electrical panels, unless altered by below items.
 2. Provide K-13 transformers when serving isolated ground electrical panels.
 3. Provide K-20 transformers when serving electrical panels in network operations centers (NOC).
- C. Circuit Breakers:
 1. Provide ground fault circuit breakers (GFCI) where indicated on the Drawings, panel schedules and / or as required by NEC 210.8(B), 422.5, etc. For example, provide protection at all EWCs, hand dryers, kitchen equipment, concessions equipment, and so on. Pull separate neutrals with each circuit to ensure correct GFCI operation.
 2. Provide combination AFCI / GFCI circuit breakers where AFCI protection is required per NEC and as indicated on the Drawings.
- D. GFCI Protection:
 1. Provide ground fault protection at all service entrance equipment in accordance with NEC 230.95.
 2. At health care facilities, provide an additional level of ground fault protection in accordance with NEC 517.17.
 3. Provide ground fault sensing and indication on emergency systems in accordance with NEC 700.27.
 4. Provide ground fault protection at any additional locations indicated on the Drawings.

3.4 INSTALLATION

- A. General:
 1. Set all equipment plumb, straight and level.
 2. Provide grounding and bonding in accordance with Section 26 05 26 - Grounding and Bonding.
 3. Provide and install all equipment, including electrical connections, in accordance with the manufacturer's written instructions, the applicable requirements of NEC and the NECA "Standard of Installation", and in accordance with recognized industry practices to ensure that products serve the intended function.
- B. Electrical Service:
 1. Underground primary: Unless otherwise noted on the Drawings, provide two 4" conduits from the power utility company service point to pad-mounted transformers. Primary conductors will be provided by the power utility company. Coordinate exact location of service point with the power utility company.
 2. Pad-mounted transformer: Construct the transformer pad in accordance with the power utility company specifications. Coordinate with the power utility company before installation of concrete for exact size, location and all requirements. The transformer will be provided by the power utility company, unless otherwise noted.
 3. Secondary enclosure: Coordinate with the power utility company and provide a secondary enclosure where required to transition from the transformer output to the service entrance feeder. Provide the pad for the secondary enclosure. Provide all conduit, wire, and terminations between the transformer and the secondary enclosure.
 4. Underground service entrance: Provide all trenching, conduit, conductors and electrical equipment from the secondary terminals of the transformer/secondary enclosure to the main service disconnects.
 5. Overhead service entrance: Provide all conduit, conductors, supports, weatherheads, and sleeving from the electric service point to the main service disconnects.
 6. Metering: Provide conduits, conductors, cabinets, racks, transocket, and supports as required by the power utility company for service metering. All utility metering equipment will be provided by

- the power utility company.
7. Final connection: Coordinate final connection with the power utility company.
- C. Panelboards and Switchboards:
1. Install in the locations as shown and as recommended in NEMA PB1.1. Mount the panelboards such that the top of the switch or circuit breaker in the highest position will not be more than 6-1/2 feet above the floor or working platform. Space all panelboards and switchboards to meet the requirements of NEC 110 and 408. Anchor enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secured.
 2. Provide required SPD breaker for each panel / switchboard as indicated on the Drawings.
 3. Coordinate installation of panelboards and enclosures with other trades, including Mechanical and Plumbing to avoid clearance issues with dedicated equipment space and working clearances.
 4. Furnish and install an engraved laminated nameplate for each circuit breaker or fused switch in distribution panelboards. Refer to Section 26 05 53 - Identification for Electrical Systems for more information.
 5. Place all free standing or floor mounted equipment on four (4) inch housekeeping pads.
 6. Where series rated panels are allowed: Field mark the factory furnished label in accordance with NEC 110.22(C).
- D. Transformers:
1. Mount transformers on additional vibration isolators and / or on neoprene and spring isolators at floor or other mounting points to meet sound ratings. Install as per manufacturer's recommendations.
 2. Mount floor-mounted transformers on vibration isolating pads suitable for isolating transformer noise from building structure on a four (4) inch thick reinforced concrete pad, unless indicated otherwise.
 3. Exterior weatherproof transformers: Mount on six (6) inch thick minimum steel reinforced concrete slab. Extend slab one (1) foot beyond transformer on each side. Provide weather shields from the manufacturer.
 4. Use flexible conduit, six (6) feet maximum length, for connections to transformer. Make conduit connections to side panel of enclosure.
 5. Check for damage and tight connections prior to energizing transformer. Measure primary and secondary voltages and make appropriate tap adjustments.
 6. At all floor-mounted transformers, installation to be level and equipment shall be bolted to a raised four (4) inch concrete pad.
 7. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by manufacturer.
- E. Fuses:
1. Check fasteners on fuse clips for tightness when installing fuses.
 2. Install fuses so label is in an upright, readable position. Fuses without labels are not acceptable.
 3. Do not install fuses until equipment is ready to be energized.
- F. Safety Switches and Enclosed Circuit Breakers:
1. Mount switches no more than six (6) inches above and within six (6) feet of the equipment served, so that operating handle is easily accessible. Align tops of switches when grouped together.
 2. Provide a four (4) inch housekeeping pad for all free standing / floor mounted safety switches whether they are mounted inside or outside.
 3. Mount vertically on required separate support system hardware with switch easily accessible (door to open 90 degrees minimum).
 4. Permanently mount safety switches from inside with plated or stainless bolts, toggle bolts or anchors. Exposed mounting bolts, screws, etc. are not acceptable.
 5. Permanently install fusible switches with Class R fuse kits so that fuses are readable when looking at open switch.
 6. Do not mount switches / disconnects to access panels or on nameplate data on equipment per NEC.
 7. Installation of Conductors: Switches shall not be used as "junction boxes" between HVAC units (splicing or "pig tailing" is not permitted). The maximum number of conductors allowed per termination is determined by the manufacturer's approved rating for each terminal or lug.
 8. Identification: Provide nameplate identification on all HVAC equipment regardless of equipment location per Section 26 05 53 - Identification for Electrical Systems.

G. Contactors and Relays:

1. Unless otherwise indicated on the Drawings, mount contactors in electrical enclosures in electrical room, mechanical room or designated area on Drawings in accordance with manufacturer's instructions and recommendations.

3.5 ELECTRICAL SERVICE AND METERING PROVISIONS

- A. The Contractor shall provide all materials and labor shown on the Drawings and / or required for the complete installation except as specifically indicated to be by the serving power utility company. The Contractor shall meet all requirements as directed by the serving power utility company at the cost to the Contractor.

3.6 GROUNDING

- A. Electrical grounding shall conform to NEC 250. See Section 26 05 26 - Grounding and Bonding for more requirements.

3.7 IDENTIFICATION

- A. See Section 26 05 53 - Identification for Electrical Systems.

3.8 ADJUSTING

- A. Electrical Load Balancing: Balance panels by checking each phase of all panels under full load and arrange so that all phases carry the same load as near as possible by moving individual branch circuits. After load balancing is complete, correct panel schedule directories to reflect all breakers and loads correctly.
- B. Transformer Voltage Adjustments: Measure primary and secondary voltages and make appropriate tap adjustments.
- C. GFCI Protection - Initial adjustments at service entrance equipment:
1. Initial settings: At the time of installation, adjust the settings of the ground fault protection device as follows:
 - a. Time delay: Adjust the time delay to 0.3 seconds.
 - b. Pick-up: In no case can the setting exceed 1,200 amps. Observing this absolute maximum, adjust the ground fault trip setting to the greater of the following two options:
 - 1) 15% of the trip rating of the main breaker in the service entrance equipment.
 - 2) At least as large as the trip rating of the largest downstream overcurrent device that serves a single piece of equipment.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Provide factory fabricated wiring devices of the type and electrical rating for the service indicated, provide proper selection to fulfill the wiring requirements. All wiring devices and associated wall plates shall be colored to match each other, unless indicated otherwise on the Drawings or changed by owner requirements, code requirements or these specifications.
- B. Provide switch, receptacle, outlet, conduit, and special purpose wall plates for wiring devices, with ganging and cutouts as indicated, provided with metal screws for securing plates to devices, screw heads colored to match finish of plate.
- C. Provide a compatible receptacle for the cap or plug and cord of all other equipment installed in this project.
- D. Mount all devices per Americans with Disabilities Act.

1.2 RELATED REQUIREMENTS

- A. Section 26 00 00 - Electrical Requirements
- B. Section 26 05 33 - Raceways and Boxes for Electrical

1.3 REFERENCES AND STANDARDS

- A. ADA - Americans with Disabilities Act
- B. ANSI / UL 20 - General Use Snap Switches
- C. ANSI / UL 498 - Electrical Attachment Plugs and Receptacles
- D. UL 943 - Ground Fault Circuit Interrupters
- E. UL 1310 - Safety Class 2 Power Units
- F. NEMA WD 1 - General Purpose Wiring Devices
- G. NEMA WD 6 - Wiring Devices Dimensional Requirements
- H. Federal Specification WC 596F and WS 896E

1.4 CLOSEOUT SUBMITTALS:

- A. Submit per Closeout Submittals requirements in 26 00 00 - Electrical and any additional requirements listed below.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following, unless specific manufacturers are listed or restricted elsewhere in this specification section:
1. Arrow Hart / Eaton Corp. / Cooper Industries
 2. Bell
 3. Bryant
 4. GE
 5. Gleason
 6. Graco
 7. Hubbell Inc.
 8. KH Industries
 9. Leviton
 10. Pass & Seymour / Legrand / Wiremold
 11. Perfectline
 12. ReelCraft
 13. Wattstopper

2.2 GENERAL REQUIREMENTS

- A. Unless otherwise specified herein or indicated on the drawings, all devices shall be specification grade, heavy duty, 20A rated (at equipment rated voltage with the required number of poles), back and side-wired with grounding terminals. Screw terminals only, no push-in terminals. These devices shall comply with NEMA WD 1 Standards and shall all be listed.
- B. Color:
1. Device color shall be coordinated with Owner's Representative and WHITE and shall reasonably match across all divisions. Emergency devices and plates shall be red.
 2. Device plate material shall be as follows: In all finished spaces use smooth nylon device plates and covers.
- C. All devices shall be properly labelled and identified per NEC, NFPA and IECC requirements. Additionally, all emergency device coverplates shall be labelled with the panel name and circuit number.

2.3 AC / TOGGLE SWITCHES

- A. Unless otherwise specified herein or indicated on the drawings, all switches to be quiet-type, complying with UL 20 and Federal Specification WC 896.
- B. Key-Operated switches shall be single pole, with factory-supplied key in lieu of switch handle. Corbin-style or barrel lock and key. Single-hump key not acceptable.

- C. Wall Switches:

	Single Pole	Double Pole	Three-Way	Four-Way	Pilot Light
Leviton	1221-S	1222-S	1223-S	1224-S	1221-PLR
Hubbell	CS1221	CS1222	CS1223	CS1224	1221-PL
P & S	CS20AC1	CS20AC2	CS20AC3	CS20AC4	CS20AC1-RPL

- D. Slotted Key-Operated Switches:

	Single Pole	Double Pole	Three-Way	Four-Way
Leviton	1221-L	1222-L	1223-L	1224-L
Hubbell	HBL 1221	HBL 1222	HBL 1223	HBL 1224
P & S	PS20AC1L	PS20AC2L	PS20AC3L	PS20AC4L

- E. Captive Twist Key-Operated Switches:

Leviton	1221-2KL w/WS-35 key	1222-2KL w/WS-35 key	1223-2KL w/WS-35 key	1224-2KL w/WS-35 key
Hubbell	HBL 1221-RKL	HBL 1222-RKL	HBL 1223-RKL	HBL 1224-RKL
P & S	PS20AC1KL	PS20AC2KL	PS20AC3KL	PS20AC4KL

F. Motor-Rated Switches:

	20A 2-Pole	20A 3-Pole	30A 3-Pole
Leviton	MS302-DS	MS303-DS	MS303-DS
Hubbell	HBL7832D	HBL7810D	HBL7810D
P & S	7802MD	7803MD	7803MD

2.4 RECEPTACLES

- A. Unless otherwise specified herein or indicated on the drawings, all receptacles to be NEMA 5-20R duplex, complying with NEMA WD 6 Standards, UL 498 and 943, Federal Specification WC 596F and WC 596.
- B. Isolated Ground (IG) Receptacles: All IG receptacles to be four wire with self-ground strap. Place these receptacles at all computer and communications / technology locations if IG panels are provided.
- C. GFCI Receptacles: GFCI receptacles to be NEMA 5-20R duplex, self-test, auto monitoring, complying with UL 943 and UL 498.

- D. SPD Receptacles: NEMA 5-20R duplex, Type 3 SPD, >200 Joules, >6kA Surge, 3-mode, with indicator light.

E. Specification Grade, Heavy Duty Receptacles:

	20A Duplex	20A GFCI	20A IG	20A SPD
Leviton	5362	G5362x	5362-IG	5380x
Hubbell	5362	GFRST20	Equal by Hubbell	5362x
P & S	5362	P2097	Equal by P&S	5362-SP

F. Weatherproof Receptacles:

- All weatherproof receptacles shall have GFCI protection at the device or at the breaker.
- Receptacle covers protected from rain shall be zinc die-cast weather-resistant cover with self-closing lid, Leviton 4992, P&S WIUCAST1, or equivalent.
- Receptacle covers not protected from rain shall be "While-In-Use" cover, Leviton 5977DGY, P&S WIUC10DGL, or equivalent.

G. Controlled Receptacles:

- Provide Leviton 5362 series or equivalent.
- All controlled receptacles required to meet the Energy Code shall be duplex receptacles with the top receptacle controlled and the bottom receptacle non-controlled, unless otherwise noted on the Drawings.
- All controlled receptacles shall meet NEC 406.3(E) marking requirements.
- When controlled receptacles are needed refer to Section 26 09 23 - Lighting Control Devices for plug load controllers and Sequence of Operations.

H. USB Charger Receptacles: 125V, 20A; comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, UL 498, UL 1310, and Federal Specification WC 596.

- Single-piece, rivetless, nickel-plated, all-brass grounding.
- USB Receptacles: Dual, Type A and C.
- Line Voltage Receptacles: Dual, two-pole, three-wire, self-grounding.
- Provide Leviton 60W T5634-W series or equivalent fast charging receptacle.

2.5 VOICE / DATA OUTLETS

- A. Refer to Division 27 for device and device plate requirements.

2.6 DEVICE PLATES

- A. Both standard and oversized (jumbo) device plates are allowed. However, where oversized device plates are used, the entire room shall use oversized device plates.

- B. Weatherproof Cover Plates: Provide cast aluminum weatherproof device plates with hinged cover for each outlet for exterior receptacles as indicated. When any outdoor receptacle is permanently in use (heat tape, etc.) provide a cover listed as "While In Use".

2.7 CORD REELS

- A. All cord reels shall be industrial duty with type "W" or "SJOW" cord, 4 roller outlet, ball stop and receptacle on cable end unless specifically noted otherwise on the Drawings. See detail or drawing notes for voltage, phase, ampacity, wire size, wire length and receptacle requirements.
- B. Where a cord reel is to be installed above a ceiling and the above ceiling space is plenum rated, provide a suitable box above ceiling to mount cord reel in so it is not in the plenum space.
- C. Cord reels in any kitchen or cooking demonstration area are to have a white housing and shall be GFCI protected.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean debris from outlet boxes before installing devices.

3.2 APPLICATION

- A. All devices shall have GFCI and AFCI protection per NEC 210.
- B. All receptacles shall meet tamper-resistant requirements of NEC 406 for the location installed.

3.3 INSTALLATION

- A. All Devices:
 - 1. Install devices plumb and level.
 - 2. Install switches with OFF position down.
 - 3. The Owner's Representative can move any device, before installation, up to six (6) feet in any direction at no additional cost to the Owner.
 - 4. Install stainless steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
 - 5. Connect wiring devices by wrapping solid conductor around screw terminal. For other options, see Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
 - 6. Do not install behind markerboards, millwork, permanent mounted equipment, etc. Verify on Architectural drawings before installation. Where installed in unsuitable location, the Contractor will move as directed at no cost to the Owner.
- B. GFCI Receptacles:
 - 1. Install separate GFCI device at each location. Do not use feed through feature for any GFCI receptacle unless specifically noted on the Drawings.
- C. Device Plates:
 - 1. Use a single one-piece device plate for ganged devices (switches & receptacle).
 - 2. Provide oversize plates where required to completely cover wall opening. Where oversize plates are used, all plates in room shall be oversize style.
- D. Cord Reels:
 - 1. Install cord reels per notes on Drawings and cord reel detail.
 - 2. Where a cord reel is required to be installed above a ceiling, mount cord reel such that roller assembly protrudes slightly through the ceiling. Provide trim plate at ceiling cutout.

3.4 QUALITY CONTROL

- A. Verify outlet boxes are installed at proper height.

- B. Verify wall openings are neatly cut and completely covered by wall plates.
- C. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- D. Operate each wall switch with circuit energized and verify proper operation.
- E. Verify each receptacle device is energized and test each for proper polarity.
- F. Test each GFCI receptacle device for proper operation.

3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

END OF SECTION

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SECTION 26 33 53

STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. This specification section describes a three-phase uninterruptible power supply, hereafter known as the UPS.

1.2 REFERENCES

- A. UL-1778, Standards for Uninterruptible Power Supply Equipment.
- B. UL-924 Standard applies to emergency lighting and power equipment.
- C. IEEE 587-1980 / ANSI C62.41 1980 Standards for Surge Withstand ability
- D. CSA 22.2, No. 107.1 (cUL equivalent).
- E. IEC, Semiconductor Converter Standards.
- F. ISO 9001 Quality Assurance program.

1.3 SYSTEM DESCRIPTION

- A. The Storm Shelter UPS shall be a UL1778 listed, continuous duty, solid-state, uninterruptible power system. The UPS shall operate continuously at rated capacity as an active power control system in conjunction with building electrical systems to provide conditioned uninterruptible power. The system shall consist of inverter, battery bank, transformer (if needed), integral distribution breakers to feed loads, and accessories.

1.4 DESIGN REQUIREMENTS

- A. See UPS Detail for UPS size and other requirements.
- B. System Type: The system shall be an on-line interactive or (double-conversion) type system.
- C. Future Expansion: The UPS shall be capable of a field upgrade to allow parallel operation with additional UPS modules for increased battery capacity or for redundant operation.
- D. Features: The UPS shall have the following features.
 - 1. Transistorized PWM IGBT intelligent converter for input.
 - 2. Digital signal processing (DSP) using PWM for direct digital control (DDC) of all UPS control and monitoring functions.
 - 3. Transistorized PWM IGBT intelligent inverter for output.
 - 4. Input isolation transformer and output isolation transformer.
 - 5. Fault memory and diagnostics.
 - 6. Menu controlled operation.
 - 7. Active control of output voltage distortion.
 - 8. Automatic current walk-in.
 - 9. Remote operation and remote monitoring panel.
 - 10. Automatic UPS restart and load pickup after the battery is depleted and the utility power is restored.
 - 11. Two strings of batteries. Systems utilizing a single battery string will not be considered.
 - 12. Internal DC disconnect and fuse protection if indicated on UPS detail.
 - 13. Remote and local emergency power of (EPO).

14. Input AC disconnect and fuse protection.
 15. Internal maintenance bypass switch if indicated on UPS detail.
- E. Audible Noise: Noise generated by the UPS under any condition of normal operation shall not exceed 65 dBA measured 1 meter from surface of the UPS.
- F. Surge Protection: The UPS shall be able to sustain input surges without damage per criteria listed in ANSI C62.41-1980.

1.5 PERFORMANCE REQUIREMENTS

- A. Capacity
1. Power Rating: The power output rating of the UPS shall be per UPS detail at 0.9 lagging power factor.
 2. Run Time: At full load, the system shall have a minimum run time per UPS detail.
 3. Output Overload Capability: The UPS module shall be capable of supplying regulated output voltage during overloads of up to 125% of its ratings for a period of 10 minutes and 150% for one (1) minute. Overloads in excess of 167% of the UPS rating on an instantaneous basis or in excess of the overload time periods previously stated shall cause the static bypass transfer switch to reverse transfer and allow the AC bypass input line to supply the necessary fault clearing current required.
- B. Full Load Efficiency
1. The overall efficiency of the module (AC to AC), with nominal input voltage, battery fully charged and the inverter supplying full rated load, shall be 93.0% at 100% load and 93% at 50% load (excluding output transformer).
- C. Current Ratings
1. Reflected Input Current THD: 6% maximum at 100% load. 9% maximum at 50% load.
- D. Voltage Specifications
1. Input:
 - a. Input voltage: The nominal UPS input voltage and phase shall be as required to match upstream panel and breaker this equipment is fed from.
 - b. Input voltage: See plans and UPS detail
 - c. Input voltage range: The allowable input voltage range shall be at least +10% and at least -15%.
 - d. Input frequency and range: 60 Hz \pm 10%.
 - e. Input power factor: .98 lagging minimum at 100% load; 0.95 lagging minimum at 50 % load without additional harmonic filters.
 2. Output:
 - a. Nominal Output Voltage: per UPS detail or per panel / loads fed. See plans and UPS detail.
 - b. Nominal Dynamic Voltage Regulation: +/- 0.5% for balanced load, +/- 2% for 50% unbalanced load.
 - c. Voltage Adjustment Range: +/- 5% manually.
 - d. Voltage Transient Response: Output voltage transients shall be limited to a maximum of 2% deviation from nominal voltage on any and all phases. Output frequency shall be maintained to within 0.1 Hz of the specified frequency during transient conditions. The maximum voltage deviation for any phase on the output of the UPS inverter shall be \pm 2% for 100% step load change. The output voltage shall return to within \pm 0.5% of the steady state value within 16.67 milliseconds (1 cycle) after a voltage transient.
 3. Output Frequency Regulation: The UPS shall be capable of providing the nominal output frequency of 60 Hz \pm 0.05 Hz when the UPS inverter is not synchronized (free-running) to the bypass AC input line. The UPS shall be capable of providing the nominal output frequency 60 Hz \pm 2.0 Hz (selectable in 0.25 Hz increments) when the UPS inverter is synchronized to the bypass AC input line.
 4. Phase Imbalance: Balanced loads 120 deg +/- 1 deg, 50% unbalanced loads 120 deg +/- 3 deg.
 5. Output Voltage Harmonic Content: Maximum < 1.5% THD Ph/Ph, < 2% THD Ph/N when the UPS is connected to 100% linear loads. Output voltage total harmonic distortion shall be less than < 2% Ph/Ph, < 3% Ph/N when connected to a 100% non-linear load with a crest factor not to exceed 3.5.

1.6 SUBMITTALS

- A. Product Data
 - 1. Submit product data for all components and accessories of the UPS.
- B. Closeout Submittals
 - 1. Operating and Maintenance Manuals: Provide 2 complete sets of operating, maintenance, and adjustment instructions and other information necessary for proper operation of the UPS. These documents shall be included as part of the project operating and maintenance manuals.
 - 2. As-built Drawings: Provide 2 complete sets of as-built plans showing the location and wiring configuration of all major components of the UPS.
 - 3. Warranty: Provide 2 copies of warranties.
 - 4. Training Documentation: Provide letter in final documents documenting that the Owner (give name of person, date, duration, and content of training) received training required in this section.
 - 5. Factory Check out Documentation: Provide documentation of manufacturer's factory testing.
 - 6. Manufacturer's Commissioning Documentation: Provide documentation of manufacturer's final testing, adjusting, and commissioning of the completed installation.

1.7 QUALITY ASSURANCE

- A. Qualifications
 - 1. The manufacturer shall have a minimum of 20 years' experience in the design, manufacture, and testing of solid-state UPS systems.
 - 2. The manufacturer shall be ISO 9001 certified.
 - 3. Service Personnel: The UPS manufacturer shall directly employ a nationwide service organization, consisting of factory trained field service personnel dedicated to the start-up, maintenance, and repair of UPS equipment. The manufacturer shall provide a national dispatch center to coordinate field service personnel schedules. One toll-free number shall reach a qualified support person 24 hours/day, 7 days/week, 365 days/year. If emergency service is required, response time shall be 4 hours or less.
 - 4. Replacement Parts Stocking: Parts shall be available through an extensive network to ensure around-the-clock parts availability throughout the country. Recommended spare parts shall be fully stocked by local field service personnel with back-up available from national parts center and the manufacturing location. The national parts center Customer Support Parts Coordinators shall be on-call 24 hours a day, 7 days a week, 365 days a year for immediate parts availability. Parts from the national parts center shall be shipped within 4 hours on the next available flight out and delivered to the customer's site within 24 hours.

1.8 REGULATORY REQUIREMENTS

- A. UL Label: All UPS products shall be UL-labeled for the specific applications utilized on this project.

1.9 PRE-INSTALLATION MEETINGS

- A. The contractor shall arrange a meeting with the UPS supplier prior to installation of the equipment to coordinate all aspects of the installation process. The contractor shall require the UPS manufacturer to provide instruction regarding the installation of the system.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. If temporary on-site storage is required before installation, then the contractor shall strictly adhere to all prescribed storage requirements set forth by the manufacturer.

1.11 WARRANTY

- A. UPS Module: The UPS manufacturer shall warrant the UPS module against defects in materials and workmanship for 12 months after initial start-up or 18 months after ship date, whichever period expires first.
- B. Battery: The battery manufacturer's standard warranty shall be passed through to the end user. The battery shall have at least a one (1) year full warranty and at least a nine (9) year pro rate warranty under

full float operation.

1.12 SYSTEM STARTUP

- A. A system start-up service package shall be available to commission the units after installation. This additional testing shall compliment the standard factory testing, and verify that no problems have been introduced by shipping or installation damage.

1.13 OWNER'S INSTRUCTIONS

- A. The contractor shall require the UPS manufacturer to provide instruction to the owner's personnel in the operation, adjustment, and maintenance of the system. The manufacturer shall provide documentation of such training in the closeout submittals.

1.14 COMMISSIONING

- A. Prior to substantial completion of the project, the contractor shall require the manufacturer to test the operation of the system to ensure the proper operation of the system throughout the range of building operating conditions. The manufacturer shall provide documentation of such commissioning in the closeout submittals.

1.15 MAINTENANCE

- A. Maintenance Contracts: A complete offering of preventive and full service maintenance contracts for both the UPS system and battery system shall be available. An extended warranty and preventive maintenance package shall be available. Warranty and preventive maintenance service shall be performed by factory-trained service personnel.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. If they comply with these specifications, products of the following manufacturers will be acceptable. Contact names are given only as an aid to the contractor with no guarantee of accuracy.
- B. Liebert
Tech Plan Inc. Plano Texas
Phone (469) 467-4000
amoore@tplan.com
- C. Mitsubishi Electric Automation Inc.
Chris Howell (Datacom Power, Inc., Plano Texas)
Phone (972) 491-0987
ChrisHowell@DataComPower.com
- D. DSPM And APC Manufacturing
Curt Herge (Tubbesing Solutions LLC, Dallas Texas)
Cell: (469) 859-0072
Office: (972) 234-3855, Ext. 244
Curt@tubbesing.com
- E. OnLine Power
Allen Pilgrim (Texas Lighting Sales)
Cell: (214) 364-4345
apilgrim@texaslighting.com
- F. Myers Emergency Power Systems
Susan Dove (Architectural Lighting Alliance)
Office: (469) 916-1955
sdove@alatx.com

2.2 COMPONENTS

- A. Rectifier/Converter: The converter shall utilize pulse-width modulated (PWM)-controlled insulated-gate bipolar transistors (IGBT) switching at a minimum of 6 kHz.
- B. Inverter: The Inverter shall be capable of providing rated output while operating from any DC voltage within the battery operating range. The inverter shall utilize solid state PWM controlled IGBT power transistors switching at a minimum of 6 kHz and DSP based control logic.
- C. System Battery: The system battery shall consist of two strings of batteries to allow for battery maintenance and replacement without disrupting the operation of the UPS.
- D. Battery Circuit Breaker: A battery disconnect circuit breaker with undervoltage release (UVR) and auxiliary contacts shall be included for isolation of the battery pack from the UPS module. When opened, there shall be no battery voltage in the UPS enclosure. The UPS shall be provided with a pushbutton to trip the breaker from the control panel.
- E. Static Transfer Switch: A static transfer switch shall be provided as an integral part of the UPS. The static switch shall be rated to conduct full load current continuously. The switch shall have an overload rating of 110% rated load continuously, 200% rated load for five seconds. The static transfer switch shall also have fault-clearing capabilities.
- F. Enclosure: The UPS shall be equipped with casters or standard forklift provisions to allow ease of installation using conventional lifting/moving equipment. The UPS shall have front access only for maintenance or service. Side access or rear access shall not be accepted. The UPS shall be designed such that its rear can be pressed against a back wall and its sides can be pressed against sidewalls.
- G. Display and Controls: UPS start-up, shutdown, and bypass operations shall be accomplished through the front-panel pushbutton controls. Menu-driven user prompts shall be provided to guide the operator through system operation without the use of additional manuals. Pushbuttons shall be provided to display the status of the UPS and to test and reset visual and audible alarms. A mimic screen shall be available on the LCD screen to depict a single-line diagram of the UPS, with switch positions and power flow.
- H. Automated Battery Testing: The system shall be equipped with a battery management system that logs battery environmental parameters, cycling history and monitors general battery health. The system shall also perform battery performance tests at predetermined intervals to assess battery health.
- I. Automatic Diagnostics: The UPS shall be equipped with a continuously operating auto-diagnostic system that evaluates the operating condition of the UPS and all the sub components. In the event that the diagnostics system detects a problem, the system shall sound an audible alarm to alert the operator.

2.3 ACCESSORIES

- A. Web / SNMP Software: The UPS shall come equipped with an internal SNMP adapter, which will connect the UPS directly to any I.P. based network using Ethernet communications. The UPS manufacturer shall provide a Web/SNMP software package to enable full management of the UPS using a browser. In the event of a utility failure the SNMP shall continue with live communication without the requirement of additional or separate UPS equipment until such time as the UPS shuts down for low battery. On resumption of utility power the SNMP shall resume full SNMP communication automatically.
- B. Computer System Shut-down Software: When the remaining battery capacity discharges to a threshold level, the UPS system shall generate a signal to be sent to the owner's computer system that will be used to initiate a controlled shut-down of the owner's computer system. The UPS vendor shall provide any software that is required on the owner's computer system to accomplish this.
- C. Internal Modem: The UPS shall come with an internal modem capable of dialing out from the UPS to notify up to two remote computers, terminals, PC's, or pocket pagers when important events occur. The modem will also be capable of accepting incoming calls, with the appropriate security, and connecting to a remote terminal, computer or PC, to perform all those functions normally available on the front panel including viewing monitoring screens.

2.4 TESTS, INSPECTION

- A. Factory Testing: Before shipment, the manufacturer shall fully and completely test the system to ensure compliance with the specification. These tests shall include operational discharge and recharge tests to ensure guaranteed rated performance.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Site verification of Conditions
 - 1. If the work is to be performed in an existing facility, both the contractor and the manufacturer's representative shall visit the site of the proposed work and observe its conditions so that they may be fully informed as to the materials, labor, workmanship and conditions under which the work is to be done.

3.2 INSTALLATION

- A. Install the UPS as required and where indicated, in accordance with manufacturer's written instructions and project shop drawings, applicable requirements of NEC, and recognized industry practices to ensure that products serve intended function.

3.3 FIELD QUALITY CONTROL

- A. Site Tests
 - 1. The systems shall be tested on-site by the manufacturer's factory trained field service personnel as part of the standard start-up procedure. Final UPS adjustments, if any, shall be made as required. Start-up includes the following:
 - 2. Load Bank Test: Site acceptance load bank testing of the system shall consist of two hours of operation at 50% of full load rating, two hours of operation at 75% of full load rating, and four hours operation of 100% of full load rating. The manufacturer shall provide all load banks required for this testing, including all wiring required and delivery to the site. If the UPS system fails the first test, the manufacturer shall rerun the load test at no addition cost to the Owner.
 - 3. Transient Test: Record output voltage, output current, bypass voltage and bypass current during the transient tests of applying and removing 0% - 100% - 0% load.
 - 4. Load Transfer Test: Record output voltage, output current, bypass voltage and bypass current during transfer from inverter to bypass and bypass to inverter with no load and 100% kW load.
 - 5. Input Failure Test: With the module operating at full load and the battery connected, disconnect the input power to the UPS. Record output voltage, output current, input voltage and input current during battery operation. Verify and record the actual battery protection time.
 - 6. Battery Capacity Test: The battery capacity test shall include a full discharge operation. This test shall utilize a microprocessor controller which shall be programmed to monitor each cell. Within the processor, provide alarm circuits to warn the operator of any performance problems. Overall battery voltage, individual cell or mono-block cell voltages, current, and elapsed time shall be logged and recorded by this system. The acquired data shall be analyzed to demonstrate measured ampere-hour capacity of the battery system and integrity of cell-to-cell connections. The measured battery system capacity shall be normalized to 77 deg. F. and compared to the manufacturer's published data to demonstrate compliance. Upon completion of this test, completed copies of this test shall be submitted to the Owner and Engineer for approval and acceptance of the battery system.
 - 7. Battery Recharge Test: As part of the battery capacity test, verify the recharge time of the battery.

3.4 INSPECTION

- A. The following inspections and checks shall be performed by the manufacturer's factory-trained field service personnel during the UPS startup.
- B. Visual Inspection:
 - 1. Inspect equipment for signs of damage.
 - 2. Verify installation per drawings.

3. Inspect cabinets for foreign objects.
 4. Verify neutral and ground conductors are properly sized and configured.
 5. Inspect battery cases.
 6. Inspect battery for proper polarity.
 7. Verify all printed circuit boards are configured properly.
- C. Mechanical Inspection:
1. Check all control wiring connections for tightness.
 2. Check all power wiring connections for tightness.
 3. Check all terminal screws, nuts, and/or spade lugs for tightness.
- D. Electrical Inspection:
1. Check all fuses for continuity.
 2. Confirm input voltage and phase rotation is correct.
 3. Verify control transformer connections are correct for voltages being used.
 4. Assure connection and voltage of the battery string(s).

3.5 MANUFACTURER'S FIELD SERVICES

- A. UPS Startup and Commissioning: The manufacturer shall use factory trained personnel to provide the initial startup and commissioning of the UPS.
- B. UPS Operator Training: The manufacturer shall train the owner's UPS operator in basic UPS operation.
- C. UPS Maintenance Training: The manufacturer shall train the owner's maintenance personnel in basic UPS operation and UPS maintenance. Maintenance training for customer employees is in addition to the basic operator training conducted as a part of the system start-up. The training course shall cover UPS theory, location of subassemblies, safety, battery considerations and UPS operational procedures. The course shall include AC to DC conversion and DC to AC inversion techniques as well as control metering, and feedback circuits to the Printed Circuit Board (PCB) level. Troubleshooting and fault isolation using alarm information and internal self-diagnostics shall be stressed. The training shall consist of at least two 4-hour training sessions.

END OF SECTION

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SECTION 26 43 00
SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Provide surge protective devices (SPDs) as indicated on the Drawings, as required in NEC 242 and as indicated in Part 3.1 Application below.
- B. Provide SPDs for phone, data, security, and other systems.

1.2 RELATED REQUIREMENTS

- A. Section 26 00 00 - Electrical

1.3 REFERENCES AND STANDARDS

- A. ANSI / IEEE C62 - Guides and Standards for Surge Protection
- B. Military Standard 220B - Method of Insertion Loss Measurement
- C. UL 497 - Paired Conductor Communications Circuits
- D. UL 1449 - Standard for Safety, Surge Protection Devices Type 1-3 Protectors

1.4 ABBREVIATIONS

- A. I_n - Nominal Discharge Current
- B. MCOV - Maximum Continuous Operating Voltage
- C. SCCR - Short Circuit Current Rating
- D. VPR - Voltage Protection Rating (clamping voltage)

1.5 SUBMITTALS

- A. Product Data: Submit product data for all SPD used on this project. Provide evidence that SPD are listed to the most current edition of UL 1449 by an OSHA approved safety testing agency (i.e. UL, ETL, or CSA). Provide a submittal package that includes specifications, third party testing and listing letters.
 - 1. Product data to be issued in submittal:
 - a. Maximum Single Impulse Surge Current Rating
 - b. Surge Life (Repetitive Surge) Rating
 - c. Clamping Voltage (VPR)
 - d. Nominal Discharge Current (I_n)

1.6 CLOSEOUT SUBMITTALS

- A. Provide cut sheets and warranty information on all devices and equipment used on this project that are referenced in this Division and used on this project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB (formerly GE)

2. ACT Communications
3. Eaton Corporation (formerly Cutler Hammer)
4. Mersen (formerly Ferraz Shawmut)
5. nVent Erico
6. Southern Tier Technologies (formerly Emerson / Liebert)
7. Square-D (Schneider Electric)
8. Surge Suppression Inc (SSI, ILSCO)

2.2 EQUIPMENT

A. General:

1. Technology: Construction shall be Metal Oxide Varister (MOV) componentry with bidirectional operation.
2. Protection Modes: Provide at least seven (7) mode protection (L-N, L-G, N-G) with discrete protection elements on each mode.
3. Protection: Each SPD shall be protected upstream by a dedicated UL rated fuse or disconnecting means.
4. Provide surge protection plus filtering of disruptive noises, EMI / RFI interference to >-40dB from 3kHz to 1 MHz according to Military Standard 220B.
5. Listing and Ratings: SPDs shall be tested and performance rated per UL 1449. Clamping voltage shall be clearly stated on both submittals and equipment installed.
6. Voltage Ratings (per UL 1449):

<u>Rated Line Voltage</u>	<u>MCOV</u>	<u>VPR</u>
120 / 240v 120 / 208v	150v	800v (L-N, L-G), 1200v (L-L)
240 / 480v 277 / 480v	320v	1200v (L-N, L-G), 1800v (L-L)
480v (2 ph. Delta)	600v	1800v (L-G), 3000v (L-L)

7. Alarms and Monitoring: Provide all SPDs with the following:
 - a. LED indicator lights for power and protection status.
 - b. Audible alarm, with silencing switch, to indicate when protection has failed.
 - c. One set of dry contacts (1-NO and 1-NC) rated at 5A and 240v for remote monitoring of protection.
 8. Mounting: All SPDs may be internally-mounted or externally-mounted if mounted directly beside the panel it serves.
 9. Digital Surge Event Counter with battery backup.
- B. Service Entrance: SPDs at the electrical service entrance (main distribution panel or main service disconnecting means) shall meet the following additional criteria:
1. Modular construction, field replaceable, internal or external mount, NEMA rated for the environment.
 2. UL 1449 location rated as Type 1 and Type 2 SPD device.
 3. UL 1449 Nominal Discharge Current (I_n): 20kA (8 x 20 μ s waveform).
 4. Maximum Single Impulse Current Rating: 135kA / mode (8 x 20 μ s waveform).
 5. Life Cycle Test (IEEE C62.41.2 C3): 10kA / phase at greater than 20,000 impulses.
 6. SCCR: 200kAIC or no less than specified rating at the service entrance.
- C. Panelboards: SPDs at all other electrical panels shall meet the following additional criteria:
1. Modular construction, field replaceable, internal or external mount, NEMA rated for the environment.
 2. UL 1449 location rated as Type 2 device.
 3. UL 1449 Nominal Discharge Current (I_n): 20kA (8 x 20 μ s waveform).
 4. Maximum Single Impulse Current Rating: 65kA / mode (8 x 20 μ s waveform).
 5. Life Cycle Test (IEEE C62.41.2 C3): 10kA / phase at greater than 5,000 impulses.
 6. SCCR: 100kAIC or no less than specified rating of the electrical subpanel.
- D. Outdoor Mechanical Equipment: SPDs at RTUs, condensers, fans, etc. shall meet the following additional criteria:
1. Outdoor rated NEMA 4X enclosure, nipple-mounted (preferred).

2. UL 1449 location rated as Type 2 SPD device.
 3. UL 1449 Nominal Discharge Current (I_n): 20kA (8 x 20 μ s waveform).
 4. Maximum Single Impulse Current Rating: 25kA / mode (8 x 20 μ s waveform).
 5. Life Cycle Test (IEEE C62.41.2 C3): 10kA / phase at greater than 2,500 impulses.
 6. SCCR: 65kAIC or no less than specified rating of the equipment.
- E. Receptacles with Type 3 SPD installed: See Section 26 27 26 - Wiring Devices for more information.
- F. SPD for telephone, video, data and alarm lines shall meet the following criteria:
1. Comply with appropriate UL 497, 497A, 497B and 497C standards for secondary protectors.
 2. Technology can be Gas Tube, Silicon Avalanche Diode or hybrid.
 3. Rate Line Voltage (RMS): 150v for phone, 24v for data and control.
 4. MCOV: 180vac tip (or ring) to ground.
 5. Clamp Voltage (Pair): Tip to ground and ring to ground to be 300v.
 6. Maximum Single Impuse Current Rating: 10kA (8 x 20 μ s waveform).
 7. Life cycle test 3kA at greater than 1,000 impulses.

PART 3 - EXECUTION

3.1 APPLICATION

- A. For new construction, provide SPDs at each location listed below. For renovations and additions, provide SPDs at the locations listed below which are affected / replaced / added to by the project but do not already have SPD.
1. Each electrical service entrance equipment.
 2. Each computer panelboard and at each isolated ground / nonlinear panelboard.
 3. All emergency systems switchboards and panelboards.
 4. Each panelboard noted on the Drawings in addition to above requirements.
 5. Provide SPD protection on all outdoor HVAC equipment unless requirement is removed or altered by Section 26 20 00 - Low Voltage Distribution, Part 2.8 Enclosed Switches and Circuit Breakers. Mount SPDs to bottom of safety switch or as recommended by the manufacturer.
 6. One SPD power outlet at each Energy Management Control Panel located by project controls contractor.
 7. Each new telephone and data incoming line.
 8. All new video or alarm system wire entering from the outside of the facility.
 9. In or on each fire pump controller in accordance with NEC 695.15.

3.2 INSTALLATION

- A. Install all SPDs per manufacturer's installation instructions.
- B. Where externally-mounted SPDs are provided, install the SPDs next to the panel they protect. Do NOT extend the lead length beyond the manufacturer's requirements.
- C. SPDs installed in distribution or branch panel locations shall be either direct connected to the main bus or via a dedicated branch breaker sized per manufacturer recommendations, unless otherwise noted on the Drawings.

END OF SECTION

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SECTION 26 50 00

LIGHTING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Interior and exterior lighting systems including, but not limited to, luminaires, drivers, emergency drivers, emergency lighting, power transfer devices, poles and pole bases, etc.
- B. Exceptions include Section 26 55 61 - Theatrical Lighting and Section 26 56 68 - Exterior Athletic Lighting.

1.2 RELATED REQUIREMENTS

- A. Section 26 00 00 - Electrical
- B. Section 26 09 16 - Electrical Control Components
- C. Section 26 09 23 - Lighting Control Devices

1.3 REFERENCES AND STANDARDS

- A. ANSI C78.377 - Specifications for the Chromaticity of Solid-State Lighting Products
- B. ASTM C150 - American Society for Testing and Materials Standard Specification for Portland Cement
- C. Code of Federal Regulations (CFR), Title 47, Part 15 - Radio Frequency Devices
- D. DLC - DesignLights® Consortium
- E. IESNA LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products
- F. IESNA LM-80 - Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules
- G. IESNA TM-21 - Projecting Long Term Lumen, Photon, and Radiant Flux Maintenance of LED Light Sources
- H. NECA / IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems
- I. NECA / IESNA 501 - Standard for Installing Exterior Lighting Systems
- J. UL 844 - Standard for Safety - Luminaires for Use in Hazardous (Classified) Locations
- K. UL 924 - Standard for Safety - Emergency Lighting and Power Equipment
- L. UL 1598 - Standard for Safety - Luminaires
- M. UL 8750 - Standard for Safety - Light Emitting Diode (LED) Equipment for Use in Lighting Products

1.4 ABBREVIATIONS

- A. CCT - Correlated color temperature
- B. CRI - Color rendering index
- C. EPA - Effective projected area

- D. LED - Light emitting diode
- E. THD - Total harmonic distortion

1.5 COORDINATION

- A. Coordinate the location, mounting height and mounting style of luminaires with architectural RCP, mechanical (HVAC duct work, grilles, etc.), plumbing (exposed piping, sprinkler heads, etc.), technology (A/V, projectors, etc.) and other trades, as required, before installation.
- B. In all specialty ceiling areas, the Contractor shall install 3-4 luminaires and make the installation available for review by the Owner's Representative before installing the remaining luminaires in the space.
- C. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.

1.6 SUBMITTALS

- A. Submit luminaires shown on the Luminaire Schedule on the Drawings and those noted on the Drawings but not on the schedule.
- B. Product Data: In addition to the above requirements, submit complete product information for the following:
 - 1. Luminaires - complete manufacturer part number, delivered lumens, L70 rating, LM-80 testing hours, CCT, CRI, input wattage, finish, EPA.
 - 2. Drivers - controls/dimming, power factor, THD.
 - 3. Emergency LED drivers - run time, battery chemistry, wattage.
 - 4. Power transfer devices for emergency lighting - manufacturer part number, wiring diagram.
 - 5. Poles - pole height, material, thickness, finish.
- C. Coordinate all luminaire (interior and exterior) finishes with the Owner's Representative before ordering per submittal requirements in Section 26 00 00 - Electrical.
- D. Indicate if DLC listing applies only to certain color temperatures, beam spreads, or other luminaire options. Indicate if any luminaire options void the DLC listing.

1.7 CLOSEOUT SUBMITTALS

- A. Submit per Closeout Submittals requirements in 26 00 00 - Electrical and any additional requirements listed below.

1.8 SAMPLES

- A. Submit non-returnable samples of luminaires upon request. Include all components necessary for a working product.

1.9 QUALITY ASSURANCE

- A. See Section 26 00 00 - Electrical for manufacturer qualifications.

1.10 WARRANTY

- A. Provide a five (5) year manufacturer's warranty for all luminaires. The warranty shall include all luminaire components including, but not limited to, LED arrays, drivers, luminaire body and hardware. LED arrays will be considered defective if a total of 15% or more of the individual diodes fail to illuminate.
- B. Provide a five (5) year manufacturer's full warranty for all emergency LED drivers.
- C. Provide a one (1) year factory warranty on the pole.
- D. Provide a five (5) year extended factory warranty on pole finishes.

- E. The warranty period shall cover the cost of equipment, materials, mobilization and labor for repair and replacement.

1.11 ADDITIONAL MATERIALS

- A. Additional materials to be a dollar cost in the base bid. At the end of the project, the Contractor shall generate a dollar amount credited back to the Owner for any unused items.
- B. Include in the base bid for additional materials:
 - 1. All costs to provide two (2) additional lighting circuits, all required branch circuit breakers, wiring, conduit, labor and devices as specified and directed by the Owner's Representative. Each circuit (wiring, conduit, ocpd, labor, etc.) to be priced with a rating of 20 amps and at a distance of 100 feet to furthest device. Each circuit to include fifteen (15) luminaires equal in value to luminaire type "B5".
 - 2. All costs to provide ten (10) exit lights equal in value to luminaire type "X" as noted on drawings, all required wiring, conduit, labor and devices as specified and directed by the Owner's Representative. Wiring and conduit to be priced at a distance of fifty (50) feet.
 - 3. All costs to provide ten (10) luminaires with emergency LED driver equal in value to luminaire type "B5E".
- C. See Section 26 00 00 - Electrical and Section 26 09 23 - Lighting Control Devices for other additional materials to be provided by this Contractor.

1.12 ATTIC STOCK

- A. All attic stock shall be provided to the Owner at substantial completion.
- B. Include in the base bid for attic stock:
 - 1. Provide four (4) luminaire type "B5".
 - 2. Provide four (4) luminaire type "B5E".
 - 3. Provide four (4) luminaire type "X".
 - 4. Provide four (4) drivers for luminaire type "B5".
- C. See Section 26 00 00 - Electrical and Section 26 09 23 - Lighting Control Devices for other attic stock to be provided by this Contractor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Only those manufacturers of luminaires and poles listed on the Luminaire Schedule are acceptable.

2.2 PERFORMANCE / DESIGN CRITERIA

- A. All luminaires shall be compatible with lighting controls shown on the Drawings or specified in Section 26 09 16 - Electrical Control Components and / or Section 26 09 23 - Lighting Control Devices.
- B. Pole assemblies shall meet wind loading requirements for the area in which they are installed or 100 mph, whichever is greater. Pole assemblies include the pole, the pole base, pole-mounted luminaires, and any other component that would affect wind loading. Pole bases shall be designed by a Structural Engineer licensed to work in the state.
- C. Exterior lighting shall meet all current city ordinances for light levels, light trespass and specific shielding requirements.
- D. Refer to Division 01 specifications to determine whether windstorm inspection program and corresponding windstorm certification is required.
- E. All luminaires, drivers, emergency LED drivers, LED replacement lamps, LED retrofit kits, accessories, etc. shall be UL listed for the purpose and environment installed.

2.3 LUMINAIRES

- A. All luminaires shall have the following listings based on usage:
 - 1. LED luminaires shall comply with UL 8750 and UL 1598 requirements.
 - 2. Emergency luminaires, including exit signs, shall be UL 924 listed.
 - 3. Luminaires in hazardous locations shall comply with UL 844 requirements and be suitable for the environment.
- B. See the Luminaire Schedule for CCT, THD, CRI, Lumen output tolerance, wattage tolerance, L70 rating. When these values are not listed on the schedule, use the following values:
 - 1. CCT: LED luminaire CCT shall be 4000K.
 - 2. CRI: Minimum 80 CRI (Interior) and 70 CRI (Exterior).
 - 3. THD: 10% maximum.
 - 4. Lumen Output Tolerance: shall be + / - 8%.
 - 5. Wattage (VA) Tolerance: shall be +5% / -10%.
 - 6. Expected Life: L70 of 50,000 hours.
- C. CCT: Color Temperature shall be within a 3-step Standard Deviation Color Matching (SCDM) or MacAdam ellipse in accordance with ANSI C78.377.
- D. Expected Life: The estimated L70 of LED luminaires shall be derived from LM-80 test data in accordance with TM-21 procedures. LM-80 test data shall be measured in accordance with LM-79 procedures.
- E. Efficacy: All general purpose LED luminaires shall have a minimum efficacy of 90 lumens / watt.

2.4 INTERIOR LUMINAIRES

- A. All luminaires in gyms, play areas, multipurpose spaces, etc. shall have a hinged wire guard and retainer latches for tool-less maintenance.
- B. Finishes: Unless otherwise noted, consult Owner's Representative for factory luminaire finish.

2.5 EMERGENCY LIGHTING AND EXIT SIGNS

- A. All emergency lighting and exit signs shall be provided with status indicator lamp and test switch. Integral test switch is preferred.
- B. See Emergency LED Drivers part below for emergency driver information.

2.6 EXTERIOR LUMINAIRES

- A. Pole mounted luminaires shall have an option for internal glare control or external glare shield.
- B. Finishes: Unless otherwise noted, consult Owner's Representative for factory UV rated luminaire finish.

2.7 POLES & POLE BASE HARDWARE

- A. Pole Height: Poles shall be of the height and with brackets, etc. as indicated on the Luminaire Schedule. Where pole height has not been given, provide twenty-five (25) feet minimum length poles for parking lot and driveway lighting, and twelve (12) feet minimum length poles for walkway lighting.
- B. Wind Load: All poles shall rated for 100 miles per hour wind speed with gust factor of 1.3.
- C. Steel and Aluminum Poles: Shall be one piece, ground smooth.
- D. Concrete Poles: Concrete poles shall conform to ASTM C150, Type I or III, or other types for special conditions.
- E. Pole Base Hardware: Provide hot-dipped galvanized anchor bolts, pole base cover (no exposed hardware acceptable), templates, ground rods, rigid metal conduit elbows, concrete base, etc., for the installation of concrete bases as detailed on the Drawings.

- F. Finishes: Unless otherwise noted, consult Owner's Representative for factory UV rated powder coat finish or clear anodized finish on all poles and associated hardware.

2.8 LED DRIVERS

- A. Drivers shall be UL Type TL or UL Class P listed and bear such labels.
- B. Drivers shall comply with UL 8750.
- C. Voltage: Drivers shall be 60 Hz, universal input voltage (120V thru 277V) + / - 10% unless otherwise indicated on the Luminaire Schedule. Drivers shall demonstrate no visible change in light output with a variation of + / - 10% change in line voltage input.
- D. Remote Drivers: Unless otherwise dictated on the Drawings, remote drivers shall have remote wiring capability of fifty (50) feet minimum.
- E. Sensor Compatibility: Drivers shall be compatible with and not cause interference with the operation of motion sensors or other infrared control systems.
- F. Power Factor: Drivers shall have a power factor of 0.9 or greater.
- G. Driver Efficiency: Drivers shall have an efficiency of 85% or greater.
- H. Case Temperature: Interior drivers shall have a maximum case temperature rating of 75°C. Exterior drivers shall have a maximum case temperature rating of 85°C.
- I. Operating Ambient Temperature Range: Interior drivers shall have an ambient temperature rating of 32°F - 122°F. Exterior drivers shall be rated to operate at 0°F.
- J. Noise: Drivers shall have an audible noise rating of 27dB Class A or less.
- K. Electromagnetic Compliance: Drivers shall comply with CFR Title 47 Part 15 Class A.

2.9 EMERGENCY LED DRIVERS

- A. Shall be factory installed, unless otherwise indicated on the Drawings or prior approval is given by the Engineer.
- B. Shall be rated to operate at 0°F when located outside or above an outside ceiling.
- C. Shall be rated for at least ninety (90) minutes at full light output (120 minutes in storm shelters) unless otherwise noted on the Drawings.
- D. Shall operate with constant output power to maintain the output wattage to the LED array even as the system voltage diminishes.
- E. Shall be maintenance-free, nickel-cadmium battery technology.
- F. Shall be universal input voltage (120V thru 277V) + / - 10% at 60Hz unless otherwise indicated on the Drawings.
- G. All remote emergency LED drivers shall have remote wiring capability of fifty (50) feet minimum, unless otherwise indicated on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide all luminaires of the types indicated, in accordance with NEMA standards, manufacturer's recommendations, and NEC requirements.

- B. Install indoor lighting systems in accordance with NECA / IESNA 500.
- C. Install exterior lighting systems in accordance with NECA / IESNA 501.
- D. Install all interior and exterior luminaires as shown on the Drawings. Where the layout needs to be altered, coordinate with the Owner's Representative for direction before installing luminaires to ensure even illumination and proper light levels.
- E. Provide support for all interior luminaires by means of bar hangers extended across the main ceiling support members. See lighting details on the Drawings for more information.
- F. All interior luminaires shall be independently supported from the building structure.
- G. Provide luminaires complete with LED arrays, LED drivers, and other accessories necessary for proper installation in the building construction and listed for fire rated ceilings where required by code or shown on the Drawings.
- H. Provide all exterior parking lot, area, site and walkway poles complete with luminaires, any required mounting hardware, wiring, controls, etc. required for a complete system.
- I. Lighting Control: Provide switches with matching technology (line voltage dimming, 0-10V dimming, etc.) for dimming drivers in the locations shown on the Drawings. Provide lighting controls in accordance with Section 26 09 16 - Electrical Control Components, Section 26 09 23 - Lighting Control Devices and / or Section 26 55 61 - Theatrical Lighting.
- J. Emergency Lighting: Provide an emergency LED driver, power transfer switch, internal wiring etc. in each luminaire that is indicated on the Drawings as an emergency luminaire or night light.
- K. Emergency Lighting Power: For all emergency lighting powered by a generator or UPS, provide an emergency power circuit to every power transfer device.
- L. Mount recessed luminaires in the center of a ceiling tile or as shown on the Drawings.
- M. Provide luminaire whips (flex conduit / metal clad cable) from a junction box to each luminaire (not to exceed four luminaires per junction box) access plate. Luminaire whips between luminaires will not be accepted. Refer to luminaire installation details on the Drawings for more information.
- N. Locate all remote LED drivers and / or emergency LED drivers as noted on the Drawings. Otherwise, install above the ceiling above each luminaire or in an adjacent room with a low ceiling for easy access. Mount drivers on rubber insulators.
- O. All Exit signs and night lights shall not be switched. Provide a constant hot tied back to the panel serving the lighting in the space.

3.2 SITE QUALITY CONTROL

- A. Prior to final inspection, check all luminaires for damage during construction and replace damaged luminaires at no additional expense to the Owner. Test all emergency luminaires for proper operation, including exercising all transfer switching, emergency LED drivers, generator, etc. All luminaires shall be cleaned and completely operational at the time of final acceptance of the building.
- B. Where specific light levels are mentioned on the Drawings and the luminaire type, quantity, locations or lumen output is changed, the Contractor shall ensure light levels are met. Re-aim or add lighting as necessary.
- C. The design intent shown on the Drawings meets the city ordinances for outdoor lighting trespass and minimum light level requirements. It is the responsibility of this Contractor to ensure that the lighting is installed to meet the design intent and city ordinances. Where required, re-aim or add shields to meet these requirements.

3.3 ADJUSTING

- A. The Contractor shall move any luminaire up to six feet in any direction as directed at no additional cost.

END OF SECTION

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SECTION 26 55 61
THEATRICAL LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Provide all equipment, luminaires, wiring, panels and breakers, disconnects, conduit, materials, labor, supervision, and services necessary for or incidental to the installation of theatrical lighting system as shown or indicated on the drawings, as specified, and as required.

1.2 RELATED SECTIONS

- A. Section 26 00 00 - Electrical
- B. Section 26 00 90 - Electrical Submittal Procedures

1.3 SUBMITTALS

- A. Submittals required in this section shall conform to and be submitted in accordance with the General Conditions, Division 1, and Division 26, Section 26 00 90 requirements.

1.4 PRODUCT DATA

- A. Submit product data for all components of the house and theatrical lighting and theatrical lighting control system.
- B. Submit manufacturer's catalog data for all lighting instruments, equipment, and components that shall include all technical data to demonstrate conformance with these specifications.

1.5 SHOP DRAWINGS

- A. Submit complete physical drawings of all items of equipment showing dimensions, etc.
- B. Submit complete load schedules that clearly indicate actual connected loads and control channel assignment, cross-reference to internal equipment identifications to circuit number where shown on the drawings, and all other scheduled information which shall relate the equipment to the project requirements.
- C. Submit complete internal and interconnection wiring diagrams showing number, size, and types of conductors between equipment, and from equipment to loads, and feeder quantity and sizes.

1.6 CLOSEOUT SUBMITTALS

- A. Operating and Maintenance Manuals: Provide 2 complete sets of operating, maintenance, and adjustment instructions and other information necessary for proper operation of the theatrical lighting system. These documents shall be included as part of the project operation and maintenance manuals.
- B. Warranty: Provide 2 copies of warranties.
- C. Training Documentation: Provide letter in final documents documenting that the Owner (give name of person, date, duration, and content of training) received training required in this section.

1.7 WARRANTY

- A. Provide a five-year parts and one-year labor warranty on the entire theatrical lighting system. Warranty coverage shall begin at the time of Project Substantial Completion.

1.8 SYSTEM START-UP

- A. It shall be the equipment manufacturers' and contractors' responsibility to provide the initial programming and start-up of the system.
- B. After system startup and prior to substantial completion of the project, the contractor shall require the manufacturer to test the operation of the complete system to ensure the proper operation of the system. The manufacturer shall provide documentation of such functional testing in the closeout submittals. This functional testing is to be done on all projects, regardless of other additional commissioning or testing requirements.

1.9 OWNER'S INSTRUCTIONS

- A. After manufacturer testing is complete, the contractor shall require the manufacturer to provide a minimum of 4 hours of on-site training to the owner's personnel in the operation, adjustment, and maintenance of the system. This training shall be mutually agreed upon by the two or more parties involved but shall take place no longer than 30 days after the system is completely installed. This training should be done in a location where it can be recorded by the owner for future reference. The manufacturer shall provide documentation of such training in closeout submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Refer to drawings for manufacturers, part numbers, and quantities.
- B. Equals by ETC. No other equals will be accepted.
- C. All dimming equipment and devices, theatrical luminaires, and control equipment specified herein shall be the sole responsibility of a single manufacturer who shall fabricate all assemblies and assemble all major sub-assemble. The manufacturer shall have been producing theatrical lighting and SCR control equipment for at least five consecutive years.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide a complete and operable system. All required equipment may not be noted or shown on drawings. Provide a complete system installation including all required equipment, hangers, plugs, outlets, pipes, connectors, etc. This will include but not limited to the following.
 - 1. Provide special control wiring (including houselight control wiring) and multi-conductor SO cable (flexible borderlight cable).
 - 2. Set up control console and dimmers - under supervision of dimmer manufacturer technician.
 - 3. Pull all load wiring to 4" X 4" X 24" long wireway above dimmer rack. Terminate in dimmer per manufacturer's direction.
 - 4. Provide all conduit, wiring, power requirements, and terminations of same in dimmer rack.
 - 5. Provide all load wiring to fixtures, or terminations at fixtures for house lighting.
 - 6. Provide mounting of plugboxes, floor pockets, back boxes, and grid-iron junction boxes (locations to be coordinated with Architect and Owner).
 - 7. For Front of House (FOH), conceal receptacles in architectural bulkheads where FOH lighting is located. If architectural bulkheads are not available to conceal luminaires and receptacles, locate receptacles in ceiling with all conduit concealed above ceiling. FOH luminaire are to match the color of the ceiling.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Provide the services of a qualified factory trained technician employed by the manufacturer of the system, who shall check the installation and ensure its proper operation. No part of the system shall be energized before being checked and the installation approved. Failure to observe this provision shall automatically relieve the owner or manufacturer of any responsibility concerning the proper operation of the system, any part thereof, and the replacement of parts that may have been damaged by premature

energizing. The technician shall be available on the job site within seven working days (7) after the manufacturer has received notice.

- B. As part of the system startup process, the manufacturer shall provide all field programming of the system.

3.3 DEMONSTRATION

- A. Upon completion of testing and adjustment, demonstrate operation of the theatrical lighting system to representatives of the Owner.
- B. Instruct the Owner's personnel in proper maintenance, adjustment, and operation of the theatrical lighting system.
- C. Upon completion of testing and adjustment, the contractor and a direct employee of the equipment manufacturer (who is already familiar with the details of the project) shall demonstrate operation, proper maintenance, troubleshooting, and adjustment of the theatrical lighting controls system. The owner shall receive a minimum of 4 hours of on-site training.

END OF SECTION

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SECTION 26 82 13
ELECTRICAL HAND / HAIR DRYERS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Furnishing and installation of electric hand dryers as shown on drawings, as herein specified.

1.2 RELATED REQUIREMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications and Division 26, Section 26 00 00 - Electrical, apply to this Section.

1.3 SUBMITTALS

- A. Product Data
 - 1. Submit product data for the following:
 - a. Hand dryer brand and series, Product description, Part numbers, Cover color, ADA compliance, Warranty Information.
 - b. Review colors with Owner's Representative before ordering.

1.4 CLOSEOUT SUBMITTALS

- A. Submit per Closeout Submittals requirements in 26 00 00 - Electrical and any additional requirements listed below:

1.5 WARRANTY

- A. Unless otherwise mentioned below, provide a ten (10) year minimum warranty from date of acceptance of project. Dryers with less than above stated warranty will not be accepted.
- B. Refer to Warranty Period information in 26 00 00 - Electrical for additional information.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Fully Automatic ADA Compliant Hand Dryer Models:
 - 1. World Model XRA5 series - (120v / 2300w or 277v / 2300w) (fully automatic) (10 year warranty) (semi-recessed) on GFCI breaker.
 - 2. Excel Model R76-I series - (120v / 2300w or 208v / 2100w or 240v / 2100w or 277v / 2250w) (fully automatic) (10 year warranty) (semi-recessed) on GFCI breaker.
 - 3. Equal by Sloan
- B. All other manufacturers shall require pre-approval in accordance with the Substitution of Products information in 26 00 00 - Electrical. Where a specific manufacturer is called out by an owner TDG, no other manufacturers will be considered.

2.2 PERFORMANCE / DESIGN REQUIREMENTS

- A. Unless specifically requested by an owner, all hand and hair dryers shall be ADA compliant semi-recessed.
- B. See plans for proper hand dryer voltage (120V / 277V).
- C. Where Fully Automatic Dryers may be specified below, the hand dryer shall be activated when hands are placed under nozzle and De-activated when hands are removed from nozzle or after 60 seconds. Infra-

red sensor preferred. No touch, no button. Heavy duty construction, vandal resistant, quiet, and chip proof finish coating.

- D. Where Push-Button Dryers may be specified below, Timer to be thirty (30) second, cam operated mechanical type, vandal resistant, heavy duty construction, quiet, and chip proof finish coating.

2.3 FINISHES

- A. Bid White epoxy powder chemical resistant coating unless another color is specified or requested. Verify color with Owner's Representative before ordering.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide all boxes, fittings and conduit in accordance with Section 26 05 33 - Raceway and Boxes. Provide all conductors in accordance with Section 26 05 19 - Low Voltage Conductors. Provide all grounding in accordance with Section 26 05 26 - Grounding and Bonding.
- B. Do not use a shared neutral. Entire unit shall be internally grounded.
- C. Install equipment in accordance with manufacturer's recommendations and instructions and meet all ADA requirements.
- D. Mounting Heights:
 - 1. Mount 42 inches above the finished floor to bottom of nozzle unless otherwise noted on Drawings.
 - 2. Verify manufacturer's mounting heights to center of electrical outlet.

END OF SECTION

SECTION 27 10 30
DATA CABLE PLANT

PART 1 - GENERAL

1.1 WORK INCLUDES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1, apply to this Section.
- B. Communication Systems complete including selective modification of existing system to be revised and expanded, cabling, special backboxes, hardware, and all other required devices and equipment.
- C. This specification and the drawings provides requirements for the installation and testing of a complete data cable plant providing all permanent premise cabling and wiring devices required to support a facility wide computer network system as shown or indicated on the drawings and/or as specified.
- D. Provide all equipment, accessories, materials, tools, scaffolding, man lifts, labor, supervision, transportation and services necessary for or incidental to the installation and testing of the data cable plant.
- E. As required by the contract documents the Data contractor shall be responsible for demolition of any devices and cabling previously abandoned back to source in the areas of the scope of work.
- F. The station (horizontal) cabling shall extend from each designated data or telephone jack to the nearest IDF or the MDF.
- G. Each IDF (Intermediate Distribution Frame) shall be connected by the data backbone cabling to the MDF (Main Distribution Frame). Refer to riser diagram on plans.
- H. Refer to Data and Telephone Cable Plant System Schedule on drawings for part numbers and additional information.
- I. Provide and install, prior to cable installation, plastic snap in bushings at each box opening, passage through a metal stud, and at the end of all open conduit stubs or sleeves to protect the cabling from damage.
- J. It is the intent of these specifications to provide complete installations although every item necessary may not be specifically mentioned or shown.
- K. This project shall include preparation of construction plans locating the data cable plant devices and having the plans reviewed by Owner and the Owner's Representative.
- L. Provide all training, as-built drawing and manual documents as outlined in these specifications.
- M. Provide an extended warranty as outlined in these specifications.
- N. It shall be the responsibility of the Division 26 Electrical Contractor to provide:
 - 1. Provide and install all conduit and standard electrical boxes for the data cable plant as specified herein. The data cable plant contractor shall coordinate all conduit and box requirements and locations with, and provide special back boxes to, the electrical contractor prior to installation.
 - 2. Provide equipment grounding system, conductors, and bus bars as outlined in Division 26.
 - 3. Cabling in all open ceiling areas shall be enclosed in conduit.
 - 4. Furnishing and installation of all floor boxes, surface raceways, and other wireways which are detailed or specified under Division 26.
 - 5. Provide required conduit for accessibility to attic or plenum space.
 - 6. Provide 120-volt power and hook-up to equipment provided in Division 27.
 - 7. Installation of special back boxes supplied by data cable plant contractor.

8. Provide equipment mounting boards as indicated on the drawings.
9. Provide conduit to remote areas outside of the building as outlined on the drawings.
10. Coordination of requirements of Division 27 with the Builder.

1.2 WORK NOT INCLUDED

- A. Contractors shall make no agreement that obligates the Owner to pay any company providing communications, monitoring, or other services.
- B. All electronic equipment, telephone-switching units, and cross connect; telephone sets, network switching equipment, transceivers, routers, network interface cards, computers, and software are not included in this section.

1.3 RELATED SECTIONS

- A. The conditions of the Division 0, Division 1, Division 26 requirements, and the contract requirements that include the General Conditions and the Supplementary Conditions apply to work of this division.
- B. Section 26 00 00 – Electrical.

1.4 OWNER FURNISHED CONTRACTOR INSTALLED (OFCI) EQUIPMENT

- A. Refer to Responsibility Matrix on drawings for equipment that applies.
- B. The contractor shall verify that new and existing products and site conditions are satisfactory for installation or relocation of OFCI equipment. If unsatisfactory conditions exist or other discrepancies are identified, the contractor shall immediately document the conditions and notify the owner in writing.
- C. The contractor shall coordinate all required equipment schedule quantities and any dimensions or variations required to adapt to field conditions with the owner at the earliest possible date. The contractor shall verify compatibility, installation rough-in, mounting, and utility requirements for the scheduled OFCI equipment.
- D. The contractor shall verify compatibility, installation rough-in, mounting, and utility requirements for the scheduled OFCI equipment.
- E. The owner shall coordinate delivery dates with the builder to meet the construction schedule.
- F. The installation of items as identified in the plans and specifications as OFCI equipment shall conform to the provisions of the Contract Documents and shall be coordinated with the builder.
- G. Installation shall be performed by competent and trained workers in accordance with all applicable codes and governing regulations.
- H. Installation, testing, and startup shall comply with the manufacturer's instructions.
- I. The contractor shall provide all miscellaneous hardware, structural support, cabling, fittings, etc. that is not included by the manufacturer, but required for installation.
- J. The contractor shall clean and adjust all relocated and new OFCI products as necessary.
- K. All crating, packing materials, and debris shall be properly disposed of off-site.
- L. Installation shall be subject to inspection by the owner representative, owner, and builder. The installer shall not proceed until any unsatisfactory conditions are corrected. Any damage caused by improper handling or installation procedures shall be corrected at no cost to the owner.
- M. For drop shipped equipment, the builder shall be the consignee and shall have a representative on-site for coordination of delivery, receiving shipments, and inspect each shipment for obvious signs of damage or shortages. The builder shall be responsible for all shipping damage claims, including hidden damage, refusal of shipment, and Return Authorization procedures. The builder shall provide secure storage, handling, and protection from the elements, prior to the contractors' acceptance for installation.

- N. For equipment stored at an owner's facility, the contractor shall load the equipment and provide transportation to the work site. Prior to loading, the contractor shall inspect the equipment for obvious signs of damage and document all quantities, noting shortages from the project requirements, indicating acceptance of the merchandise as is and in good order.
- O. The contractor shall conduct and properly document testing of all installed equipment to verify proper operation. When appropriate, on-site operation and maintenance instruction shall be provided to the owner's personnel. This instruction shall include demonstration of proper use, maintenance, and cleaning procedures.
- P. The nature of the equipment procurement shall determine responsibility for resolving any claims with the manufacturer or supplier relating to defects in material or workmanship and warranty claims. The party that purchased the equipment shall resolve these issues.

1.5 PRESCRIPTIVE CODES, STANDARDS AND REGULATIONS

- A. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards, except when requirements are exceeded by the contract documents.
- B. In addition to requirements outlined in other sections of the specifications these codes and standards are imposed as applicable to the work in each instance.
- C. The equipment, materials, and installation shall conform to the latest version of all applicable codes, standards and regulations, of authorities having jurisdiction.
- D. Nothing in the Contract Documents shall be construed to permit work not conforming to these codes and standards.
- E. When two or more codes or standards are applicable to the same work, then the stricter code or standard shall govern.
- F. The date of the code or standard is that in effect on the date of issue stated on the contract documents, except when a particular publication date is specified.
- G. The Contractor shall comply with all State, Federal, NFPA, local codes and ordinances that may alter any part of the plans or specifications. The Contractor shall bear all costs for correcting any deficiencies due to non-compliance.
- H. Where local codes and ordinances are not in writing or on record, but local precedence have been set, the Owner shall pay for any additional resulting cost.

1.6 PLANS AND SPECIFICATIONS

- A. The intent of the project drawings is to establish the types of systems and functions, but not to set forth, each item essential to the functioning of the system.
- B. The drawings are generally diagrammatic and show approximate location and extent of work.
- C. Install the work complete including minor details necessary to perform the function indicated. Provide data cable plant, including all connections, complete in every respect and ready to operate.
- D. If clarification is needed, consult the Owner's Representative.
- E. Review pertinent drawings and adjust the work to conditions shown. Where discrepancies occur between drawings, specifications, and actual field conditions, immediately notify the Owner's Representative for his interpretation.
- F. The Owner's Representative reserves the right to make any reasonable change in the location of any part of this work without additional cost to the Owner.

1.7 SITE VISIT

- A. Before submitting a proposal, each proposed contractor shall examine all plans and specifications relating to the work, shall visit the site of the project, and become fully informed of the extent and character of the work required, including all required utilities and work to remote areas.
- B. No consideration will be granted for any alleged misunderstanding of the materials to be furnished, or the amount of work to be done. It being fully understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying plans, or required by nature of the site of which may be fairly implied, as essential to the execution and completion of any and all parts of the work.

1.8 SUBMITTALS

- A. Submit a complete submittal package within 30 calendar days after award of this work for approval. Equipment is not to be ordered without approval. Partial submittals are not acceptable for review. Each submittal shall include a dated transmittal.
- B. Submittal shall be electronically transmitted in PDF file format.
- C. For each submittal provide a cover sheet with the name and location of the project, the name, address and telephone number of the Contractor, and the name, address and telephone number of the submitting sub-contractor. Include on or after the cover sheet sufficient space for review stamps.
- D. Quality Assurance Submittal including special boxes, cable, and other material as requested by the Owner's Representative:
 - 1. Letter from manufacturer stating that the Contractor is an Authorized Factory Distributor for the area where the project is located.
- E. Product Data Submittal to include:
 - 1. An indication of any deviations from Contract Document requirements, including variations and limitations. Show any revisions to equipment layout required by use of selected equipment.
 - 2. A product data index and complete equipment list including for each product submitted for approval the manufactures name and part number, including options and selections
 - 3. Cut-sheets or catalog data illustrating the physical appearance, size, function, compatibility, standards compliance, and other relevant characteristics of each product on the equipment list.
 - 4. Indicate by prominent notation (an arrow, circle, or other means) on each sheet the exact product and options being submitted.
 - 5. Submit design data, when the scope of work requires, including calculations, schematics, risers, sequences, or other data.
 - 6. Submit a sample of the extended product warranty language.
 - 7. Any resubmittals shall include a complete revised equipment list and any product data that is revised.
- F. Shop Drawings Submittal to include:
 - 1. Produce accurate to scale (min. 1/8" = 1') drawings showing equipment and device layouts prepared using a CAD or BIM engineering drawing program. When CAD background files are not available for existing buildings the Contractor shall inspect the site and collect information to create a floor plan. Walls shall be double line showing the thickness, single line diagrams are not acceptable.
 - 2. Other disciplines devices or equipment not relevant to this scope of work shall not be shown on shop drawings. Submitting modified contract documents shall not be permitted.
 - 3. Every room shall have a name and number identifying the use of the space.
 - 4. When multiple buildings make up the system, provide a block diagram of the project site showing all buildings to be covered by the system and detailing the route and type of connection between buildings. Note building entry points, conduit type and size, and routing pathway (underground or over canopy installation).
 - 5. Shop or coordination drawings shall include information that will allow the Contractor to coordinate interdisciplinary work and when necessary guide the manufacturer or fabricator in producing the product.
 - 6. Resubmittals shall include revision notation and clouded changes.

1.9 QUALIFICATIONS OF A PROPOSED CONTRACTOR

- A. Proposed contractors who do not currently possess the necessary qualifications, trained and experienced personnel, financial capacity, and meet the other requirements herein described will be disqualified
- B. The Contractor shall employ full-time, factory-trained, licensed, local technicians and installers for product installation, maintenance, support, service and warranty.
- C. The proposed contractor, as a business entity, shall be a local authorized distributor and designated representative of the equipment manufacturer, with full extended warranty privileges. The proposed contractor shall have been actively engaged in the business of selling, installing, and servicing commercial building commercial cable systems for a period of at least 5 years. Selected contractor must be certified in specified system, subcontracting other companies certified in proposed product shall not be allowed.
- D. Recently formed companies are acceptable only if specific pre-approval is requested, and granted by the owners representative, based on experience of key personnel, current and completed projects, and all licensing requirements are met 10 working days prior to the contract proposal date.
- E. The proposed Contractor shall have an office within 150-miles of the job site, staffed with factory-trained technicians who are qualified and licensed to supervise the installation, to be responsible that the system is installed as submitted, to conduct system start up, and perform a 100 percent operational audit of all installed devices. The technicians shall instruct the Owners' representatives in the proper operation of the system, and to provide service throughout the warranty period. The contractor shall be capable of dispatching technicians to repair a system within six (6) hours of a service request.
- F. The proposed contractor shall be fully experienced in the design and installation of the type of system and manufacturer herein specified and shall furnish with the contract proposal an itemized list of the installations of the type specified herein.
- G. The contractor shall employ factory-trained technicians capable of supporting the maintenance of the system. No contract employees are allowed. All installing technicians shall be employed by the proposed contractor.
- H. The Owner's Representative or Owner may investigate, as they deem necessary to determine the ability of the proposed Contractor to perform the work. The proposed contractor shall furnish to the Owner with any information or data requested for this purpose.
- I. The Owner's Representative or Owner reserves the right to reject any contract proposal if the evidence submitted, or their investigation, fails to indicate that the Contractor is qualified to fulfill of any part of the contract or to complete the work contemplated therein.
- J. The Owner's Representative or Owner reserves the right to reject the proposal of any contractor who has previously failed to perform properly, or complete on time, contracts of a similar nature.

1.10 ADDITIONAL MATERIALS: INCLUDE IN THE BASE CONTRACT PROPOSAL

- A. All costs to provide 5 additional data outlet locations including all cable and devices as directed by the Architect. Conduit and standard back boxes by Division 26 Electrical Contractor.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All cable and wiring devices provided shall be listed and labeled by Underwriters Laboratories, Inc. for the intended use under the latest appropriate testing standard.
- B. Refer to Data and Telephone Cable Plant System Schedule on plan for part numbers and additional information.

- C. Only equipment devices have been shown on the contract drawings. Specific wiring between equipment has not been shown.
- D. All equipment and components shall be new, and the manufacturers' current model. All like devices shall be of the same manufacturer and model number.

2.2 ACCEPTABLE MANUFACTURES

- A. Descriptions and details, acceptable manufacturers' names listed and specific manufacturer and model number items indicated in the plans and specifications shall establish a standard of quality, function, and design. Manufacturers and model numbers listed "no exceptions" shall not be substituted without specific notice in an addendum. Otherwise, where a specific manufacturer's product is indicated, products of other manufacturers listed as acceptable may be submitted for approval based on the substitute product being, in the opinion of the Engineer, of equivalent or better quality than that of the product specified.
- B. Proposed contractors wishing to propose any product substitution must do so in writing to the specifying authority at least ten (10) days prior to the proposal opening.
- C. For manufacturers equipment or models other than that specified, the proposed contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment. Proposals must include detailed information showing all deviations from the system as specified.
- D. Substitute products for which the proposed contractor does not obtain prior approval will not be considered acceptable for this project. Final approval of alternate products shall be based on the decision of the Owner and Architect. Prior approval to make a proposal for this project does not automatically ensure products will be an acceptable equivalent.
- E. It is the responsibility of the Contractor to provide all features and functions as outlined in these specifications. The functions and features specified are vital to the operation of this facility; therefore, inclusion in the list of acceptable manufacturers does not release the contractor from strict compliance with the requirements of this specification.
- F. The selected contractor must be a certified Integrator/Installer authorized by one of the Manufacturers listed below to provide an extended warranty to the Owner covering all network cable and connectivity hardware products comprising this installation site. All UTP cable, fiber optic cable, and all wiring devices installed shall be products of one approved manufacturer or joint manufacturers program and approved for use in their extended warranty program. The Contractor and Manufacturer shall jointly provide the Owner an extended warranty of the installed system against defects in material or workmanship; provide a copy of contractor certification.
- G. The owner's standard manufacturers model numbers, functions, and features described in this specification section are those of the Panduit and General Cable PanGen Plus Structured Cabling Solution with a 25-year warranty, and this shall constitute the quality and performance of the equipment to be furnished, no exceptions.

2.3 WALL PLATE COLOR

- A. Color of device/wall plates to best match project light switches and electrical outlets, coordinate with the Electric Contractor.

2.4 DATA/TELEPHONE CABLING PLANS

- A. Provide adjacent to the equipment rack in each MDF and IDF a plan view of all building areas covered by the equipment closet meeting the following requirements:
 - 1. Framed and secured to the wall and plan covered with clear acrylic panel.
 - 2. Size to clearly show all required information.
 - 3. "YOU ARE HERE" indicator with arrow.
 - 4. Room names and numbers. Verify with Owner.
 - 5. Show each device with symbol and identification address number as designated by owner.
 - 6. Symbol legend.

7. True north arrow
8. Scale indicator

2.5 DATA/DESK TELEPHONE STATION WALL PLATES AND JACK INSERTS

- A. Provide single or multiple jack modular wall plates where shown on plans or required. The number next to symbol on plans indicates the quantity of data lines/jacks at that location, single outlets are not numbered. Where a desk telephone jack (D/#) is designated on plans the faceplate to include a telephone jack along with the data jacks. Each data or telephone jack shall be terminated and mounted in a suitable faceplate for all wall, enclosure, millwork, floor box, modular furniture, etc. locations. All terminations shall be made per the manufacturers' instructions. Jack type to match colors above. Refer to System Schedule on plan for part numbers and additional information.
- B. Use a single gang faceplate with label window for all standard wall outlets, use NEMA duplex or Decora style frames as required for floor boxes, surface raceway, etc. Refer to System Schedule on plan for part numbers and additional information.

2.6 EMERGENCY SERVICE/VOICE LINES

- A. Provide connectivity for emergency service/voice lines from the MDF, one line to each elevator phone and 911 emergency telephone, two lines to each alarm system digital communicator (DC).

2.7 19" OPEN EQUIPMENT RACKS

- A. Rack location shall be verified by owner and engineer prior to installation.
- B. In the MDF, provide one (1) one Four Post Rack, rack space to be reserved for server equipment provided and installed by the Owner, and at least one (1) Two Post Rack as required to accommodate the drop count.
- C. In each IDF, provide at least two (2) Two Post Racks as required to accommodate the drop count.
- D. Ladder type cable tray shall be routed over all floor mounted racks from wall to wall.
- E. Mount fiber termination cabinets in the top portion of the rack and then the patch panels. Reserve the lower 50% of rack space for mounting of network electronics by the Owner.

2.8 BUSHINGS

- A. Provide a plastic snap in bushing at each box opening, passage through a metal stud, and at the end of all open conduit stubs or sleeves prior to cable installation to protect the cabling from damage:
 1. Box openings - Thomas & Betts Knockout Bushing Series 3210, or equivalent.
 2. Metal stud passage - Thomas & Betts Twist It Bushing Catalog Number SB1216-SC, or equivalent.
 3. Conduit ends - Thomas & Betts Anti-Short Bushing Series 390 or Tite-Bite Combination couplings Series 442, or equivalent.

2.9 J-HOOKS

- A. All attachments shall be specifically designed for telecommunications cabling.
- B. Attachments for cabling support shall be spaced at approximately 48 to 60 inches on center. Cable bundles shall not be allowed to sag down more than 12-inches mid-span between attachments.
- C. Attachments shall be sized for 25% capacity to allow for future expansion.
- D. Do not mix different signal strength cables on the same J-Hook (i.e. fire alarm with data and telephone cable). Multiple J-Hooks can be placed on the same attachment point, up to the rated weight load of the attachment device.
- E. Acceptable manufacturers:
 1. Erico.
 2. Panduit

3. Cooper B-line.

2.10 CABLE TIE WRAPS

- A. Plenum rated Velcro hook cable ties shall be furnished and installed to attach wire bundles to supports and for appropriate wire management as required. Provide and install Panduit TAK-TY HLTP series cable ties with UL 94-V2 flammability rating, or equivalent.
- B. Hard plastic or metal tie wraps will not be allowed on any data cable (Category rated UTP).

2.11 MEASURING PULLING TAPE (MULE TAPE)

- A. All future use innerduct and conduit cable pathways shall include a Measuring Pulling Tape (Mule Tape) made of woven Polyester, Aramid, Kevlar, or an equivalent fiber blend. Measuring Pulling Tape shall have a minimum tensile strength of 1250 lbf. or as required and shall be pre-lubricated for prevention of burn though and marked for measuring in feet. Measuring Pulling Tape installed in underground pathways shall incorporate a 22 gauge minimum solid corrosion resistant copper conductor for use in radio signal locating procedures.

2.12 LADDER TYPE CABLE TRAY

- A. Ladder type cable tray shall be routed over all floor mounted racks from wall to wall, provide all necessary hardware to attach the ladder rack to the top of the floor rack and to the walls. All field cuts shall be filed smooth, dressed square, and painted to match.
- B. Utilize tray splicing, support, and coupling hardware supplied by and installed as recommended by the manufacturer.
- C. Cable tray and rack shall be securely supported and grounded.
- D. Cable tray shall be of heavy-duty tubular steel construction with black powder coat finish, 12" wide, with cross members at 12" intervals. At each ladder rack joint, provide a Grounding Kit. Provide fire-retardant flat black colored rubberized material end caps to cover all exposed ends of ladder rack. At the top of each rack, provide a Rack-to-Runway Mounting Plate, Cable Runway Elevation Kit, and Cable Runway Radius Drop. At each wall, provide a Horizontal Wall Angle Support. Provide Cable Runway Center Support hanger brackets and similar and 5/8" all-thread rod hanger supports from the building structure at any span that exceeds 60" from other support (rack and wall mounting locations), at intervals of 60" on center maximum.
- E. Provide Chatsworth Product Inc. Universal Cable Runway or equivalent.

2.13 MESH CABLE TRAY

- A. Mesh constructed cable tray systems shall be utilized for high capacity and special pathway support requirements. Mesh cable tray shall be constructed from steel wires. All edges and welds are to be smooth and free of burs or sharp edges. Mesh tray assemblies shall be zinc plated after fabrication. All field cuts shall be filed smooth, dressed square, and touched up with zinc bearing paint to prevent rust formation. Mesh openings shall not exceed 2" x 4". Provide sizes from 3" wide x 2" deep up to 24" wide x 4" deep as required for a 50% maximum initial fill rate. Provide straight sections, vertical offsets, tees, crosses, radiused bends, reducers, and radiused dropouts as required. Utilize tray splicing, support, and coupling hardware supplied by and installed as recommended by the manufacturer. Support from building structure.
- B. Chatsworth Products Inc. Universal Cable Runway or equivalent.
- C. Provide Mono-Systems Inc. Mono-Mesh Cable Tray MM2-12-118 series as required or equivalent.

PART 3 - EXECUTION

3.1 SYSTEM DESCRIPTION

- A. Each data or telephone jack shall be terminated and mounted in a suitable faceplate for all wall, enclosure, millwork, floor box, modular furniture, etc. locations.
- B. All jack wall plates and housings shall have machine printed labels meeting ANSI/TIA-606-C standards inserted behind built-in clear plastic windows, or engraved plastic nameplates permanently attached, indicating cable run identification number(s).
- C. All outlets shall be Category 6 or Category 6A RJ-45 style jacks. All cabling and connectors provided will meet and be tested to ANSI/TIA-568 Style B Pin/Pair assignment (T568B) requirements.
- D. The data and telephone cable plant will provide the permanent part of the building wiring (cable plant) required to provide connection for telephones or network computers.
- E. Label the cable run designator on both ends of all cables, patch panel jacks, termination cabinet connectors, and all jack wall plates and housings. In addition, label the cable run designator(s) on the ceiling grid bar at jack locations that are concealed above a drop ceiling; including those for wireless access points, cameras, projectors, etc. Labels shall be polymer film Turn-Tell flexible non-smear, or equivalent, machine printed labels complying with ANSI/TIA-606-C standards.
- F. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., cable shall not be supported by or lay on suspended ceilings). Fasteners and supports shall be adequate to support the required load.
- G. The installation shall be subject to inspection and approval by the Architect/Engineer.

3.2 CABLE RUN DESIGNATOR LABELING SCHEME

- A. Each patch panel jack, wall plate jack, terminal cabinet connector, both ends of each cable run and on the ceiling grid bar at jack locations that are concealed above a drop ceiling shall be labeled with a cable scheme run designator machine printed labels installed according to EIA/TIA 606 standards. All labeling shall conform to industry standards and best practices.
- B. Labeling types and scheme shall be verified and coordinated with the Owner prior to any installation. Contractor to submit labeling scheme to Engineer and Owner for approval prior to installation.

3.3 CABLE ROUTING AND INSTALLATION

- A. System wiring and equipment installation shall be in accordance with good engineering practices as established by the EIA and the NEC. Wiring shall meet all state and local electrical code requirements.
- B. Cable pathways, conduit, and cable support systems shall be complete with bushings, de-burred, cleaned, and secure prior to installation of cable.
- C. All wiring shall test free from opens, grounds, or shorts. All communications cable shall be supported from the building structure and bundled. Do not attach any supports to joist bridging or other lightweight members.
- D. The support system shall provide a protective pathway to eliminate stress that could damage the cabling. The cable shall not be crushed, deformed, skinned, crimped, twisted, or formed into tight radius bends that could compromise the integrity of the cabling.
- E. Communications cable must not be fastened to electrical conduits, mechanical ductwork/piping, sprinkler pipes, or routed to obstruct access to hatches, doors, utility access panels, or service work areas. Do not route cables through fire doors, ventilation shafts, grates, or parallel with line voltage electrical conductors. Communication cables shall not be run loose on ceiling grid or ceiling tiles.
- F. Support shall be provided by mounting appropriate fasteners that may be loaded with multiple cables. Provided that the weight load is carried by the support rod or wire, the support assembly may attach to the ceiling grid for lateral stabilization. The required support wires for the ceiling grid or light fixtures shall not be utilized. Any fastener attached to the ceiling grid shall not interfere with inserting or removing ceiling tiles. The cable pathway of supports must be positioned at least 12 inches above the ceiling grid.

- G. Communication cables shall be run in conduits, where stubs are provided, from wall or floor jacks to accessible areas above finished ceilings. Conduit shall be required only within walls and concealed spaces to provide access.
- H. Provide bushings to protect the cable from damage for conduit ends, box openings, and passage through metal studs.
- I. Communication cables shall be run in bundles above accessible ceilings and supported from building structure. Cabling shall be loosely bundled with cable Velcro hook ties randomly spaced at 30 to 48 inches on center, cable ties shall not be tight enough to deform cabling and shall not be used to support the cabling.
- J. Each cable run shall include a three-foot service loop with Velcro hook ties located in the ceiling above the rack. This is to allow for future re-termination or repair.
- K. All cabling shall be placed with regard to the environment, EMI/RFI interference, and its effect on communication signal transmission.
- L. Non-conductive fiber optic cable is immune from EMI/RFI interference. Give priority when selecting a route to minimize exposure to possible cable damage from maintenance or service of all systems in the attic space.
- M. Do not route any data cable within two feet of any light fixture, HVAC unit, service access area, electric panel, or any device containing a motor or transformer.
- N. Communication cable will not be installed in the same conduit, raceway, tray, duct, or track with line voltage electrical cable without a metallic barrier meeting NEC requirements.
- O. Maximum cable pulling tension should not exceed 25 pound-force (110 N) or the manufactures recommendation, whichever is less.
- P. Any pulling compounds utilized must be approved by the cable manufacturer and shall not degrade the strength or electrical characteristics of the cable.
- Q. No terminations or splices shall be installed in or above ceilings, other than in designated end point housings.
- R. Cable bends shall not be tighter that the manufacturers' suggested bend radius.
- S. Mount all equipment firmly in place. Route cable in a professional, neat and orderly installation.
- T. Provide for adequate ventilation to all equipment racks and take precautions to prevent electromagnetic or electrostatic hum.

3.4 UTP CABLE TERMINATION PRACTICES

- A. Insulation Displacement Contact (IDC) connectors shall be used and installed per the manufactures' recommendations.
- B. Strip back only as much cable jacket as required to terminate.
- C. Preserve wire-pair twists as closely as possible to point of termination (0.5" maximum) to keep signal impairment to a minimum.
- D. Avoid twisting cable jacket during installation.
- E. Avoid twisting cable jacket during installation.
- F. Take care to ensure all data UTP wiring devices are designed for T568B wiring, T568A devices use a different pair assignment and should not be mixed.

- G. Data and Telephone Cable UTP T568B, Identical to AT&T 258A and WECCO, Pin/Pair Assignments (All RJ-45 modular jacks):

3.5 OPTICAL FIBER CABLE INSTALLATION AND TERMINATION PRACTICES

- A. The following fiber optic connector installation methods are acceptable; fusion splice connection of factory made pigtail connectors, epoxy/polish style connectors, or non-epoxy compression cam gel style connectors. In each case, the connector manufacturer's instructions shall be followed and the recommended tools and supplies, including break out kits when required, shall be used for termination and testing. All Fiber strands to be terminated including future use pairs.
- B. As per industry standard - IEC 61300-3-35 during optical fiber connector termination, certify, all terminations with a 200-power microscope (minimum). Follow all of the connector manufacturer's recommendations. Unacceptable flaws in the termination's will include, but not be limited to, scratches, full or partial cracks, bubbles, pits, or residual dirt, dust, oil, moisture, grinding or sanding debris in the connector. The acceptable final inspection shall show a connector tip that is properly aligned and free of imperfections in 100% of the core and 80% of the cladding. Any connectors that fail testing shall be inspected and re-tested after rework.
- C. During installation of optical fiber cable, do not allow pulling tension to exceed cable manufacturer's specification for the cable being installed. Only the strength member of the cable shall be subjected to the pulling tension.
- D. Clean all optical fiber connector tips prior to inserting them into mating receptacles or bulkheads and re-install dust covers. Clean the tester launch cord prior to each insertion, as well.

3.6 CABLE SUPPORT

- A. Conduit, duct, or track shall be used for communication cable in exposed areas.
- B. Cable fill shall not exceed the manufacturer's instructions for each type of support.
- C. All conduit, ducts, track, and raceways shall be supported from the structure at industry standard intervals for the size specified, utilizing proper anchoring devices.
- D. Solid, ladder, or mesh cable tray/duct shall be required for narrow depth cable routes that would allow sags to rest upon the ceiling, electrical conduits, HVAC equipment, ducts, or lighting fixtures.
- E. Vertical cable runs exceeding 12" in equipment closets shall require ladder or mesh type cable support tray. Attachment shall utilize appropriate mounting hardware and accessories for vertical placement and allow a minimum of 2" clearance between the wall and runway. Cable attachment shall be made by Velcro hook ties in a basket type configuration.
- F. All vertical supports shall be attached to the building support structure or concrete ceiling with anchors load rated for 100-lbs. minimum. Down rods shall be a minimum of 1/4" diameter. Steel uni-strut cross supports shall be 2" minimum.
- G. Cable runway or tray shall be grounded to an appropriate building ground at each end and bonded at each joint.
- H. Rubber or plastic boots shall be installed at the ends of horizontal support rails to prevent cable damage or injuries to personnel.

3.7 FIRE OR DRAFT STOPPING, PENETRATIONS, AND CORING

- A. UL Listed fire stopping methods that match the fire rating of the wall or floor being penetrated are to be used at all fire barrier penetrations. Seal the interior of the conduit sleeve around the cables and around the outside of the sleeve on each side of the penetration with fire-stop caulk or putty, install according to the manufacturer's instructions.

- B. All penetrations through fire rated walls or floors shall feature a suitable length of metal conduit. Hole diameter shall not exceed $\frac{1}{2}$ " larger than the conduit or sleeve to be installed. The hole shall be neatly cut, not oversize or irregular. Do not share wall/floor penetrations with ductwork, piping, line voltage electrical conduits, etc.
- C. All gypsum board or plaster penetrations shall tool cut using an appropriate hole saw / mandrel or manufactured assembly.
- D. Draft/Noise Stopping - This Contractor prepares for and applies draft/noise stopping to all non-rated wall penetrations. Draft/Noise stopping shall minimize the movement of air and sound from enclosed areas to other parts of the building. This shall include but not limited to:
 - 1. Neatly cutting all non-rated wall/floor penetrations with a 1" maximum clearance. All gypsum board or plaster penetrations shall tool cut using an appropriate hole saw / mandrel or manufactured assembly. The hole shall be neatly cut, not oversize or irregular. Do not share wall/floor penetrations with two types of ductwork, piping, line voltage electrical conduits, communications cabling, etc.
 - 2. Provide and install non-combustible mineral wool, fiberglass, cellulose insulation, caulk, and sealant as required. Seal the interior of conduit sleeves around the cables and around the outside of the sleeve on each side of the penetration with caulk or putty, install according to the manufacturers' instructions.
- E. Upon approval, the Contractor shall be required to supply all labor, equipment, tools, and materials to create any additional penetrations, and shall provide the sleeve, temporary and final fire stopping. Special care shall be taken not to stress, overheat, or penetrate any building support member. Coring shall be made with equipment appropriate for the dry penetration of concrete and block materials. Under no circumstances shall penetrations be made utilizing a chisel or percussion type equipment. Concrete, block, or plaster cores shall be made by dry saw/core methods only.

3.8 EXISTING DATA SYSTEMS DEMOLITION, MODIFICATION AND EXPANSION FOR ADDITIONS AND RENOVATIONS

- A. The Data contractor shall be responsible for demolition as required of the existing systems, including demolition of any devices and cabling previously abandoned. Demolition shall include:
 - 1. Disconnection and removal of all communication devices not to remain in service in walls, floors, and ceilings.
 - 2. Removal of exposed abandoned conduit and supports including brackets, stems, hangers, and other accessories located on walls and above accessible finished ceilings. Cut abandoned conduit flush with walls, floors, etc., and patch surfaces.
 - 3. Provide a blank cover for abandoned device backboxes that are impractical to remove from masonry construction without unnecessary damage.
 - 4. Repair of any finishes or adjacent construction damaged during modification, extension, and demolition work.

3.9 EXAMINATION

- A. Verify field conditions including existing systems, equipment models, configurations, circuiting arrangements, cabling, and devices. Adjust all circuiting, cabling, and materials to be provided as required by job conditions.
- B. Project drawings are based on casual field observation and existing record documents when available, report any significant discrepancies to the Engineer before disturbing existing systems.
- C. The Contractor accepts the existing conditions when beginning demolition.

3.10 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment in areas of renovation that are to remain or be reused.

3.11 OPERATION OF NEW EQUIPMENT PRIOR TO PROJECT COMPLETION

- A. When the phasing of a project requires that data systems are operable in certain areas and the Owner needs to operate the equipment the contractor shall make such provisions. The warranty period shall commence on new equipment when it is operated for the beneficial use of the Owner. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, properly adjust, and complete all punch list items before final acceptance by the Owner. In these cases, the date of acceptance and the start of the warranty may be different dates.

3.12 PROTECTION OF EQUIPMENT AND MATERIALS

- A. The Contractor shall take such precautions as may be necessary to protect his apparatus from damage.
- B. This shall include the creation of all required temporary shelters to protect any apparatus above the floor of the construction and the covering of apparatus in the completed building with tarpaulins or other protective covering.
- C. Failure to comply with the above to the satisfaction of the Owner's inspector will be sufficient cause for the rejection of the equipment in question and its complete replacement by the Contractor.

3.13 FINAL OBSERVATION

- A. It shall be the duty of the Contractor to make a careful observation trip of the entire project, assuring themselves that the work on the project is ready for final acceptance before calling upon the Owner Representative to make a final observation.
- B. To avoid delay of final acceptance of the work, the Contractor shall have all necessary bonds, warranties, receipts, affidavits, et cetera, called for in the various articles of these specifications, prepared and signed in advance, together with a letter of transmittal, listing each paper included, and shall deliver the same to the Owners Representative at or before the time of said final observation. The Contractor is cautioned to check over each bond, receipt, et cetera, before preparing for submission to verify that the terms check with the requirements of the specifications.
- C. The following and other provisions of Division 1 General Conditions will be required at time of final completion:
 - 1. Final clean up completed.
 - 2. All systems are fully operational, all material and devices installed.
 - 3. As-built (as installed) drawings and operations manuals.

3.14 CUTTING AND PATCHING

- A. Notify the Builder sufficiently ahead of construction of any floors, walls, ceiling, roof, et cetera, of any openings that will be required for his work.
- B. The Contractor shall see that all sleeves required for his work are set at proper times to avoid delay of the job.
- C. All necessary cutting of walls, floors, partitions, ceilings, et cetera, as required for the proper installation of the work under this Contract shall be done at the Subcontractor or at the Subcontractor's expense in a neat and workmanlike manner, and as approved by the Owner Representative.
- D. Patching of openings and/or alterations shall be provided by the communications Subcontractor or at the Subcontractor's expense in an approved manner.
- E. No joists, beams, girders, or columns shall be cut by any Contractor without first obtaining written permission of the Owners Representative.
- F. All openings in firewalls and floors shall be completely sealed after installation for a completely airtight installation. Sealing material shall be non-combustible and UL approved. The installed sealing assembly shall not cause the fire rating of the penetrated structure to be decreased.
- G. All openings in exterior walls shall be sealed watertight.

- H. Seal voids around conduits penetrating fire-rated assemblies and partitions using fire stopping materials and methods in accordance with NFPA and local codes.

3.15 WARRANTY, SERVICE, TESTING, CERTIFICATION

- A. The Contractor must provide an extended warranty that is inclusive of the Manufacturer's warranty to the Owner covering all network cable and connectivity hardware products comprising this installation site. The Contractor and Manufacturer shall jointly provide the Owner an extended warranty of the installed system against defects in material or workmanship for a period of no less than twenty years (period as is customary for the Manufacturer) from the date of substantial completion. Any equipment or cabling shown to be defective shall be replaced, repaired, or adjusted free of charge. All labor and materials shall be provided at no expense to the Owner.
- B. The System Contractor shall make a thorough inspection of the complete installation to ensure the following:
 - 1. Complete and functional system.
 - 2. Installed in accordance with manufacturers' instructions.
 - 3. All cabling shall test free from all grounds, opens, and shorts.
 - 4. A representative of the Owner shall have an opportunity to be present for all final testing. Coordinate final testing with Owner, schedule as near as possible to acceptance date.

3.16 UTP CABLES AND LINK TESTING

- A. Acceptance Testing: Test each conductor of every cable on the reel to verify length and continuity. Cables that have been damaged in transit must be replaced. Installed cable that proves to be defective will be replaced at the contractor's expense.
- B. Final Testing: All UTP cabling will be certified to meet and or exceed the specifications as set forth for Permanent Link Testing of all Power over Ethernet electrical parameters including alien crosstalk performance. Mechanical requirement testing and test methods shall meet ANSI/CEA S-90-661 or ANSI/CEA S-102-732. Certified cable channel performance shall meet or exceed the requirements of ANSI/TIA-568, ANSI/TIA-1152-A, and ISO/IEC 11801 Standards for Structured Telecommunications Cabling Installations in a configuration up to 100 meters at swept frequencies of:
 - 1. 1 to 250 MHz Level III Class E for Category 6
 - 2. 1 to 500 MHz Level IIIe Class EA for Category 6A.
- C. Test alien crosstalk (near-end and far-end loss) for a cabling system using a network analyzer with 100- Ω pair terminations per industry standards.
- D. The cable tester shall be ETL verified to IEC Level V accuracy or equivalent with the latest version of firmware and shall produce an electronic or printed report, noting label information, for each cable run. These reports are to be included in the close-out documentation. Testing shall be conducted with a Fluke DSX-5000 with OLTS and OTDR functions, or equivalent, permanent link adapters, high-performance channel adapters, termination plugs, 8-pin modular couplers and analysis software. Certifications shall include industry standard parameters for each pair of each cable installed.

3.17 OPTICAL FIBER TESTING

- A. Acceptance Testing: Test each strand of every optical fiber cable on the reel with an OTDR, to verify length and continuity. Fiber cables that have been damaged in transit must be replaced. Installed fiber cable that proves to be defective will be replaced at the contractor's expense.
- B. Final Testing: After termination, each individual fiber of each cable segment shall be tested bi-directionally using an OTDR, both to determine the installed length and continuity. All individual fibers of each cable segment will be tested using a power meter to determine the actual loss. These readings will be taken at the 850 nm and 1300 nm windows for Multi-mode and 1310 nm and 1550 nm windows for single-mode. Testing will be in both directions. The final readings shall be listed in the certification report. These readings must not be higher than the "Optimal Attenuation Loss." The OAL will be calculated using the manufacturers' factory certified test results, (dB/Km) converted to the actual installed lengths plus the manufacturers' best published attenuation losses for the connector and/or splice installed on this project. (0.20 for Connectors and 0.10 for splices.) The OAL shall be used for comparison with the end to

end power loss test results prior to acceptance by the construction manager.

- C. Fiber optic cable shall be subjected to bi-directional testing meeting ANSI/TIA-568 requirements. The cable tester shall produce a printed report, noting label information, for each cable run. These reports are to be included in the close-out documentation.

3.18 DRAWINGS, MANUALS, AND TRAINING

- A. As-built drawings and operating and maintenance manuals may be electronically transmitted in PDF file format.
- B. Upon completion of the installation, and prior to final inspection, the Contractor shall furnish as-built drawings.
- C. In addition, the contractor shall furnish complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets. Manuals shall include wiring diagrams to indicate internal wiring for each device and the interconnections between the items of equipment. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system. Provide a parts list with manufacturer and model number for commonly replaced parts. Include complete instructions for the inspection, testing, and maintenance of the system. Place final cable certification test results in manuals.
- D. All cable paths and wiring methodology shall be documented. All cables shall have both ends labeled and included in the as-built documentation. Provide an MS Excel worksheet compatible format spreadsheet file cross referencing all cable run numbers, architectural room number, and owners room number for the origin and destination of each cable run.
- E. A formal on-site training session shall be provided by the Contractor to the Owners Representative / Maintenance personnel and shall include instruction on the documentation, location, inspection, maintenance, testing, and operation of all system components. Provide a minimum of two (2) hours of documented general instruction. It shall be the responsibility of the Contractor to coordinate time and location of training sessions with the Owner.

END OF SECTION

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SECTION 27 41 31

INTEGRATED AUDIO-VISUAL SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1, apply to this Section.
- B. Audio Video Systems complete including selective modification of existing system to be revised and expanded, cabling, special backboxes, hardware, and all other required devices and equipment.
- C. Provide all equipment, accessories, materials, tools, scaffolding, man lifts, labor, supervision, transportation and services necessary for or incidental to the installation and testing of the data cable plant.
- D. As required by the contract documents this contractor shall be responsible for demolition of any devices and cabling previously abandoned back to source in the areas of the scope of work.
- E. Provide and install, prior to cable installation, plastic snap in bushings at each box opening, passage through a metal stud, and at the end of all open conduit stubs or sleeves to protect the cabling from damage.
- F. It is the intent of these specifications to provide complete installations although every item necessary may not be specifically mentioned or shown.
- G. Refer to System Schedules on plan for part numbers and additional information.
- H. This project shall include preparation of construction plans locating the audio video devices and having the plans reviewed by Owner and the Owner's Representative.
- I. Provide all training, as-built drawing and manual documents as outlined in these specifications.
- J. Provide a warranty as outlined in these specifications.
- K. It shall be the responsibility of the Division 26 Electrical Contractor to provide:
 - 1. Provide and install all conduit and standard electrical boxes for the audio video system as specified herein. The audio video contractor shall coordinate all conduit and box requirements and locations with, and provide special back boxes to, the electrical contractor prior to installation.
 - 2. Provide equipment grounding system, conductors, and bus bars as outlined in Division 26.
 - 3. Cabling in all open ceiling areas shall be enclosed in conduit.
 - 4. Furnishing and installation of all floor boxes, surface raceways, and other wireways which are detailed or specified under Division 26.
 - 5. Provide required conduit for accessibility to attic or plenum space.
 - 6. Provide 120-volt power and hook-up to equipment provided in Division 27.
 - 7. Installation of special back boxes supplied by audio video contractor.
 - 8. Provide equipment mounting boards as indicated on the drawings.
 - 9. Provide conduit to remote areas outside of the building as outlined on the drawings.
 - 10. Coordination of requirements of Division 27 with the Builder.

1.2 WORK NOT INCLUDED

- A. Contractors shall make no agreement that obligates the Owner to pay any company providing communications, monitoring, or other services.

1.3 RELATED SECTIONS

- A. The conditions of the Division 0, Division 1, Division 26 requirements, and the contract requirements that include the General Conditions and the Supplementary Conditions apply to work of this division.
- B. Section 26 00 00 – Electrical.

1.4 OWNER FURNISHED CONTRACTOR INSTALLED (OFCI) EQUIPMENT

- A. Refer to Responsibility Matrix on drawings for equipment that applies.
- B. The contractor shall verify that new and existing products and site conditions are satisfactory for installation or relocation of OFCI equipment. If unsatisfactory conditions exist or other discrepancies are identified, the contractor shall immediately document the conditions and notify the owner in writing.
- C. The contractor shall coordinate all required equipment schedule quantities and any dimensions or variations required to adapt to field conditions with the owner at the earliest possible date. The contractor shall verify compatibility, installation rough-in, mounting, and utility requirements for the scheduled OFCI equipment.
- D. The contractor shall verify compatibility, installation rough-in, mounting, and utility requirements for the scheduled OFCI equipment.
- E. The owner shall coordinate delivery dates with the builder to meet the construction schedule.
- F. The installation of items as identified in the plans and specifications as OFCI equipment shall conform to the provisions of the Contract Documents and shall be coordinated with the builder.
- G. Installation shall be performed by competent and trained workers in accordance with all applicable codes and governing regulations.
- H. Installation, testing, and startup shall comply with the manufacturer's instructions.
- I. The contractor shall provide all miscellaneous hardware, structural support, cabling, fittings, etc. that is not included by the manufacturer, but required for installation.
- J. The contractor shall clean and adjust all relocated and new OFCI products as necessary.
- K. All crating, packing materials, and debris shall be properly disposed of off-site.
- L. Installation shall be subject to inspection by the owner representative, owner, and builder. The installer shall not proceed until any unsatisfactory conditions are corrected. Any damage caused by improper handling or installation procedures shall be corrected at no cost to the owner.
- M. For drop shipped equipment, the builder shall be the consignee and shall have a representative on-site for coordination of delivery, receiving shipments, and inspect each shipment for obvious signs of damage or shortages. The builder shall be responsible for all shipping damage claims, including hidden damage, refusal of shipment, and Return Authorization procedures. The builder shall provide secure storage, handling, and protection from the elements, prior to the contractors' acceptance for installation.
- N. For equipment stored at an owner's facility, the contractor shall load the equipment and provide transportation to the work site. Prior to loading, the contractor shall inspect the equipment for obvious signs of damage and document all quantities, noting shortages from the project requirements, indicating acceptance of the merchandise as is and in good order.
- O. The contractor shall conduct and properly document testing of all installed equipment to verify proper operation. When appropriate, on-site operation and maintenance instruction shall be provided to the owner's personnel. This instruction shall include demonstration of proper use, maintenance, and cleaning procedures.
- P. The nature of the equipment procurement shall determine responsibility for resolving any claims with the manufacturer or supplier relating to defects in material or workmanship and warranty claims. The party that purchased the equipment shall resolve these issues.

1.5 PRESCRIPTIVE CODES, STANDARDS AND REGULATIONS

- A. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards, except when requirements are exceeded by the contract documents.
- B. In addition to requirements outlined in other sections of the specifications these codes and standards are imposed as applicable to the work in each instance.
- C. The equipment, materials, and installation shall conform to the latest version of all applicable codes, standards and regulations, of authorities having jurisdiction.
- D. Nothing in the Contract Documents shall be construed to permit work not conforming to these codes and standards.
- E. When two or more codes or standards are applicable to the same work, then the stricter code or standard shall govern.
- F. The date of the code or standard is that in effect on the date of issue stated on the contract documents, except when a particular publication date is specified.
- G. The Contractor shall comply with all State, Federal, NFPA, local codes and ordinances that may alter any part of the plans or specifications. The Contractor shall bear all costs for correcting any deficiencies due to non-compliance.
- H. Where local codes and ordinances are not in writing or on record, but local precedence have been set, the Owner shall pay for any additional resulting cost.

1.6 PLANS AND SPECIFICATIONS

- A. The intent of the project drawings is to establish the types of systems and functions, but not to set forth, each item essential to the functioning of the system.
- B. The drawings are generally diagrammatic and show approximate location and extent of work.
- C. Install the work complete including minor details necessary to perform the function indicated. Provide audio video systems, including all connections, complete in every respect and ready to operate.
- D. If clarification is needed, consult the Owner's Representative.
- E. Review pertinent drawings and adjust the work to conditions shown. Where discrepancies occur between drawings, specifications, and actual field conditions, immediately notify the Owner's Representative for his interpretation.
- F. The Owner's Representative reserves the right to make any reasonable change in the location of any part of this work without additional cost to the Owner.

1.7 SITE VISIT

- A. Before submitting a proposal, each proposed contractor shall examine all plans and specifications relating to the work, shall visit the site of the project, and become fully informed of the extent and character of the work required, including all required utilities and work to remote areas.
- B. No consideration will be granted for any alleged misunderstanding of the materials to be furnished, or the amount of work to be done. It being fully understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying plans, or required by nature of the site of which may be fairly implied, as essential to the execution and completion of any and all parts of the work.

1.8 SUBMITTALS

- A. Submit a complete submittal package within 30 calendar days after award of this work for approval. Equipment is not to be ordered without approval. Partial submittals are not acceptable for review. Each

submittal shall include a dated transmittal.

- B. Submittal shall be electronically transmitted in PDF file format.
- C. For each submittal provide a cover sheet with the name and location of the project, the name, address and telephone number of the Contractor, and the name, address and telephone number of the submitting sub-contractor. Include on or after the cover sheet sufficient space for review stamps.
- D. Quality Assurance Submittal including special boxes, cable, and other material as requested by the Owner's Representative:
 - 1. Letter from manufacturer stating that the Contractor is an Authorized Factory Distributor for the area where the project is located.
- E. Product Data Submittal to include:
 - 1. An indication of any deviations from Contract Document requirements, including variations and limitations. Show any revisions to equipment layout required by use of selected equipment.
 - 2. A product data index and complete equipment list including for each product submitted for approval the manufactures name and part number, including options and selections
 - 3. Cut-sheets or catalog data illustrating the physical appearance, size, function, compatibility, standards compliance, and other relevant characteristics of each product on the equipment list.
 - 4. Indicate by prominent notation (an arrow, circle, or other means) on each sheet the exact product and options being submitted.
 - 5. Submit design data, when the scope of work requires, including calculations, schematics, risers, sequences, or other data.
 - 6. Submit a sample of the extended product warranty language.
 - 7. Any resubmittals shall include a complete revised equipment list and any product data that is revised.
- F. Shop Drawings Submittal to include:
 - 1. Produce accurate to scale (min. 1/8" = 1') drawings showing equipment and device layouts prepared using a CAD or BIM engineering drawing program. When CAD background files are not available for existing buildings the Contractor shall inspect the site and collect information to create a floor plan. Walls shall be double line showing the thickness, single line diagrams are not acceptable.
 - 2. Other disciplines devices or equipment not relevant to this scope of work shall not be shown on shop drawings. Submitting modified contract documents shall not be permitted.
 - 3. Full fabrication details of any custom enclosures and millwork indicating size, material, finish and openings for equipment.
 - 4. Projector, loudspeaker, camera mounting details, include hardware types and load capacity.
 - 5. Provide complete drawings on custom fabricated plates or panels. Drawings shall include dimensioned locations of components, component types, engraving information, plate material and color, and bill of material.
 - 6. Labeling: Equipment and cabling labeling scheme - include font sizes and styles, explanation of scheme, and designator schedule.
 - 7. Schedules: Wiring schedule showing source and destination of wiring and indicating which wiring is in conduit. Junction box schedule showing type of box, size, mounting, and location. Include this information with remainder of wiring diagrams.
 - 8. Every room shall have a name and number identifying the use of the space with ceiling heights notated for each space or group of spaces throughout the design.
 - 9. When multiple buildings make up the system, provide a block diagram of the project site showing all buildings to be covered by the system and detailing the route and type of connection between buildings. Note building entry points, conduit type and size, and routing pathway (underground or over canopy installation).
 - 10. Shop or coordination drawings shall include information that will allow the Contractor to coordinate interdisciplinary work and when necessary guide the manufacturer or fabricator in producing the product.
 - 11. Resubmittals shall include revision notation and clouded changes.

1.9 QUALIFICATIONS OF A PROPOSED CONTRACTOR

- A. Proposed contractors who do not currently possess the necessary qualifications, trained and experienced personnel, financial capacity, and meet the other requirements herein described will be disqualified
- B. The Contractor shall employ full-time, factory-trained, licensed, local technicians and installers for product installation, maintenance, support, service and warranty.
- C. The proposed contractor, as a business entity, shall be a local authorized distributor and designated representative of the equipment manufacturer, with full extended warranty privileges. The proposed contractor shall have been actively engaged in the business of selling, installing, and servicing of similar systems for a period of at least 5 years. Selected contractor must be certified in specified system, subcontracting other companies certified in proposed product shall not be allowed.
- D. Employ CTS and CTS-I staff (certified by AVIXA) and assigned to, and active on this project.
- E. A minimum of one (1) CTS employee to supervise each project, and on site during the construction phase.
- F. Recently formed companies are acceptable only if specific pre-approval is requested, and granted by the owner representative, based on experience of key personnel, current and completed projects, and all licensing requirements are met 10 working days prior to the contract proposal date.
- G. The proposed Contractor shall have an office within 150-miles of the job site, staffed with factory-trained technicians who are qualified and licensed to supervise the installation, to be responsible that the system is installed as submitted, to conduct system start up, and perform a 100 percent operational audit of all installed devices. The technicians shall instruct the Owners' representatives in the proper operation of the system, and to provide service throughout the warranty period. The contractor shall be capable of dispatching technicians to repair a system within six (6) hours of a service request.
- H. The proposed contractor shall be fully experienced in the design and installation of the type of system and manufacturer herein specified and shall furnish with the contract proposal an itemized list of the installations of the type specified herein.
- I. The contractor shall employ factory-trained technicians capable of supporting the maintenance of the system. No contract employees are allowed. All installing technicians shall be employed by the proposed contractor.
- J. The Owner's Representative or Owner may investigate, as they deem necessary to determine the ability of the proposed Contractor to perform the work. The proposed contractor shall furnish to the Owner with any information or data requested for this purpose.
- K. The Owner's Representative or Owner reserves the right to reject any contract proposal if the evidence submitted, or their investigation, fails to indicate that the Contractor is qualified to fulfill of any part of the contract or to complete the work contemplated therein.
- L. The Owner's Representative or Owner reserves the right to reject the proposal of any contractor who has previously failed to perform properly, or complete on time, contracts of a similar nature.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All cable and wiring devices provided shall be listed and labeled by Underwriters Laboratories, Inc. for the intended use under the latest appropriate testing standard.
- B. Refer to System Schedule on plan for part numbers and additional information.
- C. Only equipment devices have been shown on the contract drawings. Specific wiring between equipment has not been shown.

- D. All equipment and components shall be new, and the manufacturers' current model. All like devices shall be of the same manufacturer and model number.
- E. Both ends of all cables shall be labeled utilizing self-laminating polymer film non-smear, machine printed labels.
- F. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., cable shall not be supported by or lay on suspended ceilings). Fasteners and supports shall be adequate to support the required load.
- G. Where required, provide manufacturer's rack mount adapter or one manufactured by Middle Atlantic unless specified elsewhere.
- H. Remove or blank out all manufacturer's names, logos, or other symbols from loudspeakers or other objects placed in view of the public. If logos are removable, remove and repaint to the color of the adjacent surface reattach.

2.2 ACCEPTABLE MANUFACTURERS

- A. Descriptions and details, acceptable manufacturers' names listed and specific manufacturer and model number items indicated in the plans and specifications shall establish a standard of quality, function, and design. Manufacturers and model numbers listed "no exceptions" shall not be substituted without specific notice in an addendum. Otherwise, where a specific manufacturer's product is indicated, products of other manufacturers listed as acceptable may be submitted for approval based on the substitute product being, in the opinion of the Engineer, of equivalent or better quality than that of the product specified.
- B. Proposed contractors wishing to propose any product substitution must do so in writing to the specifying authority at least ten (10) days prior to the proposal opening.
- C. For manufacturers equipment or models other than that specified, the proposed contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment. Proposals must include detailed information showing all deviations from the system as specified.
- D. Substitute products for which the proposed contractor does not obtain prior approval will not be considered acceptable for this project. Final approval of alternate products shall be based on the decision of the Owner and Architect. Prior approval to make a proposal for this project does not automatically ensure products will be an acceptable equivalent.
- E. It is the responsibility of the Contractor to provide all features and functions as outlined in these specifications. The functions and features specified are vital to the operation of this facility; therefore, inclusion in the list of acceptable manufacturers does not release the contractor from strict compliance with the requirements of this specification.
- F. The selected contractor must be a certified Integrator/Installer authorized by one of the Manufacturers listed below to provide an extended warranty to the Owner covering all network cable and connectivity hardware products comprising this installation site. The Contractor and Manufactured shall jointly provide the Owner an extended warranty of the installed system against defects in material or workmanship; provide a copy of contractor certification.

G. Acceptable Manufacturers Include:

Allen and Heath	United Kingdom
Atlas IED	Phoenix, AZ
BSS Audio	South Jordan, UT
Community Professional Loudspeakers	Chester, PA
Crestron Electronics	Rockleigh, NJ
Crown Audio	Elkhart, IN
Danley Sound Labs	Gainesville, GA
Denon Professional	Cumberland, RI

Electro-Voice	Fairport, NY
Extron	Anaheim, CA
Furman Contractor	Petaluma, CA
JBL Professional	Northridge, CA
Listen Technologies Corporation	Bluffdale, UT
Lowell Mfg.	Pacific, MO
Middle Atlantic Products	Fairfield, NJ
Neutrik	Charlotte, NC
QSC	Costa Mesa, CA
Octasound	Ajax, ON
Radio Design Labs	Prescott, AZ
Sennheiser	Old Lyme, CT
Shure Incorporated	Niles, IL
Soundcraft	Northridge, CA
West Penn Wire	Washington, PA

- H. Other manufacturers must be approved by the owners representative, unless indicated by these specifications.

2.3 WALL PLATE COLOR

- A. Color of device/wall plates to best match project light switches and electrical outlets, coordinate with the Electric Contractor.

2.4 CABLES & WIRING

- A. Cable shall have appropriate fire rating (CMR, CMP, OFNR, OFNP, etc.) and labeled on jacket of cable.
- B. Furnish an insulated #6 copper ground wire run from the amplifier to an earth ground, attached securely to the amplifier case, and terminated at each end to bare metal.
- C. Where speaker cables are run exposed through a return air plenum, provide plenum rated cable.
- D. Shielded cables located in raceways shall have aluminum foil shield with drain wire.
- E. Loudspeaker Wiring:
1. Provide wire size as required for load and length to meet industry standards
2. Jacket color: black
- F. Microphone/Line Level Wire:
1. Provide shielded 22 AWG cable
2. Bonded jacket
3. Jacket color: black
- G. Ethernet/LAN Cable (UTP):
1. Enhanced category 6
a. 4 pair, 23-AWG Bare Copper
b. Standard Termination T568B
c. Color - Yellow
2. Enhanced category 6A
a. 4 pair, 23-AWG Bare Copper
b. Standard Termination T568B
c. Color - Yellow
- H. RF Antenna Cables (as required by manufacturer's specifications)
1. RG-58/U Type
a. 20 (19x32) Tinned Copper Conductor
b. 100% Bi-Foil, Tinned Copper Braid Shield with 95% or better coverage

- c. Nominal Impedance of 50Ω
- 2. RG-213/U Type
 - a. 13 (7x21) Tinned Copper Conductor
 - b. Bare Copper Braid Shield with 95% or better coverage
 - c. Nominal Impedance of 50Ω
- 3. RG-8/U Type
 - a. 10 AWG Solid Tinned Copper Conductor
 - b. 100% Bonded Bi-Foil + 90% Tinned Cu Braid Shield
 - c. Nominal Impedance of 50Ω

I. Acceptable cable manufacturers

West Penn	Washington, PA
Windy City Wire	Bolingbrook, IL
Liberty	Colrado Springs, CO
Belden	St. Louis, MO
Commscope	Hickory, North Carolina

2.5 BUSHINGS

- A. Provide a plastic snap in bushing at each box opening, passage through a metal stud, and at the end of all open conduit stubs or sleeves prior to cable installation to protect the cabling from damage:
 - 1. Box openings - Thomas & Betts Knockout Bushing Series 3210, or equivalent.
 - 2. Metal stud passage - Thomas & Betts Twist It Bushing Catalog Number SB1216-SC, or equivalent.
 - 3. Conduit ends - Thomas & Betts Anti-Short Bushing Series 390 or Tite-Bite Combination couplings Series 442, or equivalent.

2.6 J-HOOKS

- A. All attachments shall be specifically designed for telecommunications cabling.
- B. Attachments for cabling support shall be spaced at approximately 48 to 60 inches on center. Cable bundles shall not be allowed to sag down more than 12-inches mid-span between attachments.
- C. Attachments shall be sized for 25% capacity to allow for future expansion.
- D. Do not mix different signal strength cables on the same J-Hook (i.e. fire alarm with data and telephone cable). Multiple J-Hooks can be placed on the same attachment point, up to the rated weight load of the attachment device.
- E. Acceptable manufacturers:
 - 1. Erico.
 - 2. Panduit
 - 3. Cooper B-line.

PART 3 - EXECUTION

3.1 CABLE ROUTING AND INSTALLATION

- A. Cooperation with trades of adjacent, related or affected materials or operations, and or trades performing continuations of this work under subsequent contracts are considered a part of this work. In order to effect timely and accurate placing of work and to bring together, in the proper and correct sequence, the work of such trades, including work provided under a Division 1 allowance.
- B. System wiring and equipment installation shall be in accordance with good engineering practices as established by the EIA and the NEC. Wiring shall meet all state and local electrical code requirements.
- C. Cable pathways, conduit, and cable support systems shall be complete with bushings, de-burred, cleaned, and secure prior to installation of cable.

- D. All wiring shall test free from opens, grounds, or shorts. All cable shall be supported from the building structure and bundled. Do not attach any supports to joist bridging or other lightweight members.
- E. All cable shall have a label on both ends utilizing self-laminating, flexible vinyl film, non-smear, machine printed labels.
- F. The support system shall provide a protective pathway to eliminate stress that could damage the cabling. The cable shall not be crushed, deformed, skinned, crimped, twisted, or formed into tight radius bends that could compromise the integrity of the cabling.
- G. Cable must not be fastened to electrical conduits, mechanical ductwork/piping, sprinkler pipes, or routed to obstruct access to hatches, doors, utility access panels, or service work areas. Do not route cables through fire doors, ventilation shafts, grates, or parallel with line voltage electrical conductors. Communication cables shall not be run loose on ceiling grid or ceiling tiles.
- H. Cables shall be run in bundles above accessible ceilings and supported from building structure building structure by j-hooks, conduit or cable tray. Cabling shall be loosely bundled with cable Velcro hook ties randomly spaced at 30 to 48 inches on center, cable ties shall not be tight enough to deform cabling and shall not be used to support the cabling. Cables shall not be run loose on ceiling grid or ceiling tiles.
- I. Do not mix different signal cables on the same J-Hook (i.e. fire alarm with audio video cable).
- J. Cables shall be run in conduits, where stubs are provided, from wall or floor jacks to accessible areas above finished ceilings. Conduit shall be required only within walls and concealed spaces to provide access.
- K. All work must be performed by workers skilled in their trade. The installation must be complete whether the work is concealed or exposed.
- L. Provide bushings to protect the cable from damage for conduit ends, box openings, and passage through metal studs.
- M. Each cable run shall include a three-foot service loop with Velcro hook ties located in the ceiling above the rack. This is to allow for future re-termination or repair.
- N. All cabling shall be placed with regard to the environment, EMI/RFI interference, and its effect on communication signal transmission.
- O. Non-conductive fiber optic cable is immune from EMI/RFI interference. Give priority when selecting a route to minimize exposure to possible cable damage from maintenance or service of all systems in the attic space.
- P. Do not route any cable within two feet of any light fixture, HVAC unit, service access area, electric panel, or any device containing a motor or transformer.
- Q. Cable will not be installed in the same conduit, raceway, tray, duct, or track with line voltage electrical cable without a metallic barrier meeting NEC requirements.
- R. Maximum cable pulling tension should not exceed 25 pound-force (110 N) or the manufactures recommendation, whichever is less.
- S. Any pulling compounds utilized must be approved by the cable manufacturer and shall not degrade the strength or electrical characteristics of the cable.
- T. No terminations or splices shall be installed in or above ceilings, other than in designated end point housings.
- U. Cable bends shall not be tighter than the manufacturers' suggested bend radius.
- V. Mount all equipment firmly in place. Route cable in a professional, neat and orderly installation.

- W. Provide for adequate ventilation to all equipment racks and take precautions to prevent electromagnetic or electrostatic hum.
- X. Coordinate the actual locations of devices and outlets and equipment with building features and mechanical equipment as indicated on architectural, structural, and mechanical drawings. Review with the owners representative any proposed changes in outlet or equipment location. Relocation of devices, before installation, of up to 3 feet from the position indicated, may be directed without additional cost. Remove and relocate outlets placed in an unsuitable location when so requested by the Architect.
- Y. Mount equipment and enclosures plumb and level.
- Z. Verify all locations of equipment in all rooms with Owner's Representative, Owner, and Consultant.

3.2 EQUIPMENT HOUSING CABLING AND WIRING

- A. Lace, tie, or harness wire or cable as required herein, and in accordance with good engineering practices. Dress, lace or harness all wire and cable to prevent mechanical stress on electrical connections; no wire or cable shall be supported by a connection point. Install cable and wire neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack but still allow for service and testing. Provide horizontal support bars if cable bundles sag.
- B. All system wire, except spare wire, after being cut and stripped, shall have the wire strands twisted back to their original lay and be terminated by approved soldered or mechanical means. No unterminated wire ends shall be accepted. Heat-shrink type tubing shall be used to insulate and dress the ends of all wire and cables including a separate tube for the ground or drain wire.
- C. Provide adequate service loops so that equipment mounted on rack slides may be pulled fully out, to their locked position without straining cable.
- D. Neatly bundle excess AC power cable from housing mounted equipment with plastic cable ties.
- E. Provide Velcro straps to bundle cabling and wiring.
- F. Install with connections completely visible and labeled.

3.3 GENERAL INSTALLATION PRACTICES

- A. Any structural alterations of the building structure must be approved by the Structural Engineer and owner representative before any work can be performed. Once approved, the proper rigging contractor, erection contractor, steel contractor, or others need to perform the work. This does not relate to connecting unistrut, threaded rod, clamps, or similar devices to the structural steel. However, loads must be taken into account. Verify with the Architect that all loads have been reported to the Structural Engineer and have been approved prior to suspending equipment.
- B. All installation hardware shall be Grade 5 or higher and must be rated for overhead rigging where applicable. Threadlocker and split washers shall be used for every connection.
- C. All eyebolts or eye nuts must be forged steel, not turned or welded.
- D. Shackles and Turnbuckles shall be used as necessary. All shackles and turnbuckles must be rated for overhead rigging and lifting. Secure shackle and turnbuckle pins with Threadlocker. Carabiners, Quick Links, and other similar devices are not to be used.
- E. 3/16" Aircraft Cable/Wire Rope is to be used to mount speakers, unless otherwise noted. Aircraft cable is to be secured using aluminum 3-16" x 1" wire rope swage sleeves, not copper. Avoid using wire rope clips. 3/8-Inch chain may be used as an alternate.
- F. Wrapping a beam, perlin, truss, or other structural element without using a Web Sling or Roundsling properly rated for the load being installed is not allowed. If a sling is not available, use Unistrut, Unistrut Beam Clamps, Forged Eyebolts, and other Grade 5 and Higher Hardware to properly attach to the structural element, and then attach the Wire Rope or Chain to the Eyebolt using proper Shackles and

Turnbuckles, Connecting Links, Quick Links, Snap Links, Spring Clip Links, Snap Links, or any other type of non-welded or non-forged shall be accepted. If these are used, the contractor will be required to reinstall the equipment properly at the contractor's expense.

- G. Do not penetrate any steel structure to install bolts or other hardware. Attach unistrut to the steel, and attach the equipment to the unistrut.

3.4 TERMINATION PRACTICES

- A. Use Neutrik standards for all stripping and soldering practices.
- B. Preserve wire twists as closely as possible to point of termination (0.5" maximum) to keep signal impairment to a minimum.
- C. Avoid twisting cable jacket during installation.
- D. Install Teflon tubing on drain or ground wires.
- E. Install Heat Shrink on the end of the PVC jacket surrounding the wire pairs.
- F. The Contractor shall observe proper circuit polarity and loudspeaker wiring polarity meeting industry standards. Properly and clearly label all connections and wires as to function and polarity.

3.5 ENGRAVING

- A. Text font: 1/8-inch block sans serif characters unless noted otherwise.
- B. On dark materials, provide white characters; on stainless steel or brushed natural aluminum plates, or light-colored materials, provide black characters.
- C. Provide at least two lines of text with first line listing the general device name, e.g., amplifier. Second line to include schematic reference of the device, e.g., AMP-1.
- D. Equipment label: black with white characters except where indicated.

3.6 CUTTING AND PATCHING

- A. Notify the Builder sufficiently ahead of construction of any floors, walls, ceiling, roof, et cetera, of any openings that will be required for his work.
- B. The Contractor shall see that all sleeves required for his work are set at proper times to avoid delay of the job.
- C. All necessary cutting of walls, floors, partitions, ceilings, et cetera, as required for the proper installation of the work under this Contract shall be done at the Subcontractor or at the Subcontractor's expense in a neat and workmanlike manner, and as approved by the Owner Representative.
- D. Patching of openings and/or alterations shall be provided by the communications Subcontractor or at the Subcontractor's expense in an approved manner.
- E. No joists, beams, girders, or columns shall be cut by any Contractor without first obtaining written permission of the Owners Representative.
- F. All openings in firewalls and floors shall be completely sealed after installation for a completely airtight installation. Sealing material shall be non-combustible and UL approved. The installed sealing assembly shall not cause the fire rating of the penetrated structure to be decreased.
- G. All openings in exterior walls shall be sealed watertight.
- H. Seal voids around conduits penetrating fire-rated assemblies and partitions using fire stopping materials and methods in accordance with NFPA and local codes.

3.7 FIRE OR DRAFT STOPPING, PENETRATIONS, AND CORING

- A. UL Listed fire stopping methods that match the fire rating of the wall or floor being penetrated are to be used at all fire barrier penetrations. Seal the interior of the conduit sleeve around the cables and around the outside of the sleeve on each side of the penetration with fire-stop caulk or putty, install according to the manufacturers' instructions.
- B. All penetrations through fire rated walls or floors shall feature a suitable length of metal conduit. Hole diameter shall not exceed $\frac{1}{2}$ " larger than the conduit or sleeve to be installed. The hole shall be neatly cut, not oversized or irregular. Do not share wall/floor penetrations with ductwork, piping, line voltage electrical conduits, etc.
- C. All gypsum board or plaster penetrations shall tool cut using an appropriate hole saw / mandrel or manufactured assembly.
- D. Draft/Noise Stopping - This Contractor prepares for and applies draft/noise stopping to all non-rated wall penetrations. Draft/Noise stopping shall minimize the movement of air and sound from enclosed areas to other parts of the building. This shall include but not limited to:
 - 1. Neatly cutting all non-rated wall/floor penetrations with a 1" maximum clearance. All gypsum board or plaster penetrations shall tool cut using an appropriate hole saw / mandrel or manufactured assembly. The hole shall be neatly cut, not oversized or irregular. Do not share wall/floor penetrations with two types of ductwork, piping, line voltage electrical conduits, communications cabling, etc.
 - 2. Provide and install non-combustible mineral wool, fiberglass, cellulose insulation, caulk, and sealant as required. Seal the interior of conduit sleeves around the cables and around the outside of the sleeve on each side of the penetration with caulk or putty, install according to the manufacturers' instructions.
- E. Upon approval, the Contractor shall be required to supply all labor, equipment, tools, and materials to create any additional penetrations, and shall provide the sleeve, temporary and final fire stopping. Special care shall be taken not to stress, overheat, or penetrate any building support member. Coring shall be made with equipment appropriate for the dry penetration of concrete and block materials. Under no circumstances shall penetrations be made utilizing a chisel or percussion type equipment. Concrete, block, or plaster cores shall be made by dry saw/core methods only.

3.8 EXISTING SYSTEMS DEMOLITION, MODIFICATION AND EXPANSION FOR ADDITIONS AND RENOVATIONS

- A. This contractor shall be responsible for demolition as required of the existing systems, including demolition of any devices and cabling previously abandoned. Demolition shall include:
 - 1. Disconnection and removal of all devices not to remain in service in walls, floors, and ceilings.
 - 2. Removal of exposed abandoned conduit and supports including brackets, stems, hangers, and other accessories located on walls and above accessible finished ceilings. Cut abandoned conduit flush with walls, floors, etc., and patch surfaces.
 - 3. Provide a blank cover for abandoned device backboxes that are impractical to remove from masonry construction without unnecessary damage.
 - 4. Repair of any finishes or adjacent construction damaged during modification, extension, and demolition work.

3.9 EXAMINATION

- A. Verify field conditions including existing systems, equipment models, configurations, circuiting arrangements, cabling, and devices. Adjust all circuiting, cabling, and materials to be provided as required by job conditions.
- B. Project drawings are based on casual field observation and existing record documents when available, report any significant discrepancies to the Engineer before disturbing existing systems.
- C. The Contractor accepts the existing conditions when beginning demolition.

3.10 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment in areas of renovation that are to remain or be reused.

3.11 OPERATION OF NEW EQUIPMENT PRIOR TO PROJECT COMPLETION

- A. When the phasing of a project requires that data systems are operable in certain areas and the Owner needs to operate the equipment the contractor shall make such provisions. The warranty period shall commence on new equipment when it is operated for the beneficial use of the Owner. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, properly adjust, and complete all punch list items before final acceptance by the Owner. In these cases, the date of acceptance and the start of the warranty may be different dates.

3.12 PROTECTION OF EQUIPMENT AND MATERIALS

- A. The Contractor shall take such precautions as may be necessary to protect his apparatus from damage.
- B. This shall include the creation of all required temporary shelters to protect any apparatus above the floor of the construction and the covering of apparatus in the completed building with tarpaulins or other protective covering.
- C. Failure to comply with the above to the satisfaction of the Owner's inspector will be sufficient cause for the rejection of the equipment in question and its complete replacement by the Contractor.

3.13 FINAL OBSERVATION

- A. It shall be the duty of the Contractor to make a careful observation trip of the entire project, assuring themselves that the work on the project is ready for final acceptance before calling upon the Owner Representative to make a final observation.
- B. To avoid delay of final acceptance of the work, the Contractor shall have all necessary bonds, warranties, receipts, affidavits, et cetera, called for in the various articles of these specifications, prepared and signed in advance, together with a letter of transmittal, listing each paper included, and shall deliver the same to the Owners Representative at or before the time of said final observation. The Contractor is cautioned to check over each bond, receipt, et cetera, before preparing for submission to verify that the terms check with the requirements of the specifications.
- C. The following and other provisions of Division 1 General Conditions will be required at time of final completion:
 - 1. Final clean up completed.
 - 2. All systems are fully operational, all material and devices installed.
 - 3. As-built (as installed) drawings and operations manuals.

3.14 TESTING

- A. Upon completion of installation, initial adjustments, tests as outlined in this specification, and submission and review of the results, a final observation and test shall be performed by the Owner or Owner's representative.
- B. Provide a minimum of one (1) person for observation and testing familiar with aspects of the System to assist the Owner.
- C. The process of testing the System may necessitate moving and adjusting certain components.
- D. Testing includes operation of each major system and any other components deemed necessary. Perform tests and provide required test equipment, tools and material required to make any necessary repairs, corrections, or adjustments.
- E. The following procedures shall be performed on each System:
 - 1. Observation of the methods and means employed to incorporate the System within the facility.
 - 2. Verification of proper operation, from controlling devices to controlled devices.

3. Verification of proper adjustment, balance, and alignment of equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each level control, and appropriately record these settings within the Record Documents.
 4. Other tests on equipment or systems deemed appropriate.
- F. In the event the need for further adjustment or work becomes evident during testing, the Contractor is to continue his work until the System is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications and any extension of the observation and testing period is required, the Contractor shall pay for additional time and expenses of the Owner at the standard rate in effect at that time.

3.15 WARRANTY, SERVICE, TESTING, CERTIFICATION

- A. The Contractor must provide an extended warranty that is inclusive of the Manufacturer's warranty to the Owner covering all network cable and connectivity hardware products comprising this installation site. The Contractor and Manufacturer shall jointly provide the Owner an extended warranty of the installed system against defects in material or workmanship for a period of no less than twenty years (period as is customary for the Manufacturer) from the date of substantial completion. Any equipment or cabling shown to be defective shall be replaced, repaired, or adjusted free of charge. All labor and materials shall be provided at no expense to the Owner.
- B. The System Contractor shall make a thorough inspection of the complete installation to ensure the following:
1. Complete and functional system.
 2. Installed in accordance with manufacturers' instructions.
 3. All cabling shall test free from all grounds, opens, and shorts.
 4. A representative of the Owner shall have an opportunity to be present for all final testing. Coordinate final testing with Owner, schedule as near as possible to acceptance date.

3.16 DRAWINGS, MANUALS, AND TRAINING

- A. As-built drawings and operating and maintenance manuals may be electronically transmitted in PDF file format.
- B. Upon completion of the installation, and prior to final inspection, the Contractor shall furnish as-built drawings.
- C. In addition, the contractor shall furnish complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets. Manuals shall include wiring diagrams to indicate internal wiring for each device and the interconnections between the items of equipment. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system. Provide a parts list with manufacturer and model number for commonly replaced parts. Include complete instructions for the inspection, testing, and maintenance of the system. Place final cable certification test results in manuals.
- D. All cable paths and wiring methodology shall be documented. All cables shall have both ends labeled and included in the as-built documentation. Provide an MS Excel worksheet compatible format spreadsheet file cross referencing all cable run numbers, architectural room number, and owners room number for the origin and destination of each cable run.
- E. A formal on-site training session shall be provided by the Contractor to the Owners Representative / Maintenance personnel and shall include instruction on the documentation, location, inspection, maintenance, testing, and operation of all system components. Provide a minimum of two (2) hours of documented general instruction. It shall be the responsibility of the Contractor to coordinate time and location of training sessions with the Owner.

END OF SECTION

SECTION 27 51 41

INTERCOM COMMUNICATION SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1, apply to this Section.
- B. Provide a new intercom system as indicated on plans, schedules and specified in this section.
- C. Provide all equipment, accessories, materials, tools, scaffolding, man lifts, labor, supervision, transportation and services necessary for or incidental to the installation and testing of the data cable plant.
- D. As required by the contract documents this contractor shall be responsible for demolition of any devices and cabling previously abandoned back to source in the areas of the scope of work.
- E. Provide and install, prior to cable installation, plastic snap in bushings at each box opening, passage through a metal stud, and at the end of all open conduit stubs or sleeves to protect the cabling from damage.
- F. It is the intent of these specifications to provide complete installations although every item necessary may not be specifically mentioned or shown.
- G. Refer to System Schedules on plan for part numbers and additional information.
- H. This project shall include preparation of construction plans locating the intercom devices and having the plans reviewed by Owner and the Owner's Representative.
- I. Provide all training, as-built drawing and manual documents as outlined in these specifications.
- J. Provide a warranty as outlined in these specifications.
- K. It shall be the responsibility of the Division 26 Electrical Contractor to provide:
 - 1. Provide and install all conduit and standard electrical boxes for the audio video system as specified herein. The audio video contractor shall coordinate all conduit and box requirements and locations with, and provide special back boxes to, the electrical contractor prior to installation.
 - 2. Provide equipment grounding system, conductors, and bus bars as outlined in Division 26.
 - 3. Cabling in all open ceiling areas shall be enclosed in conduit.
 - 4. Furnishing and installation of all floor boxes, surface raceways, and other wireways which are detailed or specified under Division 26.
 - 5. Provide required conduit for accessibility to attic or plenum space.
 - 6. Provide 120-volt power and hook-up to equipment provided in Division 27.
 - 7. Installation of special back boxes supplied by intercom contractor.
 - 8. Provide equipment mounting boards as indicated on the drawings.
 - 9. Provide conduit to remote areas outside of the building as outlined on the drawings.
 - 10. Coordination of requirements of Division 27 with the Builder.

1.2 WORK NOT INCLUDED

- A. Contractors shall make no agreement that obligates the Owner to pay any company providing communications, monitoring, or other services.

1.3 RELATED SECTIONS

- A. The conditions of the Division 0, Division 1, Division 26 requirements, and the contract requirements that include the General Conditions and the Supplementary Conditions apply to work of this division.
- B. Section 26 00 00 – Electrical.

1.4 OWNER FURNISHED CONTRACTOR INSTALLED (OFCI) EQUIPMENT

- A. Refer to Responsibility Matrix on drawings for equipment that applies.
- B. The contractor shall verify that new and existing products and site conditions are satisfactory for installation or relocation of OFCI equipment. If unsatisfactory conditions exist or other discrepancies are identified, the contractor shall immediately document the conditions and notify the owner in writing.
- C. The contractor shall coordinate all required equipment schedule quantities and any dimensions or variations required to adapt to field conditions with the owner at the earliest possible date. The contractor shall verify compatibility, installation rough-in, mounting, and utility requirements for the scheduled OFCI equipment.
- D. The contractor shall verify compatibility, installation rough-in, mounting, and utility requirements for the scheduled OFCI equipment.
- E. The owner shall coordinate delivery dates with the builder to meet the construction schedule.
- F. The installation of items as identified in the plans and specifications as OFCI equipment shall conform to the provisions of the Contract Documents and shall be coordinated with the builder.
- G. Installation shall be performed by competent and trained workers in accordance with all applicable codes and governing regulations.
- H. Installation, testing, and startup shall comply with the manufacturer's instructions.
- I. The contractor shall provide all miscellaneous hardware, structural support, cabling, fittings, etc. that is not included by the manufacturer, but required for installation.
- J. The contractor shall clean and adjust all relocated and new OFCI products as necessary.
- K. All crating, packing materials, and debris shall be properly disposed of off-site.
- L. Installation shall be subject to inspection by the owner representative, owner, and builder. The installer shall not proceed until any unsatisfactory conditions are corrected. Any damage caused by improper handling or installation procedures shall be corrected at no cost to the owner.
- M. For drop shipped equipment, the builder shall be the consignee and shall have a representative on-site for coordination of delivery, receiving shipments, and inspect each shipment for obvious signs of damage or shortages. The builder shall be responsible for all shipping damage claims, including hidden damage, refusal of shipment, and Return Authorization procedures. The builder shall provide secure storage, handling, and protection from the elements, prior to the contractors' acceptance for installation.
- N. For equipment stored at an owner's facility, the contractor shall load the equipment and provide transportation to the work site. Prior to loading, the contractor shall inspect the equipment for obvious signs of damage and document all quantities, noting shortages from the project requirements, indicating acceptance of the merchandise as is and in good order.
- O. The contractor shall conduct and properly document testing of all installed equipment to verify proper operation. When appropriate, on-site operation and maintenance instruction shall be provided to the owner's personnel. This instruction shall include demonstration of proper use, maintenance, and cleaning procedures.
- P. The nature of the equipment procurement shall determine responsibility for resolving any claims with the manufacturer or supplier relating to defects in material or workmanship and warranty claims. The party that purchased the equipment shall resolve these issues.

1.5 PRESCRIPTIVE CODES, STANDARDS AND REGULATIONS

- A. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards, except when requirements are exceeded by the contract documents.
- B. In addition to requirements outlined in other sections of the specifications these codes and standards are imposed as applicable to the work in each instance.
- C. The equipment, materials, and installation shall conform to the latest version of all applicable codes, standards and regulations, of authorities having jurisdiction.
- D. Nothing in the Contract Documents shall be construed to permit work not conforming to these codes and standards.
- E. When two or more codes or standards are applicable to the same work, then the stricter code or standard shall govern.
- F. The date of the code or standard is that in effect on the date of issue stated on the contract documents, except when a particular publication date is specified.
- G. The Contractor shall comply with all State, Federal, NFPA, local codes and ordinances that may alter any part of the plans or specifications. The Contractor shall bear all costs for correcting any deficiencies due to non-compliance.
- H. Where local codes and ordinances are not in writing or on record, but local precedence have been set, the Owner shall pay for any additional resulting cost.

1.6 PLANS AND SPECIFICATIONS

- A. The intent of the project drawings is to establish the types of systems and functions, but not to set forth, each item essential to the functioning of the system.
- B. The drawings are generally diagrammatic and show approximate location and extent of work.
- C. Install the work complete including minor details necessary to perform the function indicated. Provide audio video systems, including all connections, complete in every respect and ready to operate.
- D. If clarification is needed, consult the Owner's Representative.
- E. Review pertinent drawings and adjust the work to conditions shown. Where discrepancies occur between drawings, specifications, and actual field conditions, immediately notify the Owner's Representative for his interpretation.
- F. The Owner's Representative reserves the right to make any reasonable change in the location of any part of this work without additional cost to the Owner.

1.7 SITE VISIT

- A. Before submitting a proposal, each proposed contractor shall examine all plans and specifications relating to the work, shall visit the site of the project, and become fully informed of the extent and character of the work required, including all required utilities and work to remote areas.
- B. No consideration will be granted for any alleged misunderstanding of the materials to be furnished, or the amount of work to be done. It being fully understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying plans, or required by nature of the site of which may be fairly implied, as essential to the execution and completion of any and all parts of the work.

1.8 SUBMITTALS

- A. Submit a complete submittal package within 30 calendar days after award of this work for approval. Equipment is not to be ordered without approval. Partial submittals are not acceptable for review. Each

submittal shall include a dated transmittal.

- B. Submittal shall be electronically transmitted in PDF file format.
- C. For each submittal provide a cover sheet with the name and location of the project, the name, address and telephone number of the Contractor, and the name, address and telephone number of the submitting sub-contractor. Include on or after the cover sheet sufficient space for review stamps.
- D. Quality Assurance Submittal including special boxes, cable, and other material as requested by the Owner's Representative:
 - 1. Letter from manufacturer stating that the Contractor is an Authorized Factory Distributor for the area where the project is located.
- E. Product Data Submittal to include:
 - 1. An indication of any deviations from Contract Document requirements, including variations and limitations. Show any revisions to equipment layout required by use of selected equipment.
 - 2. A product data index and complete equipment list including for each product submitted for approval the manufactures name and part number, including options and selections
 - 3. Cut-sheets or catalog data illustrating the physical appearance, size, function, compatibility, standards compliance, and other relevant characteristics of each product on the equipment list.
 - 4. Indicate by prominent notation (an arrow, circle, or other means) on each sheet the exact product and options being submitted.
 - 5. Submit design data, when the scope of work requires, including calculations, schematics, risers, sequences, or other data.
 - 6. Submit a sample of the extended product warranty language.
 - 7. Any resubmittals shall include a complete revised equipment list and any product data that is revised.
- F. Shop Drawings Submittal to include:
 - 1. Produce accurate to scale (min. 1/8" = 1') drawings showing equipment and device layouts prepared using a CAD or BIM engineering drawing program. When CAD background files are not available for existing buildings the Contractor shall inspect the site and collect information to create a floor plan. Walls shall be double line showing the thickness, single line diagrams are not acceptable.
 - 2. Other disciplines devices or equipment not relevant to this scope of work shall not be shown on shop drawings. Submitting modified contract documents shall not be permitted.
 - 3. Full fabrication details of any custom enclosures and millwork indicating size, material, finish and openings for equipment.
 - 4. Projector, loudspeaker, camera mounting details, include hardware types and load capacity.
 - 5. Provide complete drawings on custom fabricated plates or panels. Drawings shall include dimensioned locations of components, component types, engraving information, plate material and color, and bill of material.
 - 6. Labeling: Equipment and cabling labeling scheme - include font sizes and styles, explanation of scheme, and designator schedule.
 - 7. Schedules: Wiring schedule showing source and destination of wiring and indicating which wiring is in conduit. Junction box schedule showing type of box, size, mounting, and location. Include this information with remainder of wiring diagrams.
 - 8. Every room shall have a name and number identifying the use of the space with ceiling heights notated for each space or group of spaces throughout the design.
 - 9. When multiple buildings make up the system, provide a block diagram of the project site showing all buildings to be covered by the system and detailing the route and type of connection between buildings. Note building entry points, conduit type and size, and routing pathway (underground or over canopy installation).
 - 10. Shop or coordination drawings shall include information that will allow the Contractor to coordinate interdisciplinary work and when necessary guide the manufacturer or fabricator in producing the product.
 - 11. Resubmittals shall include revision notation and clouded changes.

1.9 QUALIFICATIONS OF A PROPOSED CONTRACTOR

- A. Proposed contractors who do not currently possess the necessary qualifications, trained and experienced personnel, financial capacity, and meet the other requirements herein described will be disqualified
- B. The Contractor shall employ full-time, factory-trained, licensed, local technicians and installers for product installation, maintenance, support, service and warranty.
- C. The proposed contractor, as a business entity, shall be a local authorized distributor and designated representative of the equipment manufacturer, with full extended warranty privileges. The proposed contractor shall have been actively engaged in the business of selling, installing, and servicing of similar systems for a period of at least 3 years. Selected contractor must be certified in specified system, subcontracting other companies certified in proposed product shall not be allowed.
- D. Recently formed companies are acceptable only if specific pre-approval is requested, and granted by the owner representative, based on experience of key personnel, current and completed projects, and all licensing requirements are met 10 working days prior to the contract proposal date.
- E. The proposed Contractor shall have an office within 150-miles of the job site, staffed with factory-trained technicians who are qualified and licensed to supervise the installation, to be responsible that the system is installed as submitted, to conduct system start up, and perform a 100 percent operational audit of all installed devices. The technicians shall instruct the Owners' representatives in the proper operation of the system, and to provide service throughout the warranty period. The contractor shall be capable of dispatching technicians to repair a system within six (6) hours of a service request.
- F. The proposed contractor shall be fully experienced in the design and installation of the type of system and manufacturer herein specified and shall furnish with the contract proposal an itemized list of the installations of the type specified herein.
- G. The contractor shall employ factory-trained technicians capable of supporting the maintenance of the system. No contract employees are allowed. All installing technicians shall be employed by the proposed contractor.
- H. The Owner's Representative or Owner may investigate, as they deem necessary to determine the ability of the proposed Contractor to perform the work. The proposed contractor shall furnish to the Owner with any information or data requested for this purpose.
- I. The Owner's Representative or Owner reserves the right to reject any contract proposal if the evidence submitted, or their investigation, fails to indicate that the Contractor is qualified to fulfill of any part of the contract or to complete the work contemplated therein.
- J. The Owner's Representative or Owner reserves the right to reject the proposal of any contractor who has previously failed to perform properly, or complete on time, contracts of a similar nature.

1.10 ADDITIONAL MATERIALS: INCLUDE IN THE BASE CONTRACT PROPOSAL

- A. All costs to provide 5 additional intercom speaker locations including all cable and devices as directed by the Architect. Conduit and standard back boxes by Division 26 Electrical Contractor.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All cable and wiring devices provided shall be listed and labeled by Underwriters Laboratories, Inc. for the intended use under the latest appropriate testing standard.
- B. Refer to System Schedule on plan for part numbers and additional information.
- C. Only equipment devices have been shown on the contract drawings. Specific wiring between equipment has not been shown.

- D. All equipment and components shall be new, and the manufacturers' current model. All like devices shall be of the same manufacturer and model number.
- E. Both ends of all cables shall be labeled utilizing self-laminating polymer film non-smear, machine printed labels.
- F. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., cable shall not be supported by or lay on suspended ceilings). Fasteners and supports shall be adequate to support the required load.
- G. Where required, provide manufacturer's rack mount adapter or one manufactured by Middle Atlantic unless specified elsewhere.
- H. Remove or blank out all manufacturer's names, logos, or other symbols from loudspeakers or other objects placed in view of the public. If logos are removable, remove and repaint to the color of the adjacent surface reattach.

2.2 ACCEPTABLE MANUFACTURERS

- A. Descriptions and details, acceptable manufacturers' names listed and specific manufacturer and model number items indicated in the plans and specifications shall establish a standard of quality, function, and design. Manufacturers and model numbers listed "no exceptions" shall not be substituted without specific notice in an addendum. Otherwise, where a specific manufacturer's product is indicated, products of other manufacturers listed as acceptable may be submitted for approval based on the substitute product being, in the opinion of the Engineer, of equivalent or better quality than that of the product specified.
- B. Proposed contractors wishing to propose any product substitution must do so in writing to the specifying authority at least ten (10) days prior to the proposal opening.
- C. For manufacturers equipment or models other than that specified, the proposed contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment. Proposals must include detailed information showing all deviations from the system as specified.
- D. Substitute products for which the proposed contractor does not obtain prior approval will not be considered acceptable for this project. Final approval of alternate products shall be based on the decision of the Owner and Architect. Prior approval to make a proposal for this project does not automatically ensure products will be an acceptable equivalent.
- E. It is the responsibility of the Contractor to provide all features and functions as outlined in these specifications. The functions and features specified are vital to the operation of this facility; therefore, inclusion in the list of acceptable manufacturers does not release the contractor from strict compliance with the requirements of this specification.
- F. The selected contractor must be a certified Integrator/Installer authorized by one of the Manufacturers listed below to provide an extended warranty to the Owner covering all network cable and connectivity hardware products comprising this installation site. The Contractor and Manufacturer shall jointly provide the Owner an extended warranty of the installed system against defects in material or workmanship; provide a copy of contractor certification.
- G. The model numbers used are those of Rauland-Borg Corporation (Rauland). This shall constitute the quality and performance of the equipment to be furnished, no exceptions.

2.3 WALL PLATE COLOR

- A. Color of device/wall plates to best match project light switches and electrical outlets, coordinate with the Electric Contractor.

2.4 CABLES & WIRING

- A. Cable shall have appropriate fire rating (CMR, CMP, OFNR, OFNP, etc.) and labeled on jacket of cable.

- B. The Contractor shall provide and install new and unused ASTM bare solid copper conductor wire per ANSI/NEMA codes. Follow the manufacturer's instructions. All wire shall be UL listed for communication and control circuits.
- C. All cable shall have labels on both ends utilizing self-laminating, flexible vinyl film and non-smear nylon marking pens.
- D. Cabling between buildings shall be fully enclosed in rigid threaded conduit, including underground and over canopy installations. Cable used between buildings shall be rated for direct burial. Cable shall be moisture, abrasion, and crush resistant. Use shielded or unshielded cabling as recommended by the manufacturer. When recommended, shielded cable should be utilized to minimize electrical noise interference with signal transmission.
- E. For RJ-45 modular cable system connections utilize data grade UTP eight conductor cabling, NEC type CM or MP, Category 6 minimum, at lengths up to 2700 feet using a single home run cable.
- F. Each call button shall be wired with data grade Category 6 cable and punched down on 110 type blocks to allow flexibility for future equipment.
- G. Where cables are run exposed through a return air plenum, provide plenum rated cable.
- H. Furnish an insulated #6 copper ground wire run from the amplifier to an earth ground, attached securely to the amplifier case, and terminated at each end to bare metal.
- I. Speaker Wiring:
 - 1. Provide shielded 18AWG cable minimum or as required for length.
 - 2. Jacket color: White
- J. Microphone/Line Level Wire:
 - 1. Provide shielded 22 AWG cable
 - 2. Bonded jacket
 - 3. Jacket color: black
- K. Ethernet/LAN Cable (UTP):
 - 1. Enhanced category 6
 - a. 4 pair, 23-AWG Bare Copper
 - b. Standard Termination T568B
 - c. Color - Yellow
 - 2. Enhanced category 6A
 - a. 4 pair, 23-AWG Bare Copper
 - b. Standard Termination T568B
 - c. Color - Yellow
- L. Secondary Clock Wiring:
 - 1. Provide shielded 18AWG cable minimum or as required for length.
 - 2. Jacket color: White
- M. Acceptable cable manufacturers

West Penn	Washington, PA
Windy City Wire	Bolingbrook, IL
Liberty	Colorado Springs, CO
Belden	St. Louis, MO
Commscope	Hickory, North Carolina

2.5 BUSHINGS

- A. Provide a plastic snap in bushing at each box opening, passage through a metal stud, and at the end of all open conduit stubs or sleeves prior to cable installation to protect the cabling from damage:
 - 1. Box openings - Thomas & Betts Knockout Bushing Series 3210, or equivalent.
 - 2. Metal stud passage - Thomas & Betts Twist It Bushing Catalog Number SB1216-SC, or equivalent.

3. Conduit ends - Thomas & Betts Anti-Short Bushing Series 390 or Tite-Bite Combination couplings Series 442, or equivalent.

2.6 J-HOOKS

- A. All attachments shall be specifically designed for telecommunications cabling.
- B. Attachments for cabling support shall be spaced at approximately 48 to 60 inches on center. Cable bundles shall not be allowed to sag down more than 12-inches mid-span between attachments.
- C. Attachments shall be sized for 25% capacity to allow for future expansion.
- D. Do not mix different signal strength cables on the same J-Hook (i.e. fire alarm with data and telephone cable). Multiple J-Hooks can be placed on the same attachment point, up to the rated weight load of the attachment device.
- E. Acceptable manufacturers:
 1. Erico.
 2. Panduit
 3. Cooper B-line.

2.7 COMMUNICATIONS CIRCUIT SURGE PROTECTION

- A. Surge protection shall be provided for all exterior devices, communications service, or antenna entrance connections, and for each circuit that connects one building to another (i.e. any other portion of a building complex not under one continuous roof) at both entry/exit points to prevent damage to equipment.
- B. Each surge protector shall be mounted in a standard grounded metallic electric box or equipment backboard with a separate ground wire ran directly to the ground bus bar or equipment panel ground stud, do not daisy chain ground wires.

PART 3 - EXECUTION

3.1 INTERCOM AND PUBLIC ADDRESS SEQUENCE OF OPERATION

- A. Each classroom shall be equipped with a call button and an intercom ceiling speaker with a station call number.
- B. Each office and special use area (conference room, gym, cafeteria, library, etc.) shall be equipped with intercom ceiling speaker(s) with a station call number.
- C. Common zone intercom speakers shall serve all corridors, passageways, and janitors' closets.
- D. Zone exterior speakers separately.
- E. The system shall allow the classroom call switch to place a normal call by pressing the call button once. It shall be possible to place an emergency call by pressing the call button three times in quick succession.
- F. All speakers: classroom, office, corridor, exterior, gymnasium, cafeteria, and common areas shall produce clear human voice reproduction at 10 dBA over fully occupied ambient noise levels minimum (i.e. corridors at class change) but never less than 65 dBA or more than 110 dBA throughout all normally occupiable areas.
- G. Provide as indicated on plans an Intercom Administrative Phone Desksets "AS" with digital readout to provide the following functions:
 1. The digital readout displays shall identify incoming calls by their designated numbers. The display shall show visually, in the order received, three (3) calls at a time. Emergency calls shall override normal calls and shall annunciate with the letters "EMER" and the calling station number. There shall be an audible indication of incoming intercom calls. Emergency calls shall initiate a distinctive

- audible alert and be indicated on the display.
2. Provide facilities for answering calls registered in the display by pressing a single "response" button on an authorized administrative telephone.
 3. Provide the capability to broadcast all-call or zoned intercom announcements and class change time tones over all interior, exterior, and corridor speakers. Zone exterior speakers separately.
 4. The system shall provide facilities for calling a staff (classroom) station or making page announcements from any administrative system telephone.
- H. The system shall provide facilities for calling a staff (classroom) station by dialing the station number. User programmable room station numbers for any combination of 2 to 4 numeric digits.
- I. The central microprocessor control equipment shall be of modular design, expandable to 250 stations. All programming shall be alphanumeric menu driven. The system shall be equipped with self-diagnostics.
- J. The system shall provide the capability of assigning speaker locations to any one or more of the eight (8) software programmable zones for zone paging or time signal reception.
- K. Systems amplifiers shall be capable of providing sufficient power for emergency paging of all speakers with a 30 percent reserved capacity for future expansion.
- L. System central control equipment shall be Underwriters Laboratory listed under Commercial Audio Systems and Accessories UL 813 and installed in a 19" rack cabinets and located where shown on the drawings or as directed by the Architect.
- M. Provide an Uninterruptible Power Supply (UPS) with sufficient standby battery capacity to operate the intercom clock system without AC power for two hours of normal operation (no announcements) and thirty minutes of all-call announcement operation (full load) at the end of this period.

3.2 TELEPHONE SYSTEM INTERFACE FUNCTIONS

- A. In order for these functions to operate, the Owner must provide licensing and telephone system enrolment into the building telephone system for the below SIP Analog Telephone Adapter and programing it with a designated station number to allow each building system telephone set to access this port. If the Owner elects not to provide a telephone system with these capabilities, then provide a labeled intercom service jack at the main telephone backboard for future connection.
- B. Provide one (1) Cisco SPA112 Two Port Phone Adapter, a SIP Analog Telephone Adapter (ATA) interface. This interface shall provide transparent access from the building telephone system to the intercom DTMF analog port. The intercom system shall feature a distinctive dial tone and DTMF touch tone recognition to provide this transparent interface.
- C. Any administrative system telephone shall be able to answer normal or emergency calls initiated from a classroom call button.
- D. Any administrative system telephone shall be able to page on an all-call, and zone basis to any of the eight paging zones.
- E. Any administrative system telephone shall be able to initiate an emergency announcement to all locations. Emergency announcements override all other programs.
- F. Any administrative system telephone shall be able to initiate manual time tones to any combination of time zones.
- G. Any administrative system telephone shall be able to initiate emergency evacuation and signal tones.

3.3 EMERGENCY SIGNAL TONE OPERATION

- A. Provide facility through both rack mounted switches and dial-up operation through the telephone system interface the ability to distribute various emergency signal tones through all intercom speakers. Verify exact requirements with Owner. Provide the following functions each with a distinctive signal:
1. Take Cover (Hazardous Weather Conditions) European siren or similar.

2. Evacuate (Hazardous Condition within Building) stutter tone or similar.
3. Security Alert (Suspicious Person on Campus, keep students in class and lock doors) chime or similar.

3.4 CABLE ROUTING AND INSTALLATION

- A. Cooperation with trades of adjacent, related or affected materials or operations, and or trades performing continuations of this work under subsequent contracts are considered a part of this work. In order to effect timely and accurate placing of work and to bring together, in the proper and correct sequence, the work of such trades, including work provided under a Division 1 allowance.
- B. System wiring and equipment installation shall be in accordance with good engineering practices as established by the EIA and the NEC. Wiring shall meet all state and local electrical code requirements.
- C. Cable pathways, conduit, and cable support systems shall be complete with bushings, de-burred, cleaned, and secure prior to installation of cable.
- D. All wiring shall test free from opens, grounds, or shorts. All cable shall be supported from the building structure and bundled. Do not attach any supports to joist bridging or other lightweight members.
- E. All cable shall have a label on both ends utilizing self-laminating, flexible vinyl film, non-smear, machine printed labels.
- F. The support system shall provide a protective pathway to eliminate stress that could damage the cabling. The cable shall not be crushed, deformed, skinned, crimped, twisted, or formed into tight radius bends that could compromise the integrity of the cabling.
- G. Cable must not be fastened to electrical conduits, mechanical ductwork/piping, sprinkler pipes, or routed to obstruct access to hatches, doors, utility access panels, or service work areas. Do not route cables through fire doors, ventilation shafts, grates, or parallel with line voltage electrical conductors. Communication cables shall not be run loose on ceiling grid or ceiling tiles.
- H. Cables shall be run in bundles above accessible ceilings and supported from building structure building structure by j-hooks, conduit or cable tray. Cabling shall be loosely bundled with cable Velcro hook ties randomly spaced at 30 to 48 inches on center, cable ties shall not be tight enough to deform cabling and shall not be used to support the cabling. Cables shall not be run loose on ceiling grid or ceiling tiles.
- I. Do not mix different signal cables on the same J-Hook (i.e. fire alarm with audio video cable).
- J. Cables shall be run in conduits, where stubs are provided, from wall or floor jacks to accessible areas above finished ceilings. Conduit shall be required only within walls and concealed spaces to provide access.
- K. All work must be performed by workers skilled in their trade. The installation must be complete whether the work is concealed or exposed.
- L. Provide bushings to protect the cable from damage for conduit ends, box openings, and passage through metal studs.
- M. Each cable run shall include a three-foot service loop with Velcro hook ties located in the ceiling above the rack. This is to allow for future re-termination or repair.
- N. All cabling shall be placed with regard to the environment, EMI/RFI interference, and its effect on communication signal transmission.
- O. Non-conductive fiber optic cable is immune from EMI/RFI interference. Give priority when selecting a route to minimize exposure to possible cable damage from maintenance or service of all systems in the attic space.
- P. Do not route any cable within two feet of any light fixture, HVAC unit, service access area, electric panel, or any device containing a motor or transformer.

- Q. Cable will not be installed in the same conduit, raceway, tray, duct, or track with line voltage electrical cable without a metallic barrier meeting NEC requirements.
- R. Maximum cable pulling tension should not exceed 25 pound-force (110 N) or the manufactures recommendation, whichever is less.
- S. Any pulling compounds utilized must be approved by the cable manufacturer and shall not degrade the strength or electrical characteristics of the cable.
- T. No terminations or splices shall be installed in or above ceilings, other than in designated end point housings.
- U. Cable bends shall not be tighter that the manufacturers' suggested bend radius.
- V. Mount all equipment firmly in place. Route cable in a professional, neat and orderly installation.
- W. Provide for adequate ventilation to all equipment racks and take precautions to prevent electromagnetic or electrostatic hum.
- X. Coordinate the actual locations of devices and outlets and equipment with building features and mechanical equipment as indicated on architectural, structural, and mechanical drawings. Review with the owners represenative any proposed changes in outlet or equipment location. Relocation of devices, before installation, of up to 3 feet from the position indicated, may be directed without additional cost. Remove and relocate outlets placed in an unsuitable location when so requested by the Architect.
- Y. Mount equipment and enclosures plumb and level.
- Z. Verify all locations of equipment in all rooms with Owner's Representative, Owner, and Consultant.

3.5 EQUIPMENT HOUSING CABLING AND WIRING

- A. Lace, tie, or harness wire or cable as required herein, and in accordance with good engineering practices. Dress, lace or harness all wire and cable to prevent mechanical stress on electrical connections; no wire or cable shall be supported by a connection point. Install cable and wire neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack but still allow for service and testing. Provide horizontal support bars if cable bundles sag.
- B. All system wire, except spare wire, after being cut and stripped, shall have the wire strands twisted back to their original lay and be terminated by approved soldered or mechanical means. No unterminated wire ends shall be accepted. Heat-shrink type tubing shall be used to insulate and dress the ends of all wire and cables including a separate tube for the ground or drain wire.
- C. Provide adequate service loops so that equipment mounted on rack slides may be pulled fully out, to their locked position without straining cable.
- D. Neatly bundle excess AC power cable from housing mounted equipment with plastic cable ties.
- E. Provide Velcro straps to bundle cabling and wiring.
- F. Install with connections completely visible and labeled.

3.6 TERMINATION PRACTICES

- A. Use Neutrik standards for all stripping and soldering practices.
- B. Preserve wire twists as closely as possible to point of termination (0.5" maximum) to keep signal impairment to a minimum.
- C. Avoid twisting cable jacket during installation.
- D. Install Teflon tubing on drain or ground wires.

- E. Install Heat Shrink on the end of the PVC jacket surrounding the wire pairs.
- F. The Contractor shall observe proper circuit polarity and loudspeaker wiring polarity meeting industry standards. Properly and clearly label all connections and wires as to function and polarity.

3.7 ENGRAVING

- A. Text font: 1/8-inch block sans serif characters unless noted otherwise.
- B. On dark materials, provide white characters; on stainless steel or brushed natural aluminum plates, or light-colored materials, provide black characters.
- C. Provide at least two lines of text with first line listing the general device name, e.g., amplifier. Second line to include schematic reference of the device, e.g., AMP-1.
- D. Equipment label: black with white characters except where indicated.

3.8 CUTTING AND PATCHING

- A. Notify the Builder sufficiently ahead of construction of any floors, walls, ceiling, roof, et cetera, of any openings that will be required for his work.
- B. The Contractor shall see that all sleeves required for his work are set at proper times to avoid delay of the job.
- C. All necessary cutting of walls, floors, partitions, ceilings, et cetera, as required for the proper installation of the work under this Contract shall be done at the Subcontractor or at the Subcontractor's expense in a neat and workmanlike manner, and as approved by the Owner Representative.
- D. Patching of openings and/or alterations shall be provided by the communications Subcontractor or at the Subcontractor's expense in an approved manner.
- E. No joists, beams, girders, or columns shall be cut by any Contractor without first obtaining written permission of the Owners Representative.
- F. All openings in firewalls and floors shall be completely sealed after installation for a completely airtight installation. Sealing material shall be non-combustible and UL approved. The installed sealing assembly shall not cause the fire rating of the penetrated structure to be decreased.
- G. All openings in exterior walls shall be sealed watertight.
- H. Seal voids around conduits penetrating fire-rated assemblies and partitions using fire stopping materials and methods in accordance with NFPA and local codes.

3.9 FIRE OR DRAFT STOPPING, PENETRATIONS, AND CORING

- A. UL Listed fire stopping methods that match the fire rating of the wall or floor being penetrated are to be used at all fire barrier penetrations. Seal the interior of the conduit sleeve around the cables and around the outside of the sleeve on each side of the penetration with fire-stop caulk or putty, install according to the manufacturers' instructions.
- B. All penetrations through fire rated walls or floors shall feature a suitable length of metal conduit. Hole diameter shall not exceed 1/2" larger than the conduit or sleeve to be installed. The hole shall be neatly cut, not oversize or irregular. Do not share wall/floor penetrations with ductwork, piping, line voltage electrical conduits, etc.
- C. All gypsum board or plaster penetrations shall tool cut using an appropriate hole saw / mandrel or manufactured assembly.
- D. Draft/Noise Stopping - This Contractor prepares for and applies draft/noise stopping to all non-rated wall penetrations. Draft/Noise stopping shall minimize the movement of air and sound from enclosed areas to other parts of the building. This shall include but not limited to:

1. Neatly cutting all non-rated wall/floor penetrations with a 1" maximum clearance. All gypsum board or plaster penetrations shall tool cut using an appropriate hole saw / mandrel or manufactured assembly. The hole shall be neatly cut, not oversize or irregular. Do not share wall/floor penetrations with two types of ductwork, piping, line voltage electrical conduits, communications cabling, etc.
 2. Provide and install non-combustible mineral wool, fiberglass, cellulose insulation, caulk, and sealant as required. Seal the interior of conduit sleeves around the cables and around the outside of the sleeve on each side of the penetration with caulk or putty, install according to the manufacturers' instructions.
- E. Upon approval, the Contractor shall be required to supply all labor, equipment, tools, and materials to create any additional penetrations, and shall provide the sleeve, temporary and final fire stopping. Special care shall be taken not to stress, overheat, or penetrate any building support member. Coring shall be made with equipment appropriate for the dry penetration of concrete and block materials. Under no circumstances shall penetrations be made utilizing a chisel or percussion type equipment. Concrete, block, or plaster cores shall be made by dry saw/core methods only.

3.10 EXISTING SYSTEMS DEMOLITION, MODIFICATION AND EXPANSION FOR ADDITIONS AND RENOVATIONS

- A. This contractor shall be responsible for demolition as required of the existing systems, including demolition of any devices and cabling previously abandoned. Demolition shall include:
1. Disconnection and removal of all devices not to remain in service in walls, floors, and ceilings.
 2. Removal of exposed abandoned conduit and supports including brackets, stems, hangers, and other accessories located on walls and above accessible finished ceilings. Cut abandoned conduit flush with walls, floors, etc., and patch surfaces.
 3. Provide a blank cover for abandoned device backboxes that are impractical to remove from masonry construction without unnecessary damage.
 4. Repair of any finishes or adjacent construction damaged during modification, extension, and demolition work.

3.11 EXAMINATION

- A. Verify field conditions including existing systems, equipment models, configurations, circuiting arrangements, cabling, and devices. Adjust all circuiting, cabling, and materials to be provided as required by job conditions.
- B. Project drawings are based on casual field observation and existing record documents when available, report any significant discrepancies to the Engineer before disturbing existing systems.
- C. The Contractor accepts the existing conditions when beginning demolition.

3.12 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment in areas of renovation that are to remain or be reused.

3.13 OPERATION OF NEW EQUIPMENT PRIOR TO PROJECT COMPLETION

- A. When the phasing of a project requires that data systems are operable in certain areas and the Owner needs to operate the equipment the contractor shall make such provisions. The warranty period shall commence on new equipment when it is operated for the beneficial use of the Owner. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, properly adjust, and complete all punch list items before final acceptance by the Owner. In these cases, the date of acceptance and the start of the warranty may be different dates.

3.14 PROTECTION OF EQUIPMENT AND MATERIALS

- A. The Contractor shall take such precautions as may be necessary to protect his apparatus from damage.
- B. This shall include the creation of all required temporary shelters to protect any apparatus above the floor of the construction and the covering of apparatus in the completed building with tarpaulins or other

protective covering.

- C. Failure to comply with the above to the satisfaction of the Owner's inspector will be sufficient cause for the rejection of the equipment in question and its complete replacement by the Contractor.

3.15 FINAL OBSERVATION

- A. It shall be the duty of the Contractor to make a careful observation trip of the entire project, assuring themselves that the work on the project is ready for final acceptance before calling upon the Owner Representative to make a final observation.
- B. To avoid delay of final acceptance of the work, the Contractor shall have all necessary bonds, warranties, receipts, affidavits, et cetera, called for in the various articles of these specifications, prepared and signed in advance, together with a letter of transmittal, listing each paper included, and shall deliver the same to the Owners Representative at or before the time of said final observation. The Contractor is cautioned to check over each bond, receipt, et cetera, before preparing for submission to verify that the terms check with the requirements of the specifications.
- C. The following and other provisions of Division 1 General Conditions will be required at time of final completion:
 - 1. Final clean up completed.
 - 2. All systems are fully operational, all material and devices installed.
 - 3. As-built (as installed) drawings and operations manuals.

3.16 TESTING

- A. Upon completion of installation, initial adjustments, tests as outlined in this specification, and submission and review of the results, a final observation and test shall be performed by the Owner or Owner's representative.
- B. Provide a minimum of one (1) person for observation and testing familiar with aspects of the System to assist the Owner.
- C. The process of testing the System may necessitate moving and adjusting certain components.
- D. Testing includes operation of each major system and any other components deemed necessary. Perform tests and provide required test equipment, tools and material required to make any necessary repairs, corrections, or adjustments.
- E. The following procedures shall be performed on each System:
 - 1. Observation of the methods and means employed to incorporate the System within the facility.
 - 2. Verification of proper operation, from controlling devices to controlled devices.
 - 3. Verification of proper adjustment, balance, and alignment of equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each level control, and appropriately record these settings within the Record Documents.
 - 4. Other tests on equipment or systems deemed appropriate.
- F. In the event the need for further adjustment or work becomes evident during testing, the Contractor is to continue his work until the System is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications and any extension of the observation and testing period is required, the Contractor shall pay for additional time and expenses of the Owner at the standard rate in effect at that time.

3.17 WARRANTY, SERVICE, TESTING, CERTIFICATION

- A. The Contractor must provide an extended warranty that is inclusive of the Manufacturer's warranty to the Owner covering all network cable and connectivity hardware products comprising this installation site. The Contractor and Manufacturer shall jointly provide the Owner an extended warranty of the installed system against defects in material or workmanship for a period of no less than twenty years (period as is customary for the Manufacturer) from the date of substantial completion. Any equipment or cabling shown to be defective shall be replaced, repaired, or adjusted free of charge. All labor and materials

shall be provided at no expense to the Owner.

- B. The System Contractor shall make a thorough inspection of the complete installation to ensure the following:
 - 1. Complete and functional system.
 - 2. Installed in accordance with manufacturers' instructions.
 - 3. All cabling shall test free from all grounds, opens, and shorts.
 - 4. A representative of the Owner shall have an opportunity to be present for all final testing. Coordinate final testing with Owner, schedule as near as possible to acceptance date.

3.18 DRAWINGS, MANUALS, AND TRAINING

- A. As-built drawings and operating and maintenance manuals may be electronically transmitted in PDF file format.
- B. Upon completion of the installation, and prior to final inspection, the Contractor shall furnish as-built drawings.
- C. In addition, the contractor shall furnish complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets. Manuals shall include wiring diagrams to indicate internal wiring for each device and the interconnections between the items of equipment. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system. Provide a parts list with manufacturer and model number for commonly replaced parts. Include complete instructions for the inspection, testing, and maintenance of the system. Place final cable certification test results in manuals.
- D. All cable paths and wiring methodology shall be documented. All cables shall have both ends labeled and included in the as-built documentation. Provide an MS Excel worksheet compatible format spreadsheet file cross referencing all cable run numbers, architectural room number, and owners room number for the origin and destination of each cable run.
- E. A formal on-site training session shall be provided by the Contractor to the Owners Representative / Maintenance personnel and shall include instruction on the documentation, location, inspection, maintenance, testing, and operation of all system components. Provide a minimum of two (2) hours of documented general instruction. It shall be the responsibility of the Contractor to coordinate time and location of training sessions with the Owner.

END OF SECTION

SECTION 28 05 44

EMERGENCY RESPONDER RADIO COVERAGE SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDES

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1 apply to this Section.
- B. This performance specification provides the requirements for preliminary testing, design, furnish, install, and final field test a complete and operating in-building Emergency Responder Radio Coverage System (ERRCS), consisting of a Distributed Antenna System (DAS) to provide complete coverage for emergency responder portable radios as required by the local fire department and the authority having jurisdiction (AHJ). The system will support only Emergency Responder and Public Safety Land Mobile Radios. The system shall not support other radio, cellular, and/or wi-fi signals.
- C. The purpose of the ERRCS is to extend and amplify the emergency responder radio signal to a strength of -95dBm or better in all areas of the facility including command centers, fire pump rooms, elevators, stairwells and all floors. The building shall be considered to have acceptable signal strength coverage when 95% coverage is achieved on each floor.
- D. All aspects of this scope of work shall comply with the International Fire Code (IFC) Section 510 and the Authority Having Jurisdiction (AHJ) for the project. Refer to the AHJ for the current adopted edition of the IFC and of any local amendments to the code.
- E. Provide all equipment, devices, materials, labor, supervision and services necessary for or incidental to the installation of a complete Emergency Responder Radio Coverage System.
- F. It is the intent of these specifications to provide a complete, code compliant installation, although every item necessary may not be specifically mentioned or shown.
- G. It shall be the responsibility of the ERRCS contractor to obtain all required permits, approvals and certifications from the authorities having jurisdiction (AHJ).
- H. All fees associated with the licensing shall be paid by the Contractor.
- I. Install the work complete including minor details necessary to perform the function required by code, standards, and Owner requirements. Provide the ERRCS, including all connections, complete in every respect and ready to operate.
- J. Testing of the system shall conform to the testing requirements as described in the International Fire Code (IFC) Section 510.5.3 Acceptance Test Procedure.
- K. All testing must be done on frequencies authorized by the FCC and in use by local agencies as directed by the AHJ.
- L. Final acceptance and approval shall be required from the AHJ.
- M. It shall be the responsibility of this Contractor to provide if licensed, or to contract with a Licensed Electrical contractor to provide, installation of all conduit and raceway systems, standard electrical boxes for the system. This Contractor shall coordinate all system requirements with and provide special back boxes to the Electrical Contractor prior to installation of conduit.
- N. It shall be the responsibility of this Contractor to provide if licensed, or to contract with a Licensed Electrical contractor to provide, 120-volt power through separate dedicated branch circuits, maximum 20 amperes each. Each such circuit shall be labeled at the power distribution panel as EMERGENCY RESPONDER RADIO SYSTEM. The location of all circuit breakers serving the Emergency Responder

EMERGENCY RESPONDER RADIO COVERAGE SYSTEM

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Radio Coverage System shall be posted in the control unit cabinets. Each cabinet and all surge protection devices shall be grounded securely to the building grounding system. These expenses will not be included in the electrical contractor primary bid.

- O. Provide all testing, documentation, training, and warranty service contract as outlined in these specifications.

1.2 WORK NOT INCLUDED

- A. Contractors shall make no agreement that obligates the Owner to pay any company providing communications, monitoring, or other services.

1.3 RELATED SECTIONS

- A. The conditions of the Division 0, Division 1, Division 26 requirements, and the contract requirements that include the General Conditions and the Supplementary Conditions apply to work of this division.
- B. Section 26 00 00 - Electrical
- C. Section 28 46 21 - Fire Detection and Alarm System

1.4 DEFINITIONS

- A. Attenuation: The reduction in signal power, expressed in decibels, as a result of coupling, heat loss, or transmission distance in a cable or in air.
- B. Bi-Directional Amplifier (BDA): A device used to amplify band-selective or multi-band RF signals in the uplink, to the base station for enhanced signals and improved coverage. Also known as a signal booster.
- C. Coupled Bonding Conductor (CBC): a bonding conductor placed on the outside of any technology cable. Used to suppress transient noise.
- D. Delivered Audio Quality (DAQ) Definitions: The universal standard often cited in system design, specifications, and testing reports for DAS.
 - 1. DAQ 1: Unusable, speech present but not intelligible.
 - 2. DAQ 2: Understandable with considerable effort. Frequent repetition required due to noise and/or distortion.
 - 3. DAQ 3: Speech understandable with slight effort. Occasional repetition required due to noise and/or distortion.
 - 4. DAQ 3.5: Speech understandable with repetition only rarely required. Some noise and/or distortion
 - 5. DAQ 4: Speech easily understood. Occasional noise and/or distortion.
 - 6. DAQ 4.5: Speech easily understood. Infrequent noise and/or distortion.
 - 7. DAQ 5: Speech easily understood.
- E. Distributed Antenna System (DAS): A network of service antennas connected at intervals along shielded coaxial transmission lines and all connected to head-end electronics amplifying the signals to be distributed. Often refers to a system that includes both the passive distribution system and the active amplifying electronics.
- F. Directional Coupler: A component which directs a small portion of downstream RF energy to a port which can be connected to an antenna or another branch of distribution cabling, and also serves as a combiner of upstream energy between the tap port and through the connection port.
- G. Donor Antenna: The antenna, usually mounted on the outside of a structure where a DAS is installed, which picks up signals over-the-air from a donor source.
- H. Donor Source: The repeater, transceiver, cell site, or other radio site that produces signals which a DAS will relay and distribute.

- I. Emergency Responder Radio Coverage System (ERRCS): A two-way radio communication system installed to assure the effective operation and coverage of radio communications systems for fire, emergency medical services, and/or law enforcement agencies within a building or structure. The system is not designed for use with District LMR, Cellular Services, or Wi-Fi Services.
- J. Federal Communications Commission (FCC): federal agency responsible for implementing and enforcing America's communications laws and regulations.
- K. Near-far Effect: a situation where a handheld radio that is closer to an antenna, when keyed, takes signal strength away from a handheld radio that is farther from the same antenna.
- L. OET 65 Standards: The FCC's Bulletin that provides Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
- M. Public Safety and/or First Responder: agencies which are charged with the responsibility of responding to emergency situations. These include, but are not limited to, law enforcement, fire departments, and emergency medical services.
- N. Reflected Power: Power which is reflected back along a transmission line as a result of discontinuities in line impedance caused at connectors or close proximity of metallic objects.
- O. Radio Frequency (RF): Energy from electromagnetic waves, or alternating currents that produce electromagnetic waves, in the spectrum of radio frequencies (30 kHz to 300GHz)
- P. Signal Booster: See Bi-Directional Amplifier (BDA).
- Q. Splitter: A passive component that has a single input port and two or more output ports, effectively splitting the signal equally among the output ports. It also serves to combine upstream signals from the "output" ports into composite signals at the "input" port.

1.5 CODES AND REGULATIONS

- A. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards except when requirements are exceeded by the contract documents.
- B. The equipment, materials, and installation shall conform to the latest version of all applicable codes, standards and regulations of authorities having jurisdiction including the following:
 - NFPA 1 - The National Fire Code
 - NFPA 70 - The National Electrical Code
 - NFPA 72 - National Fire Alarm and Signaling Code
 - NFPA 1221 - Standard for the Installation, Maintenance and Use of Emergency Services Communication Systems
 - UL 2524 - Standard for In-building 2-Way Emergency Radio Communication Enhancement Systems
 - FCC 47 CFR - Private Land Mobile Radio
 - FCC 47 90.219-2007 - Services-Use of Signal Boosters
 - IFC - International Fire Code, AHJ current adopted edition
 - ADA "Americans with Disabilities Act"
 - FCC's OET 65 Standards "Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields"
 - FCC Rules Part 22, Part 90, and Part 101

1.6 PLANS AND SPECIFICATIONS

- A. The intent of the project drawings is to establish the types of systems and functions, but not to set forth each item essential to the functioning of the system.
- B. Electrical drawings are generally diagrammatic and show approximate location and extent of the work. If clarification is needed, consult the Architect/Engineer.

- C. Review pertinent drawings and adjust the work to conditions shown. Where discrepancies occur between drawings, specifications, and actual field conditions, immediately notify the Architect/Engineer for his interpretation.
- D. The Architect/Engineer reserves the right to make any reasonable change in the location of any part of this work without additional cost to the Owner.

1.7 SITE VISIT

- A. Before submitting a proposal, each proposed contractor shall examine all plans and specifications relating to the work, shall visit the site of the project, and become fully informed of the extent and character of the work required, including all required utilities.
- B. No consideration will be granted for any alleged misunderstanding of the materials to be furnished or the amount of work to be done, it being fully understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying plans or required by nature of the site of which may be fairly implied as essential to the execution and completion of any and all parts of the work.

1.8 SUBMITTALS

- A. Submittal procedures: See Section 28 05 00.
- B. Submit a complete submittal package within 30 calendar days, for approval, after award of this work. Equipment is not to be ordered without approval. Partial submittals are not acceptable for review. Each submittal shall include a dated transmittal.
- C. Submittal shall be electronically transmitted in PDF file format .
- D. For each submittal provide a cover sheet with the name and location of the project, the name, address and telephone number of the Contractor, and the name, address and telephone number of the submitting sub-contractor. Include on or after the cover sheet sufficient space for review stamps.
- E. Quality Assurance:
 - 1. Letter from manufacturer stating that the Contractor is an Authorized Factory Distributor for the area where the project is located.
 - 2. Copies of FCC Licenses for both the Designer and Project Manager.
 - 3. The Contractor and Manufacturer shall supply sufficient information to indicate that the proposed system is based on the latest hardware, software technology and products comply with specified requirements and FCC Regulations.
 - 4. The system described in the submittals shall be certified by an FCC Licensed Designer and installation shall be supervised by an FCC Licensed Project Manager.
- F. Product Data:
 - 1. A product data index and complete equipment list including for each product submitted for approval the manufacturers name and part number including options and selections.
 - 2. Cut-sheets or catalog data illustrating the physical appearance, size, function, compatibility, standards compliance and other relevant characteristics of each product on the equipment list. Indicate by prominent notation (an arrow, circle or other means) on each sheet the exact product and options being submitted for approval.
 - 3. Indicate by prominent notation (an arrow, circle, or other means) on each sheet the exact product and options being submitted.
 - 4. Submit design data when the scope of work requires, including passband curves for both uplink and downlink for all bands, calculations, schematics, risers, sequences or other data.
 - 5. An indication of any deviations from Contract Document requirements, including variations and limitations. Show any revisions to equipment layout required by use of selected equipment.
 - 6. Any resubmittal shall include a complete revised equipment list and any product data that is revised.
 - 7. Any rejected submittals must be corrected and resubmitted to the AHJ and Architect/Engineer within 10 days of receipt of the rejected material.

- G. Shop Drawings:
 - 1. Locate all equipment and components of the system, conduit placement, circuit routing, cable type, and gauge.
 - 2. Illustrate the submitted portion of work, this may require diagrams, schedules, details, risers, floor plans and accurate to scale, (minimum of 1/8" = 1'-0"), equipment and device layouts prepared using a CAD or BIM engineering drawing program.
 - 3. Information that will allow the Contractor to coordinate interdisciplinary work and when necessary guide the manufacturer or fabricator in producing the product.
- H. Testing:
 - 1. Submit all field test records of the radio systems. These shall include, but not be limited to:
 - a. Preconstruction Tests: Performed with the AHJ prior to construction of the new facility to verify that the Emergency Responder Radio System has signal coverage in that area.
 - b. Mid-Construction Tests: Performed with the AHJ during construction, once walls and glazing have been constructed and the exterior roof is installed.
 - c. Final Tests: Performed in conforming with IFC Section 510.5.3 and Section 510.6. This testing is to be approved by the AHJ. Engineers shall also be present for the final testing process.
 - 2. All testing records shall be submitted with O&M information and close-out documents.

1.9 QUALIFICATIONS OF A PROPOSED CONTRACTOR

- A. Proposed contractors who do not currently possess the necessary qualifications, trained and experienced personnel, financial capacity, and meet the other requirements herein described will be disqualified.
- B. The proposed contractor, as a business entity, shall be an authorized distributor and designated representative of the emergency responder radio coverage system manufacturer, with full warranty privileges, and shall have been actively engaged in the business of selling, installing, and servicing emergency responder radio coverage systems for a period of at least 5 years.
- C. Recently formed companies are acceptable only if specific pre-approval is requested, and granted by the Architect/Engineer, based on experience of key personnel, current and completed projects, and all licensing requirements are met 10 working days prior to the contract proposal date.
- D. The Contractor shall employ factory trained technicians capable of supporting the maintenance of the system. No contract employees are allowed unless they have been to the factory service school within the last 18 months. A certificate of this training shall be provided with the Contractors submittal.
- E. The contractor shall employ full time local technicians and installers. The manufacturer shall maintain a full-time factory employed service staff for product support and service.
- F. The proposed Contractor shall have an office within 150-miles of the job site, staffed with trained technicians who are qualified and licensed to supervise the installation, to be responsible that the system is installed as submitted, to conduct system start up and perform a 100 percent operational audit of all installed devices, to instruct the Owners representatives in the proper operation of the system, and to provide service throughout the warranty period.
- G. All testing shall be conducted, documented and signed by a person in possession of an FCC General Radio Telephone Operators License and be a full-time employee of contractor.
- H. The proposed contractor shall be fully experienced in the design and installation of the type of system herein specified and shall furnish with the contract proposal an itemized list of the installations of the type specified herein. The list shall include the name of the project, date of completion, the amount of the contract, the name, and telephone number of a qualified person to contact for reference. This list must contain at least two (2) projects within a 150-mile radius of the project to allow prospective Owners to visit the job site for review of the system installation and service. Each reference project listed must utilize equipment by the same manufacturer as the proposed system.

- I. The Proposed Contractor shall not have any grievances or complaints of record regarding workmanship, code compliance, or service response. A Proposed Contractor that has any prior finding(s) of a code or license violation or has any litigation in process concerning the installation of a system is unacceptable.
- J. The ability of a proposed Contractor to obtain plans and provide a performance bond shall not be regarded as the sole qualification of the Contractors' competency and responsibility to meet the requirements and obligations of the contract.
- K. The Builder shall be satisfied that a proposed Contractor meets all the requirements expressed herein before including the Contractor's proposal in the project.
- L. The Owner may investigate, as they deem necessary to determine the ability of the proposed Contractor to perform the work. The proposed Contractor shall furnish to the Owner with any information or data requested for this purpose.
- M. The Owner reserves the right to reject any contract proposal if the evidence submitted, or their investigation, fails to indicate that the Contractor is qualified to fulfill of any part of the contract or to complete the work contemplated therein.
- N. The Owner reserves the right to reject the proposal of any Contractor who has previously failed to perform properly, or complete on time, contracts of a similar nature.

1.10 SYSTEM PRICING, PHASING AND AWARD

- A. Contractor shall provide a proposal for new installation based on separate pricing for each of the following steps as outlined below:
 - 1. Step One - site test: This price shall include verifying the outdoor signal strength at the facility's location. When there is no signal the following steps are not required.
 - 2. Step Two - full test (in accordance with IFC Section 510, Grid Testing): This price shall include verification of signal strength throughout the entire facility.
 - 3. Step Three - complete system installation price: This price shall include a full system design and installation, including costs for permit, design, components, materials, labor and testing. This pricing shall be for a complete system throughout the facility for budgeting purposes. When the building envelope is substantially complete the "Step Two" test shall be performed to determine the final design. A revised installation price shall then be proposed.
- B. The project must be budgeted as a complete set of processes, thus the reason for the three-step pricing prior to performing any work. This pricing will provide a budget before the work begins.
- C. The award of the work will be made in phases, in accordance with the three (3) steps outlined above. The phases are:
 - 1. Phase I award authorizes step one. Once step one is completed, results are to be provided to the General Contractor, Architect, and Engineer for review. Following this review, step two may be delayed, pending adjustment to the donor signal. If donor signal strength at the facility does not meet IFC Section 510 requirements, the AHJ must be consulted, prior to moving to step two. If the donor signal strength is adequate to meet IFC Section 510 requirements, authorization for step two will be given.
 - 2. The Phase II award authorizes step two. Testing of the facility to determine signal strength status and to provide a base for a full system design. Step two testing shall only be authorized to be completed when the building exterior walls, glazing, interior walls and HVAC duct and electrical systems are in place. Basically, all building components that will affect a portable radio transmission are installed. Testing shall be completed as follows:
 - a. Full building test (in accordance with IFC Section 510 Grid Testing and AHJ adopted codes) of the public safety RF signal strength throughout the entire facility.
 - b. Testing shall be accomplished by the use of a calibrated spectrum analyzer measurement tool. The spectrum analyzer shall be an RF Explorer or equivalent instrument.
 - c. Testing shall include capturing and recording the public safety spectrum and individual channel RSSI measurements throughout the building.
 - d. Provide the full testing documentation and data from the spectrum analyzer showing each grid area pass/fail for the building.

- e. Provide a building floor plan layout of the testing grid with plotted testing results showing signal strength, color coded, with a minimum of three parameters to include:
 - 1) Red color, -95dBm or weaker, below signal strength threshold, radios unlikely to key up, reception unachievable.
 - 2) Yellow color, at or slightly above signal strength threshold, radios likely to key up, reception on certain channels, some distortion in DAQ.
 - 3) Green color, -95dBm or stronger, above signal strength threshold, radios likely key up, reception on all channels, minimum distortion in DAQ.
 - f. Provide one digital copy of all testing documentation and data, in pdf format, for all areas of the building.
 - g. After testing, a final revised proposal for a full system design, installation and final testing shall be issued to the General Contractor for review. No further work is authorized until award of Phase III is granted.
3. Phase III award authorizes step three. Final design, installation, and final testing of the Emergency Responder Radio Coverage System. Provide a code compliant design and system installation. The final system shall be tested for compliance per IFC 510 and the AHJ.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The system shall conform to the requirements as identified in IFC Section 510.4 and Section 510.5. Testing records are required to confirm performance of the system.
- B. Compatibility: The equipment, including but not limited to repeaters, transmitters, receivers, signal boosters, cabling, fiber distributed antenna systems, etc., shall not interfere with the existing communication systems utilized by the Public Safety and First Responder agencies.
- C. Power Supplies: At least two (2) independent and reliable power supplies shall be provided: one primary and one secondary. The primary power source shall be supplied from a dedicated 20-ampere branch circuit and comply with 10.6.5 of NFPA 72. The secondary power source shall be a dedicated battery back-up, capable of operating the in-building system for at least 12 hours at 100% operation. The battery system shall automatically charge in the presence of external power input. The battery system shall be contained in one NEMA 3R or higher rated type enclosure. Monitoring the integrity of the power supplies shall be in accordance with 10.6.9 of NFPA 72.
- D. Equipment and Circuit Protection:
 1. Fire Performance: All main risers or trunks of the antenna system shall be installed with resistance to attack from fire using one of the following methods:
 - a. A 2-hour fire rated cable or cable system.
 - b. Routing the cable through a 2-hour fire rated enclosure(s) or shaft(s).
 2. Cabinet: The signal booster and all associated equipment shall be housed in a single NEMA 4 certified, painted steel weather tight box. The cabinet shall be large enough to dissipate internal heat without venting from inside of the cabinet to outside atmosphere. Equipment installed on the roof of structures shall be rated for the expected extreme temperature and weather associated with rooftop installation.
 3. Batteries that require venting shall be in a NEMA 3R type enclosure.
 4. Rooftop Installations shall require a Pitch Pocket for proper weather-tight roof penetrations.

2.2 PRODUCT SUBSTITUTIONS

- A. Descriptions and details, acceptable manufacturers' names listed shall establish a standard of quality, function, and design. Manufacturers and model numbers listed "no exceptions" shall not be substituted without specific notice in an addendum. Otherwise, where a specific manufacturer's product is indicated, products of other manufacturers listed as acceptable may be submitted for approval based on the substitute product being, in the opinion of the Architect/Engineer, of equivalent or better quality than that of the product specified.
- B. Proposed contractors wishing to propose systems which differ in manufacturer, features, functions, or operating characteristics from those outlined in these specifications must do so in writing to the

specifying authority at least ten (10) days prior to the proposal opening.

- C. For manufacturers equipment or models other than that specified, the proposed contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment. Proposals must include detailed information showing all deviations from the system as specified and include relevant technical and cost data. This shall include a complete description of the proposed substitution, drawings, catalog cuts, performance data, test data, or any other data or information necessary for evaluation.
- D. The Engineer will consider all such submittals and the Architect will issue an addendum listing items that the Engineer considers acceptable. Only such items as specified or approved as acceptable will be installed on this project.
- E. Substitute products for which the proposed contractor does not obtain prior approval will not be considered acceptable for this project. Final approval of the alternate system shall be based on the decision of the Owner and Architect. Prior approval to make a proposal for this project does not automatically ensure the system will be an acceptable equivalent.
- F. The Contractors' proposal represents that the contract proposal price is based solely upon the materials, equipment, and labor described in the Contract Proposal Documents (including addenda, if any) and that he contemplates no substitutions or extras.
- G. The manufacturer of the proposed substitute unit shall provide samples for evaluation, when required, at no charge and non-returnable.
- H. Requests for substitution are understood to mean that the Contractor:
 - 1. Has personally investigated the proposed substitution and determined that it is equivalent or superior in all respects to that specified.
 - 2. Will provide the same guarantee for the substitution that he would for that specified.
 - 3. Will, at no cost to the Owner, replace the substitute item with the specified product if the substitute item fails to perform satisfactorily.
 - 4. After Award of the Contract, substitutions will be considered only under one or more of the following circumstances:
 - a. The substitution is required for compliance with subsequent interpretations of code or insurance requirements.
 - b. The specified product is unavailable through no fault of the Contractor.
 - c. The manufacturer refuses to warranty the specified products as required.
 - d. Subsequent information indicates that the specified product is unable to perform properly or to fit in the designated space.
 - e. In the Engineer's sole judgment, the substitution would be in the Owner's best interest.
 - f. Revisions to the electrical system caused by substitutions shall be under the supervision of the Engineer, at a standard hourly rate charged by the Engineer. Charges from the Engineer, Architect, and Electrical Contractor shall be paid by the Contractor originating the changes.

2.3 MANUFACTURERS

- A. Subject to compliance with requirements, available integrators offering products that may be incorporated in the work include, but are not limited to:
 - Farenhyt
 - Westell
 - Gamewell-FCI
 - Notifier
 - SOLiD Technologies
 - Other manufacturers upon approval.
- B. Subject to compliance with requirements, available integrators offering products that may be incorporated in the work include the products listed in the ERRCS Schedule on the contract drawings.

2.4 SYSTEM COMPONENTS

- A. Signal Strength

1. The emergency responder radio coverage system signal strength shall meet all the requirements of inbound and outbound signal strength per IFC 510.4.1.
 2. Signal strength and coverage shall meet all requirements of the local fire officials and AHJ.
- B. Permissible Systems
1. Buildings and structures shall be equipped with an FCC Certified Class B Bi-Directional VHF, UHF, and 700-900 MHz amplifier(s) as needed.
 2. The distributed antenna system may utilize a radiating cable, fixed antennas, or a combination of both.
- C. Supported Frequencies: The system shall support VHF, UHF, and 700-900 MHz as required for local public safety and first responder bands as utilized by the local fire service.
- D. Degraded Performance in Emergencies: The system shall be designed to allow degraded performance in adverse conditions, such as abnormally high temperatures resulting from nearby fires, extreme voltage fluctuations and/or other abnormal conditions that may occur during an emergency. Circuits that intentionally disable the signal booster in such situations (i.e. under/over voltage, over/under current, over/under temperature, etc.) shall not be implemented as the standard mode for public safety applications.
- E. Mode of Operation: The system shall be normally powered on and shall continuously provide passing of frequencies within the Public Safety and First Responder bands.
- F. All in-building radio systems shall be compatible with both analog and digital communications simultaneously at the time of installation.

2.5 SYSTEM MONITORING

- A. The emergency responder radio coverage system shall include connections to the fire alarm system to monitor the operational integrity of the signal booster, power supplies and annunciate malfunctions by a listed fire alarm control unit. Coordinate and provide this integration, as part of this system, with the fire alarm system contractor that is authorized to service the facility's fire alarm system. The integration of the emergency responder radio coverage system with the fire alarm system shall comply with Chapter 10.14 of NFPA 72. The automatic monitored conditions shall include the following:
1. Loss of normal AC power supply.
 2. System battery charger(s) failure.
 3. Malfunction of the donor antenna(s).
 4. Failure of active RF-emitting device(s).
 5. Low-battery capacity at 70-percent reduction of operating capacity.
 6. Failure of critical system components.
 7. The communications link between the fire alarm system and the emergency responder radio coverage system.
- B. A sign shall be located at the fire alarm panel with the name and telephone number of the local municipality indicating that they shall be notified of any failures that extend past the 2-hour time limit.
- C. A dedicated supervised monitoring panel shall be provided within the emergency command center or other location as designated by AHJ to annunciate the status of all emergency responder radio coverage component locations. The monitoring panel shall provide visual and labeled indication of the following for each signal booster:
1. Normal AC power
 2. Loss of Normal AC Power
 3. Battery Charger Failure
 4. Low-battery Capacity
 5. Donor Antenna Failure
 6. Active RF-emitting Device Malfunction
 7. Active System Component Malfunction

2.6 CABLE ROUTING, INSTALLATION, AND SUPPORT

- A. System wiring, and equipment installation shall be in accordance with good engineering practices. Wiring shall meet all state and local electrical code requirements.

- B. Wires and cables shall enter each equipment enclosure, console, cabinet or rack in such a manner that all doors or access panels can be opened and closed without removal or disruption of the cables.
- C. Cable pathways, conduit, and cable support systems shall be complete with bushings, de-burred, cleaned, and secure prior to installation of cable.
- D. Before energizing the system check all cables for correct connections and test for short circuits, ground faults, continuity, and insulation.
- E. In all exposed areas such as mechanical rooms, parking garages, stairwells, etc., cable shall be fully enclosed in conduit.
- F. Do not attach any supports to joist bridging or other lightweight members. The support system shall provide a protective pathway to eliminate stress that could damage the cabling.
- G. Mount all equipment firmly in place such that vibration or jarring will not interfere with system operation. Route cable in a professional, neat, and orderly installation.
- H. The cable shall not be crushed, deformed, skinned, crimped, twisted, or formed into tight radius bends that could compromise the integrity of the cabling.
- I. Cable must not be fastened to electrical conduits, mechanical ductwork or piping, sprinkler pipes, or routed to obstruct access to hatches, doors, utility access panels, or service work areas. Do not route cables through fire doors, ventilation shafts, grates, or parallel for more than four-feet with line voltage electrical conductors. System cables shall not be run loose on ceiling grid or ceiling tiles.
- J. Provide for adequate ventilation to all equipment housings and take precautions to prevent electromagnetic or electrostatic hum.
- K. All conduit, duct, track, and raceway runs shall be spaced apart to allow for maintenance, such as the installation of couplings, without disturbing adjacent pathways.
- L. Each cable run shall be free of splices. No terminations, splices, or equipment will be installed in or above ceilings.
- M. Do not route any communication cable within two feet of any light fixture, HVAC unit, service access area, electric panel, or any device containing a motor or transformer.
- N. System cable will not be installed in the same conduit, duct, or track with line voltage electrical cable.
- O. When cabling is installed for future use, it shall be identified with a tag of sufficient durability to withstand the environment involved.
- P. Any pulling compounds utilized must be approved by the cable manufacturer and shall not degrade the strength or electrical characteristics of the cable.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Contractors shall coordinate with an FCC licensed engineering firm regularly employed in the business of designing and implementing Emergency Responder Radio Coverage Systems for emergency responders.
- B. Proposed Contractor is required to provide for and coordinate with Electrical Contractor for any, and all required electrical work, including but not limited to, circuiting, conduits, back boxes, and more. These expenses will not be included in the electrical contractor primary bid.

3.2 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to job site in OEM's original unopened containers, clearly labeled with the OEM's name and equipment model and serial identification numbers.
- B. Store and protect equipment in a conditioned space until installation.

3.3 SYSTEMS INSTALLATION

- A. Coaxial antenna cabling shall not be installed in the same conduit, raceway, or cable trays used for other systems.
- B. All equipment shall be connected according to the OEM's specifications to insure correct installation and system performance.
- C. Coordinate all roof penetrations with General Contractor and Roofing Contractor.

3.4 GROUNDING

- A. Ground cable shields and equipment per Manufacturer's requirements.
- B. Antenna mast shall be grounded per NFPA 70 NEC requirements and antenna manufacturer's requirements. Provide grounding blocks and surge protection for outside coaxial cabling. Bond the antenna mast to the existing lightning protection system.

3.5 TESTING, WARRANTY SERVICE

- A. A factory trained representative of the manufacturer shall supervise the final connections and testing of the system and it shall be subject to the final acceptance of the Architect/Engineer and Owner. All testing shall meet the testing standards set forth in IFC Section 510.
- B. This contractor will thoroughly test all components of the systems and devices proposed herein to assure equipment specifications are met. This contractor will start up, test, and debug systems to ensure that all aspects of the system are working, documented, and reporting properly.
- C. This Contractor shall make a thorough inspection and test of the complete installed Emergency Responder Radio Coverage System including all components and controls to ensure the following:
 - 1. Complete and functional system.
 - 2. Installed in accordance with manufacturer's instructions.
 - 3. Verify proper operation and processing of signals.
 - 4. Verify that units and controls are properly labeled, and interconnecting wires and terminals are identified.
 - 5. Rectify deficiencies indicated by tests and completely re-test work affected by such deficiencies at Contractor's expense.
- D. A final System Acceptance Test shall be performed in the presence of a designated Owner representative and the AHJ. In the event that a system does not pass or only partially passes the Acceptance Test, the Project Manager will file a discrepancy report. Corrected items will be re-tested via a punch list to ensure that they comply with the system requirements.
- E. This Contractor shall provide a warranty of the installed system against defects in material or workmanship for a period of one (1) year from the date of substantial completion. Any equipment, cabling or wiring shown to be defective shall be replaced, repaired, or adjusted free of charge. All labor and materials shall be provided at no expense to the Owner. All equipment will carry a one-year warranty or manufacturer's warranty whichever is greater.
- F. Neither the final payment nor any provisions in Contract Documents shall relieve the Contractor of the responsibility for faulty materials or workmanship.
- G. Immediately prior to the end of the warranty period, the system shall be inspected and certified for the following year at no additional cost to the Owner.

3.6 PROJECT RECORD DOCUMENTS

- A. Upon submitting his request for final payment, he shall turn over to the Architect , for subsequent transmittal to the Owner revised plans showing "as installed" work.
- B. In addition to the above, the Contractor shall accumulate during the jobs progress the following data in PDF file format (preferred) or paper copies to be turned over to the Architect for checking and subsequent delivery to the Owner:
 - 1. All warranties, guarantees, and manufacturer`s directions on equipment and material covered by the Contract.
 - 2. PDF file or paper copies of all Shop Drawing prints and CAD or BIM engineering drawing program files.
 - 3. Any software programs, data/programming files, passwords, special interface cables, or keys that may be needed to maintain or access equipment.
 - 4. Set of operating instructions. Operating instructions shall also include recommended maintenance and seasonal changeover procedures.
 - 5. Any and all other data and/or plans required during construction.
 - 6. Repair parts lists of all major items and equipment including name, address, and telephone number of local supplier or agent.
 - 7. The first page, or pages, shall have the names, addresses, and telephone numbers of the following:
 - a. Builder and all Contractors.
 - b. Major Equipment Suppliers.
 - c. Submit communication systems warranties.

3.7 DRAWINGS, MANUALS, AND TRAINING

- A. As-built drawings and operating and maintenance (O&M) manuals may be electronically transmitted in PDF file format (preferred) or paper copies may be provided in quantities indicated in Division 1. Paper copies shall be organized including index tabs in a 3-ring black binder of sufficient size.
 - 1. Provide one (1) digital copy of all close-out documents.
 - 2. Provide three (3) copies of closeout documents bound in a 3-Ring binder with dividers and table of contents.
- B. Upon completion of the installation, and prior to final inspection, the Contractor shall furnish as-built drawings.
- C. In addition, the contractor shall furnish complete operating and maintenance manuals listing the manufacturer`s name(s), including technical data sheets. Manuals shall include wiring diagrams to indicate internal wiring for each device and the interconnections between the items of equipment. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system. Provide a parts list with manufacturer and model number for commonly replaced parts. Include complete instructions for the inspection, testing, and maintenance of the system. Include copies of all calculation sheets used to configure the system.
- D. Formal on-site training sessions shall be conducted by the Emergency Responder Radio Coverage System contractor. It shall be the responsibility of the Contractor to coordinate time and location of training sessions with the Owner. Provide documented general instruction as follows:
 - 1. Provide instruction to the maintenance personnel to include the location, inspection, normal maintenance, testing, and operation of all system components. Provide a minimum of two (2) hours—two 1-hour sessions separated by a minimum of two weeks.
 - 2. Provide instruction to designated personnel on the functions and operation of the system provided including capabilities, limitations, and the meaning of status messages. State the proper procedure for testing, routine maintenance, and request for service. Provide detailed instruction on the operation of the system. Provide a minimum of four (4) hours—two 2-hour sessions separated by a minimum of two weeks.

END OF SECTION

SECTION 28 13 27

BUILDING ACCESS CONTROL SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1, apply to this Section.
- B. This specification and the drawings provides requirements for the expansion to an existing credential card based, Building Access Control System that shall serve the doors as indicated on the project drawings.
- C. The access control system shall provide for controlled entry doors to be released when a valid credential card is presented to the card reader located adjacent to the door. This system shall control access to the building, monitor for unauthorized entry attempts, and log entry information. The system shall in no way impede free emergency exit from the building. Exit from the building shall not require special effort or knowledge.
- D. Provide all equipment, materials, labor, software, licensing, supervision, and services necessary for or incidental to the installation of a card reader operated access control system, as specified and as shown on the contract drawings and schedules.
- E. Provide an audio/video intercom system with two way audio/one way video door station(s) and a desktop master station with a door unlocking pushbutton. Provide door station(s) as shown on the drawings and access control system schedule.
- F. Door releasing (unlocking) pushbutton(s), located under the counter/desk, that shall unlock doors for a set period of time, to allow entry to authorized persons, as shown on the contract drawings.
- G. Provide campus lockdown capabilities as provided for by the access control system. The campus lockdown system shall be initiated by an undercounter pushbutton, located as indicated on the drawings.
- H. Refer to the Building Access Control System schedule on drawings for part numbers and additional information.
- I. Provide Video Surveillance System integration. See Section 28 23 20 - Video Surveillance System.
- J. Provide Premises Intruder Alarm System integration. See Section 28 16 24 - Premises Intruder Alarm System.
- K. An Access Control System card reader activation shall disarm the Intruder Alarm System at specific points of entry. Coordinate with the District on the card readers that will disarm the Intrusion Alarm System.
- L. Equipment specified herein is designed to provide specific functional and operational characteristics. It is the responsibility of the Contractor to provide all features and functions as outlined in these specifications.
- M. Furnish and install all equipment, accessories, materials, tools, scaffolding, man lifts, labor, and transportation in accordance with these specifications to provide a complete and operating access control system.
- N. Provide and install, prior to cable installation, plastic snap in bushings at each box opening, passage through a metal stud, and at the end of all open conduit stubs or sleeves to protect the cabling from damage.

- O. It is the intent of these specifications to provide complete installations although every item necessary may not be specifically mentioned or shown.
- P. This project shall include preparation of construction plans locating the access control system devices and having the plans reviewed by Owner, the Owner's Representative, and local AHJ for permitting.
- Q. It shall be the responsibility of this Contractor to obtain all required approvals and certifications from Authorities Having Jurisdiction (AHJ).
- R. The Division 26 Electrical Contractor shall provide:
 - 1. Dedicated 120VAC power to the access control units maximum 20-amps each. Each electrical disconnect device shall be labeled "ACCESS CONTROL".
 - 2. Provide and install all conduit and standard electrical boxes for the access control system as specified herein. The access control system contractor shall coordinate all conduit and box requirements and locations with, and provide special back boxes to, the electrical contractor prior to installation.
 - 3. Cabling in all open ceiling areas shall be enclosed in conduit.
 - 4. Provide required conduit for accessibility to attic or plenum space.
 - 5. Installation of special back boxes supplied by Division 28 contractor.
 - 6. Provide equipment mounting boards as indicated on the drawings.
 - 7. Provide conduit to remote areas outside of the building as outlined on the drawings.
 - 8. Coordination of requirements of Division 28 with the Builder.
- S. NOTE: All electric door locks shall be configured for fail-safe un-delayed egress operation and fail-secure to prevent unauthorized entry on loss of power.

1.2 WORK NOT INCLUDED

- A. Contractors shall make no agreement that obligates the Owner to pay any company providing communications, monitoring, or other services.
- B. Contractors shall not make selection, purchase, or installation of interconnect instruments and/or equipment to be used on this project.

1.3 RELATED SECTIONS

- A. Section 26 00 00 - Electrical
- B. Section 27 10 30 - Data and Telephone Cable Plant
- C. Section 28 21 23 - Video Surveillance System
- D. Section 28 31 24 - Premises Intruder Alarm System

1.4 PRESCRIPTIVE CODES, STANDARDS AND REGULATIONS

- A. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards, except when requirements are exceeded by the contract documents.
- B. In addition to requirements outlined in other sections of the specifications these codes and standards are imposed as applicable to the work in each instance.
- C. The equipment, materials, and installation shall conform to the latest version of all applicable codes, standards and regulations, of authorities having jurisdiction.
- D. Nothing in the Contract Documents shall be construed to permit work not conforming to these codes and standards.
- E. When two or more codes or standards are applicable to the same work, then the stricter code or standard shall govern.

- F. The date of the code or standard is that in effect on the date of issue stated on the contract documents, except when a particular publication date is specified.
- G. The Contractor shall comply with all State, Federal, NFPA, local codes and ordinances that may alter any part of the plans or specifications. The Contractor shall bear all costs for correcting any deficiencies due to non-compliance.
- H. Where local codes and ordinances are not in writing or on record, but local precedence have been set, the Owner shall pay for any additional resulting cost.

1.5 PLANS AND SPECIFICATIONS

- A. The intent of the project drawings is to establish the types of systems and functions, but not to set forth, each item essential to the functioning of the system.
- B. The drawings are generally diagrammatic and show approximate location and extent of work.
- C. Install the work complete including minor details necessary to perform the function indicated. Provide access control systems, including all connections, complete in every respect and ready to operate.
- D. If clarification is needed, consult the Owner's Representative.
- E. Review pertinent drawings and adjust the work to conditions shown. Where discrepancies occur between drawings, specifications, and actual field conditions, immediately notify the Owner's Representative for his interpretation.
- F. The Owner's Representative reserves the right to make any reasonable change in the location of any part of this work without additional cost to the Owner.

1.6 SITE VISIT

- A. Before submitting a proposal, each proposed Contractor shall examine all plans and specifications relating to the work, shall visit the site of the project, and become fully informed of the extent and character of the work required, including all required utilities and work to remote areas.
- B. No consideration will be granted for any alleged misunderstanding of the materials to be furnished, or the amount of work to be done. It being fully understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying plans, or required by nature of the site of which may be fairly implied, as essential to the execution and completion of any and all parts of the work.

1.7 SUBMITTALS

- A. Submit a complete submittal package within 30 calendar days after award of this work for approval. Equipment is not to be ordered without approval. Partial submittals are not acceptable for review. Each submittal shall include a dated transmittal.
- B. Submittal shall be electronically transmitted in PDF file format.
- C. For each submittal provide a cover sheet with the name and location of the project, the name, address and telephone number of the Contractor, and the name, address, and telephone number of the submitting sub-contractor. Include on or after the cover sheet sufficient space for review stamps.
- D. Quality Assurance Submittal including special boxes, cable, and other material as requested by the Owner's Representative:
 - 1. Letter from manufacturer stating that the Contractor is an Authorized Factory Distributor for the area where the project is located.
 - 2. The Contractor and Manufacturer shall supply sufficient information to indicate that the proposed system is based on the latest hardware, software technology available.
 - 3. Current copy of the Contractors Electronic Access Control Company license issued by the governing authority.

- E. Product Data Submittal including special boxes, cable, and other material as requested by the Owner's Representative including:
 - 1. An indication of any deviations from Contract Document requirements, including variations and limitations. Show any revisions to equipment layout required by use of selected equipment.
 - 2. A product data index and complete equipment list including for each product submitted for approval the manufactures name and part number, including options and selections.
 - 3. Cut-sheets or catalog data illustrating the physical appearance, size, function, compatibility, standards compliance, and other relevant characteristics of each product on the equipment list.
 - 4. Indicate by prominent notation (an arrow, circle, or other means) on each sheet the exact product and options being submitted.
 - 5. Submit design data, when the scope of work requires, including calculations, schematics, risers, sequences, or other data.
 - 6. If not included in the Shop Drawings, calculations for circuit current drop, conductor size, and battery backup for each unit.
 - 7. Resubmittal shall include a complete revised equipment list and any product data that is revised with revision notation and clouded changes.

- F. Shop Drawings Submittal to include:
 - 1. A cover page that includes project name and address, index of drawings, scope of work description, code editions designed under, local AHJ information, a sequence of operation Input/Output matrix, bill of material, device and cable legends, typical device connections and installation height details, schedules, and location map.
 - 2. Produce accurate to scale (min. 1/8" = 1') drawings showing equipment and device layouts prepared using a CAD or BIM engineering drawing program. When CAD background files are not available for existing buildings the Contractor shall inspect the site and collect information to create a floor plan. Walls shall be double line showing the thickness, single line diagrams are not acceptable.
 - 3. Every room shall have a name and number identifying the use of the space with ceiling heights notated for each space or group of spaces throughout the design.
 - 4. Indicate and/or notate door swings, glass walls, half walls, floor to ceiling windows, skylights, and other openings, projections, ceiling features, elevation changes, et cetera that affect the placement of alarm devices.
 - 5. Locate and label all components of the system, label and indicate circuit routing, cable type, and gauge. The system's panel locations, and all device locations shall be clearly identified by symbols matching the symbol legend. The labeling of circuits and devices shall correspond with the riser diagram.
 - 6. Riser diagrams showing all components of the system. Show control panels, power supply panels, and network interfaces. Partial or typical riser diagrams are not acceptable.
 - 7. If not included in the Product Data Submittal, include calculations device circuit current drop, conductor size, and battery backup for all panels.
 - 8. When multiple buildings make up the system, provide a block diagram of the project site showing all buildings to be covered by the system and detailing the route and type of connection between buildings. Note building entry points, conduit type and size, and routing pathway (underground or over canopy installation).
 - 9. Shop or coordination drawings shall include information that will allow the Contractor to coordinate interdisciplinary work and when necessary guide the manufacturer or fabricator in producing the product.
 - 10. Resubmittals shall include revision notation and clouded changes.

1.8 QUALIFICATIONS OF A PROPOSED CONTRACTOR

- A. Proposed Contractors who do not currently possess the necessary qualifications, trained and experienced personnel, financial capacity, hold required current licenses, or meet the other requirements herein described will be disqualified.
- B. The Contractor and employees shall be licensed by the governing authority to sell, install, and service electronic locking systems.
- C. The Contractor shall not have any grievances or complaints of record regarding workmanship, code compliance, or service response with a licensing authority. A proposed Contractor that has any prior

- finding(s) of a code or license violation or has any litigation in process concerning the installation of a system is unacceptable.
- D. The Contractor shall employ full-time, factory-trained, licensed, local technicians and installers for product installation, maintenance, support, service and warranty.
 - E. All work associated with the installation of the access control system shall be under the direct supervision of a licensed and factory-trained technician. A certificate of this training shall be provided with the Contractor's submittal.
 - F. The proposed Contractor, as a business entity, shall be an authorized distributor and designated representative of the access control system manufacturer, with full warranty privileges, and shall have been actively engaged in the business of selling, installing, and servicing commercial building access control systems for a period of at least 5 years.
 - G. Recently formed companies are acceptable only if specific pre-approval is requested, and granted by the Owner's Representative, based on experience of key personnel, current and completed projects, and all licensing requirements are met ten (10) working days prior to the contract proposal date.
 - H. No contract employees are allowed unless they have been to the factory-training school within the last 18 months. A certificate of this training shall be provided with the Contractor's submittal.
 - I. The proposed Contractor shall have an office within 150-miles of the job site, staffed with factory-trained technicians who are qualified and licensed to supervise the installation, to be responsible that the system is installed as submitted, to conduct system start up, and perform a 100 percent operational audit of all installed devices. The technicians shall instruct the Owners' representatives in the proper operation of the system, and to provide service throughout the warranty period. The Contractor shall be capable of dispatching technicians to repair a system within six (6) hours of a service request.
 - J. The proposed Contractor shall be fully experienced in the design and installation of the type of security system, herein specified, and shall furnish with the contract proposal an itemized list of the installations of the type specified herein. The list shall include the name of two (2) projects, date of completion, the amount of the contract, the name, and telephone number of a qualified person to contact for reference. Each reference project listed must utilize equipment by the same manufacturer as the proposed system.
 - K. The ability of a proposed Contractor to obtain plans and provide a performance bond shall not be regarded as the sole qualification of the Contractors' competency and responsibility to meet the requirements and obligations of the contract.
 - L. The Builder shall be satisfied that a proposed Contractor meets all the requirements expressed herein before including the Contractor's proposal in the project.
 - M. The Owner's Representative or the Owner may investigate, as they deem necessary, to determine the ability of the proposed Contractor to perform the work. The proposed Contractor shall furnish to the Owner with any information or data requested for this purpose.
 - N. The Owner's Representative or the Owner reserves the right to reject any contract proposal if the evidence submitted, or their investigation, fails to indicate that the Contractor is qualified to fulfill of any part of the contract or to complete the work contemplated therein.
 - O. The Owner's Representative or the Owner reserves the right to reject the proposal of any Contractor who has previously failed to perform properly, or complete on time, contracts of a similar nature.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide a complete and satisfactorily operating Access Control System as described herein, using materials and equipment of types, sizes, ratings, and performances as specified. Use materials and equipment that comply with referenced standards and manufacturers' standard design and construction, in accordance with published product information. Coordinate the features of all materials and equipment

so they form a functional system, with components and interconnections matched for optimum performance of specified functions.

- B. The system provided shall be fully compatible and integrated with the Owners existing system hardware, software, credentials, and credential database.
- C. Refer to Building Access Control System schedule on drawings for part numbers and additional information.
- D. All equipment and components shall be installed in strict compliance with manufacturers` recommendations and the requirements of the components UL listing. Consult the manufacturer`s installation manuals for all wiring diagrams, schematics, electrical requirements, cable types, and physical equipment sizes, etc., before beginning system installation. Refer to the manufacturers` riser / connection diagrams for all specific system installation/termination/wiring data.
- E. The control units, power supplies, batteries, subassemblies, software, firmware, cable, and all accessories provided shall be listed and labeled by Underwriters Laboratories, Inc. for commercial security system use under the latest appropriate testing standard. Provide all equipment and components required to provide a complete and operating system.
- F. All date keeping hardware, firmware, and software provided shall be fully compliant with the calendar year designated in four-digit date format. Any time equations must function normally, leap year, and daylight savings time must be supported.
- G. The system and all components shall be tested and found suitable for the specified purpose as part of a commercial building security system by a nationally recognized approvals agency acceptable to the AHJ.
- H. All equipment and components shall be new, and the manufacturer`s current model. All like devices shall be of the same manufacturer and model number.
- I. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.
- J. Equipment devices, make/model numbers, accessories, and comments have been shown on the contract drawings. Specific wiring between equipment has not been shown.

2.2 BUILDING ACCESS CONTROL SYSTEM INSTALLATION REQUIREMENTS

- A. Contractors shall provide all material, labor, tools, and equipment required to perform the work described and make complete, safe, and functional systems.
- B. Contractors shall pay for and acquire all permits and inspections required by the Authority Having Jurisdiction and/or other controlling authorities.
- C. All work shall be installed in accordance with state, local, and national codes.
- D. All work shall be done by mechanics skilled in the particular trade involved, under responsible supervision.
- E. Contractors shall warrant his workmanship and materials for a period of one year from the date of acceptance upon completion of the project.
- F. No surface mounted raceway or conduit will be accepted on any new construction job.
- G. Seal all wall and floor penetrations with approved sealant at a fire rating equal to, or better, than the original or current fire rating.
- H. All cabling must be suspended up off the ceiling grid.
- I. The Access Control Contractor shall provide and install all required parts and local cabling to get the system online and operational; this includes power supplies required to operate the electrified exit

devices.

- J. The Access Control Contractor must provide the Owner with all security equipment MAC addresses and network drop information.
- K. The Electrical Contractor shall provide 110-volt electrical receptacles to accommodate door release hardware/electrified exit devices and system transformers in an accessible location at each door and 12" above the finished ceiling.

2.3 RELATED WORK - NETWORK CONNECTIVITY

- A. The system shall be utilizing the customer's existing Ethernet system backbone for all security devices communications.
- B. No Ethernet cabling, network RJ-45 jacks, or patch cords are included in the scope of this Specification Section.
- C. The Owner will provide this Contractor with a terminated network drop at security devices, and the required TCP/IP configuration settings: static IP address, domain, gateway, and subnet mask.
- D. This Contractor will program and test all access control system devices for connection to the network.
- E. This Contractor will provide complete programming of all device parameters in accordance with the Owners requirements.

2.4 ACCEPTABLE BUILDING ACCESS CONTROL SYSTEM MANUFACTURER

- A. Descriptions and details, acceptable manufacturers' names listed, specific manufacturers' model number items indicated in the plans and specifications shall establish a standard of quality, function, and design. Manufacturers and model numbers listed "no exceptions" shall not be substituted without specific notice in an addendum. Otherwise, where a specific manufacturer's product is indicated, products of other manufacturers listed as acceptable may be submitted for approval based on the substitute product being, in the opinion of the Owner's Representative, of equivalent or better quality than that of the product specified.
- B. Proposed Contractors wishing to propose any product substitution must do so in writing to the specifying authority at least ten (10) days prior to the proposal opening.
- C. For manufacturers equipment or models other than that specified, the proposed Contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment. Proposals must include detailed information showing all deviations from the system as specified.
- D. Substitute products for which the proposed Contractor does not obtain prior approval will not be considered acceptable for this project. Final approval of alternate products shall be based on the decision of the Owner and Owner's Representative. Prior approval to make a proposal for this project does not automatically ensure products will be an acceptable equivalent.
- E. It is the responsibility of the Contractor to provide all features and functions as outlined in these specifications. The functions and features specified are vital to the operation of this facility; therefore, inclusion in the list of acceptable manufacturers does not release the Contractor from strict compliance with the requirements of this specification.
- F. The system manufacturers model numbers, functions, and features described in this specification section are those of Open Options Inc./Mercury Access Technology-DNA Fusion enterprise class soft. This shall constitute the quality and performance of the equipment to be furnished, no exceptions.

2.5 DOOR CONTROLLER MODULES

- A. The access control system controller modules shall be configured to automatically receive policy and schedule updates for all identities and hardware configurations as distributed by the software platform. The controllers shall ensure security is enforced at the controlled doors - even when upstream network

communications are temporally interrupted.

- B. All system programming shall be maintained in non-volatile memory such that program information is maintained even if all external AC and battery power is removed.
- C. Provide as required Power-over-Ethernet and/or RS-485 serial interface controllers and door modules that include a door/reader interface and supports standard reader technologies.
- D. Each module shall be housed in a wall enclosure and connected, internally or adjacently, to a 12 VDC battery backed up power supply.

2.6 CREDENTIAL CARD READERS

- A. Controlled access door location as indicated on plans shall be provided with an entry card reader to allow access to authorized individuals as scheduled. Readers shall be of a weatherproof design, capable of operation in indoor or outdoor environments, with a temperature and humidity range to withstand the environment of deployment.
- B. Each proximity card reader shall mount on a standard single-gang electrical wall box, window mullion or on the surface of an interior or exterior wall and feature a read range of 6-9 inches. The electronics shall be potted with UL listed potting compound to protect the reader from harsh environmental conditions.
- C. Exterior card reader locations shall be prepared including a recessed single-gang weatherproof metal back box located approximately 44" centered from the ground and 12" off the opened door edge to the side, with a ½" secured rigid or flex conduit with pull string to an accessible interior location concealed above the finished ceiling.
- D. Outdoor weatherproof back boxes shall be flush mounted and connected to a ½" threaded rigid pipe conduit and sealed. The reader casing shall be grounded to prevent electrostatic discharge from interfering with the operation of the reader.
- E. Threaded conduit is required for outdoor applications and dielectric grease shall be used to coat field connections.
- F. An Access Control System card reader activation shall disarm the Intruder Alarm System at specific points of entry. Coordinate with the District on the card readers that will disarm the Intrusion Alarm System.

2.7 PREMISES INTRUDER ALARM SYSTEM INTEGRATION

- A. When a valid credential is read requesting access to an ARMED zone of the Premises Intruder Alarm System, access shall be DENIED unless all of the following conditions are met:
 - 1. The controlled entry is located at a Premises Intruder Alarm System keypad.
 - 2. The credential holder is in an access group authorized for armed Premises Intruder Alarm System zone access.
 - 3. The time and day match the group schedule are for armed Premises Intruder Alarm System zone access.
- B. When the Premises Intruder Alarm System zone is armed, the door contacts or motion sensors shall initiate an alarm condition, activate the local siren, log the event, and transmit the alarm to the security system monitoring service. The monitoring service will then alert security personnel or the police to evaluate the situation.

2.8 MODULE ENCLOSURES AND POWER SUPPLY/BATTERY BACKUPS

- A. For centralized controller locations, provide as required to house all modules, enclosures that shall be high grade steel with textured finish enclosures for indoor use, suitable for surface wall mounting, and shall include battery backup power supplies. Each enclosure shall include a removable back plate for module mounting, a keyed lock, and tamper switch. Access power enclosures shall include a single AC power connection (for power supply), and a pre-wired LSP power section. Each tamper switch shall be wired to a module input circuit for monitoring by the System.

- B. Provide UL 294 listed power limited source, filtered and electronically regulated 12 VDC output power supplies with short circuit/thermal overload protection, and automatic switch over to stand-by battery backup when AC fails. Each power supply shall include a built-in charger and sealed type battery.
- C. Power supply/chargers and batteries shall operate and emergency power to the system. Provide sufficient battery capacity for operation without AC power for all control modules, card readers, and electric unlocking/locking devices for a minimum of 4-hours (design calculations required with submittals). Include a 20% safety factor in battery calculations to ensure adequate performance for the service life of batteries.
- D. Batteries: Provide an up to 12Ah size sealed maintenance free battery per power supply/charger sized as required.

2.9 DOOR RELEASE HARDWARE

- A. Verify exact hardware requirements with Division 08 and Door Hardware Schedules including door and frame preparation details.
- B. Only when the door hardware does not include an integrated Request-to-Exit Switch, provide a request-to-exit sensor when required.
- C. NOTE: All electric door locks shall be configured for fail-safe un-delayed free egress operation and fail-secure to prevent unauthorized entry on loss of power.

2.10 DOOR SWITCHES (ACCESS SYSTEM DOOR CONTACTS)

- A. Provide door switches as indicated on floor plans with conduit run to a nearby, accessible, junction box located above ceiling.
- B. Door frame flush mount: Provide recessed magnetic contact door switches - dual contact DPDT switch, to support both access and security system connections with wire leads as required or equivalent.
- C. Doors surface mount, heavy duty armored: Provide magnetic contact door switches designed for roll up overhead doors.

2.11 REQUEST-TO-EXIT SWITCH OR SENSOR

- A. Note that a request to exit indication switch is not required for a door controlled only by the Visitor Entry Video Intercom System and will not be connected, however this will be required for proper functioning of any future building access control system that will provide override control of the same door.
- B. The system shall not be programmed to unlock a door automatically from a request to exit signal, as this presents a security breach. The request to exit signal shall be used only to indicate a normal exit status, as opposed to a forced entry. Exit shall be made with the normal door hardware and shall not be impeded or assisted by the electronic system. Exit shall not be affected if the power is off and the battery backup exhausted.
- C. When no request-to-exit switch is provided integrated into the door hardware (see above), provide at the exit side of each controlled door a request-to-exit passive infrared detector with x-y targeting and digital signal processing.

2.12 CABLE

- A. All wiring shall be NEC type CMP (plenum rated) or equivalent rating low voltage cable.
- B. All exterior cabling shall be exterior/underground rated and installed in threaded rigid metallic conduit.
- C. Avoid if at all possible, junctions or splicing - all junctions in cable shall be made by proper splicing techniques in a junction box.
- D. All cabling is to be concealed where construction permits.

- E. This Contractor shall provide and install new and unused ASTM bare stranded copper conductor wire per ANSI/NEMA codes. Follow the manufacturer's instructions. All wire shall be as recommended by the manufacturer for the application.
- F. All cable shall have a machine printed label located within 2" from every terminal block and within 6" from all other connections utilizing self-laminating flexible vinyl film labels.
- G. Wire gauge shall be selected per circuit based on cable length and current requirements.

2.13 CABLE TIES

- A. HALAR Fluoropolymer plenum rated cable ties shall be furnished and installed to attach wire bundles to supports and for appropriate wire management as required.

2.14 BUSHINGS

- A. Provide a plastic snap in bushing at each box opening, passage through a metal stud, and at the end of all open conduit stubs or sleeves prior to cable installation to protect the cabling from damage.

2.15 CEILING MOUNTED DEVICE BOX HANGERS

- A. All ceiling mounted devices including smoke detectors, heat detectors, remote power/status LEDs, ceiling mounted strobes and horn/strobes, et cetera, when mounted in a drop ceiling shall be supported by an electrical box hanger. Box hangers shall be attached to the ceiling grid only for lateral stabilization, separate support wires shall be provided. The required support wires for the ceiling grid or light fixtures shall not be utilized. The backbox shall be flush and level with the bottom of the ceiling tile and the hole neatly cut for a finished appearance when the device is installed.
- B. Device and box hanger assemblies shall not be supported solely by suspended ceilings. Fasteners and supports shall be adequate to support the required load.

2.16 J-HOOKS

- A. Attachments for cabling support shall be spaced at approximately 48 to 60 inches on center. The cable bundle shall not be allowed to sag more than 12-inches mid-span between attachments. Attachments shall be sized as recommended by the manufacturer. Single cables or bundles up to four cables may be supported directly by the building structure.
- B. Do not mix different signal strength cables on the same J-Hook (i.e., security/fire alarm system cable with telephone/data cable).

2.17 SURGE AND AMPERAGE PROTECTION

- A. Electrical surge protection shall be provided for all service entrance connections that power control panels, power supply panels, etc.
- B. Each copper pair that connects one building to another (i.e., any other portion of a building complex not under one continuous roof) at both exit points, shall be protected by surge devices, to prevent damage to equipment.
- C. Security system circuit surge protectors shall be mounted in a standard grounded metallic electric box and be of the type with a permanently mounted base and a removeable/plug in type surge suppression device.

PART 3 - EXECUTION

3.1 GENERAL

- A. This access control system shall provide for controlled access through entry doors and into restricted areas when a valid credential card is presented to the credential card reader located adjacent to the door, only if the users group access rights and time schedules allow for access. This system shall

monitor for unauthorized entry attempts, control access to the building, and log entry information. The system shall in no way impede free emergency exit from the building. Exit from the building shall not require special effort or knowledge. Controlled door locks shall fail secure from outside entry on loss of power and backup power.

- B. Scheduled automatic door unlocking/locking of specific entry doors shall be programmed to require verification before being enacted. A card from a select group at the local facility (including the Principal, Vice Principals, Owner, Manager, etc. as requested) must be presented at the facility within a two-hour period prior to the scheduled unlocking event. This is to prevent the entrance doors from being unlocked when no one is present, such as due to a snow day, or other unscheduled occurrence. If a scheduled unlocking event is delayed, and a card from the select group is presented within two hours after the unlocking event was scheduled, the unlocking shall be enacted immediately.
- C. Door Forced and/or Door Held Open alarms shall have the capacity to be locally annunciated via Auxiliary Output relays on the individual controllers. This annunciation shall be controlled as follows. A direct one-to-one relationship shall be able to be programmed between the Door Forced and/or Door Held Open alarm and the auxiliary output. When either condition exists, the auxiliary output is energized. When either condition is cleared, the auxiliary output is de-energized.
- D. The system shall provide the capability for individual controlled door locations as noted on plans to include a local sounder. Unless otherwise required, the local sounder shall annunciate when a door is held open, left ajar, or propped open for over one minute. If the door remains held open for over three minutes, a system Door Held Open Alarm alert shall pop-up and generate an entry in the log file for later review, the alert shall be automatically silenced and cleared once the door is closed.
- E. At specifically identified individual locations as noted on plans, in lieu of the actions previously described, Door Forced and/or Door Held Open alarms shall require local card access verification from authorized individuals before the local sounder output annunciation is cleared. At these locations, the intent is that a local sounder will be energized from either a Door Forced or Door Held Open and will remain energized even after the door has closed again. The local sounder shall continue to be energized until a valid card read occurs at the door associated with the sounder by an authorized individual (a teacher, a staff member, or a Principal).
- F. Where required, the system shall interface with electric door openers utilized for ADA access. This interface shall interconnect to door control interface to mechanically open the door when a valid card is read, and the exterior door button is pressed. The exterior button shall also open the door when the door is scheduled to be unlocked without a card read. The interior door open button shall always be functional, allowing full egress, regardless of the status of the access control system, the interior button shall also be interfaced to the request to exit function.
- G. The request-to-exit switch or sensor shall provide a means for the system to monitor the status of the controlled door and detect a forced entry condition. The request-to-exit signal shall be used only to indicate a normal exit status, as opposed to forced entry. Exit shall be made with the normal door hardware and shall not be impeded or assisted by the electronic system. Exit shall not be affected if the power is off and the battery backup exhausted.
- H. The access system door contact switch shall provide a means for the system to monitor the open/closed status of the controlled door and detect if the door is held open or left ajar after a valid card read.
- I. This system shall allow for normal exit, but also detect door held open too long (propped) and door forced entry conditions. Either situation shall generate a status condition event that is logged and acted upon in accordance with the system programming.
- J. The system shall have the capability of mapping inputs to outputs in a one-to-one capacity. When the input is triggered, the output turns on. When the input clears, the output turns off.
- K. Individual door switches shall also have the capability of being monitored for status. When the door is opened, the door switch shall trigger an internal controller timer. That timer will set a fixed uninterruptible time frame for another interlocked output to be turned on. This output is to be energized on any one of the three following situations:
 - 1. A normal situation when there is a legitimate card read and the door is opened.

2. A situation where a key is used to open the door without a legitimate card read.
 3. A situation where an ordinary Door Forced event occurs.
- L. The building access control shall be controlled, accessed, and updated via the web-based Client Software Application via a PC and the facility Ethernet network and by an Internet connection (if the network is configured for access).
 - M. The building security system shall be controlled from its own internal software. Interface to the building access control shall be via hard-wired interface points.
 - N. All system programming shall be maintained in non-volatile memory such that program information is maintained even if all AC and battery power is removed. The master system database shall reside on the server and shall be constantly updated to all the access system door control panels via the Ethernet network connection. In the event the Ethernet network connection goes offline, the system shall continue to operate in accordance with the latest copy of the master system database until the network connection is restored and the database updated.
 - O. The web-based Client Software Application shall provide for authorized operators password protected access to the functions and operation of system including real time monitoring of status messages, verify and controlling settings and conditions, and for generating reports.
 - P. The web-based Client Software Application Graphical User Interface shall include a real-time system status monitor that graphically depicts all logical devices on dynamic graphical maps with indicator icons to represent Input/Output points, and logical devices. The interactive maps shall display the state and condition of alarm points and the ability to monitor system status and event logs.
 - Q. The web-based Client Software Application software shall allow authorized operators to add and delete users, assign users into and out of various groups, to disable cards reported lost or stolen, and to re-enable recovered cards. Authorized operators shall be able to adjust the operating parameters of the system including group access rights and scheduling.
 - R. The Premises Intruder Alarm System shall be armed / disarmed by zone via keypads located inside the building entry. In no case shall the integrated system be programmed to automatically disarm the Premises Intruder Alarm System when an access card is read. Two levels of security shall be maintained when the intrusion system is armed, requiring both a valid access card for entry and keypad security code within one minute to disarm the system.
 - S. When the Premises Intruder Alarm System zone is armed, the door contacts, glass break sensors, motion sensors, or the failure to enter an authorized keypad code within one minute shall indicate an alarm condition. An alarm condition shall activate the local siren, log the event, and transmit the alarm to the virtual server, and the security system monitoring service. The monitoring service will then alert security personnel or the police to evaluate the situation.
 - T. When a Premises Intruder Alarm System zone is disarmed, activation of a panic button shall initiate an alarm condition without the local siren (silent alarm), log the event, and transmit the alarm to the virtual server, and the security system monitoring service. The monitoring service will then alert security personnel or the police to evaluate the situation.

3.2 DATABASE OPERATIONS

- A. Identity management functionality shall include data import of identity records using standard Comma Separated Value (.csv) files and their associated image in a standard jpeg format. Data imports may be pre-loaded prior to implementation or added at any time after deployment.
- B. Individual identity enrollment into the credential database shall provide for the entry and maintenance of required and optional data fields, and JPEG user photo file import.
- C. The credential database shall allow multiple field-based identity / credential searches using AND / OR logic and field content filters.
- D. The credential database shall include standard identity and user defined data fields plus audit trail information system including credential activation date, deactivation date, and optional scheduled time

for expiration.

3.3 OPERATION OF NEW EQUIPMENT PRIOR TO PROJECT COMPLETION

- A. When the phasing of a project requires that electronic safety and security systems be operable in certain areas and the Owner needs to operate the equipment the Contractor shall make such provisions. The warranty period shall commence on new equipment when it is operated for the beneficial use of the Owner. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, properly adjust, and complete all punch list items before final acceptance by the Owner. In these cases, the date of acceptance and the start of the warranty may be different dates.

3.4 PROTECTION OF EQUIPMENT AND MATERIALS

- A. The Contractor shall take such precautions as may be necessary to protect his apparatus from damage.
- B. This shall include the creation of all required temporary shelters to protect any apparatus above the floor of the construction and the covering of apparatus in the completed building with tarpaulins or other protective covering.
- C. Failure to comply with the above to the satisfaction of the Owner's inspector will be sufficient cause for the rejection of the equipment in question and its complete replacement by the Contractor.

3.5 CABLE ROUTING, INSTALLATION, AND SUPPORT

- A. System wiring and equipment installation shall be in accordance with good engineering practices as established by NEC, NFPA, and all applicable codes and standards. Wiring shall meet all state and local electrical code requirements.
- B. All cable shall have a label on both ends utilizing self-laminating, flexible vinyl film, non-smear, machine printed labels.
- C. All conduit, ducts, track, and raceways shall be supported from the structure at industry standard intervals for the size specified, utilizing proper anchoring devices. Cable fill may not exceed the manufacturers' instructions for each type of support.
- D. Mount all equipment firmly in place such that vibration or jarring will not interfere with system operation. Route cable in a professional, neat, and orderly installation.
- E. Cables shall be run in bundles above accessible ceilings and supported from building structure by j-hooks, conduit, or cable tray. Cabling shall be loosely bundled with cable ties randomly spaced at 30 to 48 inches on center, cable ties shall not be tight enough to deform cabling and shall not be used to support the cabling.
- F. Support shall be provided by mounting appropriate fasteners that may be loaded with multiple cables. If the weight load is carried by the support rod or wire, the support assembly may attach to the ceiling grid for lateral stabilization. The required support wires for the ceiling grid or light fixtures shall not be utilized. Any fastener attached to the ceiling grid shall not interfere with inserting or removing ceiling tiles. The cable pathway of supports must be positioned at least 12 inches above the ceiling grid.
- G. Do not attach any supports to joist bridging or other lightweight members. The support system shall provide a protective pathway to eliminate stress that could damage the cabling.
- H. Cable must not be fastened to electrical conduits, mechanical ductwork / piping, sprinkler pipes, or routed to obstruct access to hatches, doors, utility access panels, or service work areas. Do not route cables through fire doors, ventilation shafts, grates, or parallel for more than four-feet with line voltage electrical conductors. Cables shall not be run loose on ceiling grid or ceiling tiles.
- I. In all exposed areas, system cable shall be fully enclosed in conduit.
- J. Cables shall be run in conduit stubs from wall boxes to accessible areas above finished ceilings. Conduit shall be required only within walls and concealed spaces to provide access. Provide bushings to protect

the cable from damage for conduit ends, box openings, and passage through metal studs.

- K. All conduit, duct, track, and raceway runs shall be spaced apart to allow for maintenance, such as the installation of couplings, without disturbing adjacent pathways.
- L. Cable pathways, conduit, and cable support systems shall be complete with bushings, de-burred, cleaned, and secure prior to installation of cable.
- M. Cable will not be installed in the same conduit, duct, or track with line voltage electrical cable.
- N. Each cable run shall be free of splices. No terminations, splices, or equipment will be installed in or above ceilings.
- O. The cable shall not be crushed, deformed, skinned, crimped, twisted, or formed into tight radius bends that could compromise the integrity of the cabling.
- P. Each cable run shall include a three-foot service loop with wire tie located in the ceiling above the control unit panel. This is to allow for future re-termination or repair.
- Q. Provide for adequate ventilation to all equipment housings and take precautions to prevent electromagnetic or electrostatic hum.
- R. All cabling will be placed with regard to the environment, EMI/RFI interference, and its effect on communication signal transmission.
- S. Do not route any cable within two feet of any light fixture, HVAC unit, service access area, electric panel, or any device containing a motor or transformer.
- T. Before energizing the system check all cables for correct connections and test for short circuits, ground faults, continuity, and insulation.
- U. Maximum cable pulling tension should not exceed 25 pound-force (110 N) or the manufactures recommendation, whichever is less.
- V. Any pulling compounds utilized must be approved by the cable manufacturer and shall not degrade the strength or electrical characteristics of the cable.

3.6 TERMINATION PRACTICES

- A. Strip back only as much cable jacket as required to terminate.
- B. Do not "loop" over wiring terminals, the cable could come loose, and the condition not be detected as an open circuit or disconnected device.
- C. Preserve wire twists as closely as possible to point of termination (0.5" maximum) to keep signal impairment to a minimum.
- D. Avoid twisting cable jacket during installation.

3.7 CUTTING AND PATCHING

- A. The building access control system Contractor shall notify the Builder sufficiently ahead of construction of any floors, walls, ceiling, roof, etc., of any openings that will be required for his work.
- B. The Contractor shall see that all sleeves required for his work are set at proper times to avoid delay of the job.
- C. All necessary cutting of walls, floors, partitions, ceilings, etc., as required for the proper installation of the work under this Contract shall be done at the Subcontractor or at the Subcontractor's expense in a neat and workmanlike manner, and as approved by the Owner's Representative.
- D. Patching of openings and/or alterations shall be provided by the building access control system Contractor or at the subcontractor's expense in an approved manner.

- E. No joists, beams, girders, or columns shall be cut by any Contractor without first obtaining written permission of the Owner's Representative.
- F. All openings in firewalls and floors shall be completely sealed after installation for a completely airtight installation. Sealing material shall be non-combustible and UL approved. The installed sealing assembly shall not cause the fire rating of the penetrated structure to be decreased.
- G. All openings in exterior walls shall be sealed watertight.
- H. Seal voids around conduits penetrating fire-rated assemblies and partitions using fire stopping materials and methods in accordance with NFPA and local codes.

3.8 FIRE STOPPING, DRAFT/NOISE STOPPING, PENETRATIONS, AND CORING

- A. UL Listed fire stopping methods that match the fire rating of the wall or floor being penetrated are to be used at all fire barrier penetrations. Seal the interior of the conduit sleeve around the cables and around the outside of the sleeve on each side of the penetration with fire-stop caulk or putty, install according to the manufacturers' instructions.
- B. All penetrations through fire rated walls or floors shall feature a suitable length of metal conduit. Hole diameter shall not exceed 1/2" larger than the conduit or sleeve to be installed. The hole shall be neatly cut, not oversize or irregular. Do not share wall/floor penetrations with ductwork, piping, line voltage electrical conduits, etc.
- C. All gypsum board or plaster penetrations shall tool cut using an appropriate hole saw / mandrel or manufactured assembly.
- D. Draft/Noise Stopping - All penetrations through non-rated walls shall include draft/noise stopping to minimize the transfer of air and sound between enclosed areas. This shall include but not limited to:
 - 1. Neatly cutting all non-rated wall penetrations with a 1" maximum clearance. All gypsum board or plaster penetrations shall be tool cut using an appropriate hole saw / mandrel or manufactured assembly. The hole shall be neatly cut and not oversize or irregular. Do not share wall penetrations with other types of ductwork, piping, line voltage electrical conduits, communications cabling, etc.
 - 2. Provide and install non-combustible mineral wool, fiberglass, cellulose insulation, caulk, and/or sealant as required. Seal the interior of conduit sleeves around the cables and around the outside of the sleeve on each side of the penetration with caulk or putty, install materials according to the manufacturers' instructions.
- E. The Contractor shall make every effort to coordinate with the building Architect, Engineer, Builder and Electrical Contractor to have sleeves placed in new construction so that later coring or drilling of building structural members will not be required. The Contractor must consult with the building Architect, Engineer, and Builder prior to drilling, coring, or sawing of any wall, floor, etc. All penetrations shall be made at approved, appropriate, locations.
- F. Upon approval, the Contractor shall be required to supply all labor, equipment, tools, and materials to create any additional penetrations, and shall provide the sleeve, temporary and final fire stopping. Special care shall be taken not to stress, overheat, or penetrate any building support member. Coring shall be made with equipment appropriate for the dry penetration of concrete and block materials. Under no circumstances shall penetrations be made utilizing a chisel or percussion type equipment. Concrete, block, or plaster cores shall be made by dry saw methods only.

3.9 FINAL OBSERVATION

- A. It shall be the duty of the Contractor to make careful observation of the entire project, assuring themselves that the work on the project is ready for final acceptance before calling upon the Owner's Representative to make a final observation.
- B. To avoid delay of final acceptance of the work, the Contractor shall have all necessary bonds, warranties, receipts, affidavits, et cetera, called for in the various articles of these specifications, prepared and signed in advance, together with a letter of transmittal, listing each paper included, and shall deliver the same to the Owner's Representative at or before the time of said final observation. The

Contractor is cautioned to check over each bond, receipt, et cetera, before preparing for submission to verify that the terms check with the requirements of the specifications.

- C. The following and other provision of Division 1 General Conditions will be required at time of final completion:
 - 1. Final clean up completed.
 - 2. All systems are fully operational, all material and devices installed.
 - 3. As built (as installed) drawings and operations manuals.

3.10 TESTING, WARRANTY SERVICE

- A. A factory trained representative of the manufacturer shall supervise the final connections and testing of the system, and it shall be subject to the final acceptance of the Owner's Representative and the Owner.
- B. This Contractor will thoroughly test all components of the systems and devices proposed herein to assure equipment specifications are met. This Contractor will start up, test, and debug systems to ensure that all aspects of the system are working, documented, and reporting properly.
- C. This Contractor shall make a thorough inspection and test of the complete installed security system including all components and controls to ensure the following:
 - 1. Complete and functional system.
 - 2. Installed in accordance with manufacturer's instructions.
 - 3. Verify proper operation and processing of signals.
- D. The installation will be verified through use of an Acceptance Test Plan (ATP). This test is based upon our standard testing procedures and is modified by Engineering to test the specific functions and requirements of your system.
- E. After completion of the installation, a System Acceptance Test will be performed in the presence of a designated Owner representative. When the system has satisfactorily passed the ATP, then the System Acceptance form will be signed by both our Project Manager and your designated representative. In the event that a system does not pass or only partially passes the Acceptance Test, the Project Manager will file a discrepancy report. Corrected items will be re-tested via a punch list to ensure that they comply with the system requirements.
- F. This Contractor shall provide a warranty of the installed system against defects in material or workmanship for a period of one (1) year from the date of substantial completion. Any equipment or wiring shown to be defective shall be replaced, repaired, or adjusted free of charge. All labor and materials shall be provided at no expense to the Owner. All equipment will carry a one-year warranty or manufacturer's warranty whichever is greater.

3.11 DRAWINGS, MANUALS, AND TRAINING

- A. As-built drawings and operating and maintenance manuals may be electronically transmitted in PDF file format.
- B. Upon completion of the installation, and prior to final inspection, the Contractor shall furnish as-built drawings.
- C. In addition, the Contractor shall furnish complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets. Manuals shall include wiring diagrams to indicate internal wiring for each device and the interconnections between the items of equipment. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system. Provide a parts list with manufacturer and model number for commonly replaced parts. Include complete instructions for the inspection, testing, and maintenance of the system. Include copies of all programming sheets used to configure the system.
- D. Provide the Owner a copy of the panel control software including the licensed program, site specific data file, and passwords that the Owner may require to maintain the system.
- E. Formal on-site training sessions shall be conducted by this Contractor. It shall be the responsibility of this Contractor to coordinate time and location of training sessions with the Owner. Provide documented

general instruction as follows:

1. Provide instruction to the maintenance personnel to include the location, inspection, maintenance, testing, and operation of all system components. Provide a minimum of four (4) hours—two 2-hour sessions separated by a minimum of two weeks.
2. Provide instruction to designated personnel on the functions and operation of the building access system including capabilities, limitations, reporting, monitoring, and the meaning of status messages. State the proper procedure for testing, routine maintenance, and request for service. Provide detailed instruction on the operation of the system including group scheduling, adding users, deleting users, and changing passwords. Provide a minimum of four (4) hours—two 2-hour sessions separated by a minimum of two weeks.

END OF SECTION

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SECTION 28 21 23

VIDEO SURVEILLANCE SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1, apply to this Section.
- B. This specification and the drawings provides requirements for the expansion to an existing, IP based, video surveillance system that shall serve the areas as indicated on the project drawings.
- C. The video surveillance system shall provide for video monitoring and recording of entrances, exits, and sensitive areas.
- D. Provide all equipment, accessories, materials, tools, scaffolding, man lifts, labor, supervision, transportation and services necessary for or incidental to a complete and operating networked IP communication based video surveillance system as shown or indicated on the drawings and/or as specified.
- E. Refer to the video surveillance system schedule on drawings for part numbers and additional information.
- F. Provide, configure for network connection, mount, and align IP network cameras as herein specified and as indicated on the drawings. Existing cameras to remain.
- G. Provide Building Access Control System integration. See Section 28 13 27 - Building Access Control System.
- H. Equipment specified herein is designed to provide specific functional and operational characteristics. It is the responsibility of the Contractor to provide all features and functions as outlined in these specifications.
- I. It is the intent of these specifications to provide complete installations although every item necessary may not be specifically mentioned or shown.
- J. This project shall include preparation of construction plans locating the fire alarm system devices and having the plans reviewed by Owner, the Owner's Representative, and local AHJ for permitting.
- K. Provide all documentation and training as outlined in these specifications.
- L. It shall be the responsibility of the Video Surveillance System Contractor to obtain all required approvals and certifications from authorities having jurisdiction.
- M. It shall be the responsibility of the Division 26 Electrical Contractor to provide:
 - 1. Dedicated 120VAC power to the video surveillance units maximum 20 amps each. Each electrical disconnect device shall be labeled "VIDEO SURVEILLANCE SYSTEM".
 - 2. Provide and install all conduit and standard electrical boxes for the video surveillance system as specified herein. The video surveillance system contractor shall coordinate all conduit and box requirements and locations with, and provide special back boxes to, the electrical contractor prior to installation.
 - 3. Cabling in all open ceiling areas shall be enclosed in conduit.
 - 4. Provide required conduit for accessibility to attic or plenum space.
 - 5. Installation of special back boxes supplied by Division 28 contractor.
 - 6. Provide equipment mounting boards as indicated on the drawings.
 - 7. Provide conduit to remote areas outside of the building as outlined on the drawings.
 - 8. Coordination of requirements of Division 28 with the Builder.

1.2 WORK NOT INCLUDED

- A. Contractors shall make no agreement that obligates the Owner to pay any company providing communications, monitoring, or other services.
- B. Contractors shall not make selection, purchase, or installation of interconnect instruments and/or equipment to be used on this project.

1.3 RELATED SECTIONS

- A. Section 26 00 00 - Electrical
- B. Section 27 10 30 - Data and Telephone Cable Plant
- C. Section 28 13 27 - Building Access Control System

1.4 PRESCRIPTIVE CODES, STANDARDS AND REGULATIONS

- A. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards, except when requirements are exceeded by the contract documents.
- B. In addition to requirements outlined in other sections of the specifications these codes and standards are imposed as applicable to the work in each instance.
- C. The equipment, materials, and installation shall conform to the latest version of all applicable codes, standards and regulations, of authorities having jurisdiction.
- D. Nothing in the Contract Documents shall be construed to permit work not conforming to these codes and standards.
- E. When two or more codes or standards are applicable to the same work, then the stricter code or standard shall govern.
- F. The date of the code or standard is that in effect on the date of issue stated on the contract documents, except when a particular publication date is specified.
- G. The Contractor shall comply with all State, Federal, NFPA, local codes and ordinances that may alter any part of the plans or specifications. The Contractor shall bear all costs for correcting any deficiencies due to non-compliance.
- H. Where local codes and ordinances are not in writing or on record, but local precedence have been set, the Owner shall pay for any additional resulting cost.

1.5 PLANS AND SPECIFICATIONS

- A. The intent of the project drawings is to establish the types of systems and functions, but not to set forth, each item essential to the functioning of the system.
- B. The drawings are generally diagrammatic and show approximate location and extent of work.
- C. Install the work complete including minor details necessary to perform the function indicated. Provide video surveillance systems, including all connections, complete in every respect and ready to operate.
- D. If clarification is needed, consult the Owner's Representative.
- E. Review pertinent drawings and adjust the work to conditions shown. Where discrepancies occur between drawings, specifications, and actual field conditions, immediately notify the Owner's Representative for his interpretation.
- F. The Owner's Representative reserves the right to make any reasonable change in the location of any part of this work without additional cost to the Owner.

1.6 SITE VISIT

- A. Before submitting a proposal, each proposed contractor shall examine all plans and specifications relating to the work, shall visit the site of the project, and become fully informed of the extent and character of the work required, including all required utilities and work to remote areas.
- B. No consideration will be granted for any alleged misunderstanding of the materials to be furnished, or the amount of work to be done. It being fully understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying plans, or required by nature of the site of which may be fairly implied, as essential to the execution and completion of any and all parts of the work.

1.7 SUBMITTALS

- A. Submit a complete submittal package within 30 calendar days after award of this work for approval. Equipment is not to be ordered without approval. Partial submittals are not acceptable for review. Each submittal shall include a dated transmittal.
- B. Submittal shall be electronically transmitted in PDF file format.
- C. For each submittal provide a cover sheet with the name and location of the project, the name, address and telephone number of the Contractor, and the name, address and telephone number of the submitting sub-contractor. Include on or after the cover sheet sufficient space for review stamps.
- D. Quality Assurance Submittal including special boxes, cable, and other material as requested by the Owner's Representative:
 - 1. Letter from manufacturer stating that the Contractor is an Authorized Factory Distributor for the area where the project is located.
 - 2. The Contractor and Manufacturer shall supply sufficient information to indicate that the proposed system is based on the latest hardware, software technology available.
 - 3. Current copy of the Contractors Video Surveillance System Company license issued by the governing authority.
- E. Product Data Submittal including special boxes, cable, and other material as requested by the Owner's Representative including:
 - 1. An indication of any deviations from Contract Document requirements, including variations and limitations. Show any revisions to equipment layout required by use of selected equipment.
 - 2. A product data index and complete equipment list including for each product submitted for approval the manufactures name and part number, including options and selections.
 - 3. Cut-sheets or catalog data illustrating the physical appearance, size, function, compatibility, standards compliance, and other relevant characteristics of each product on the equipment list.
 - 4. Indicate by prominent notation (an arrow, circle, or other means) on each sheet the exact product and options being submitted.
 - 5. Submit design data, when the scope of work requires, including calculations, schematics, risers, sequences, or other data.
 - 6. Resubmittal shall include a complete revised equipment list and any product data that is revised with revision notation and clouded changes.
- F. Shop Drawings Submittal to include:
 - 1. A cover page that includes project name and address, index of drawings, scope of work description, code editions designed under, local AHJ information, a sequence of operation input/output matrix, bill of material, device and cable legends, typical device connections and installation height details, schedules and location map.
 - 2. Produce accurate to scale (min. 1/8" = 1') drawings showing equipment and device layouts prepared using a CAD or BIM engineering drawing program. When CAD background files are not available for existing buildings the Contractor shall inspect the site and collect information to create a floor plan. Walls shall be double line showing the thickness, single line diagrams are not acceptable.
 - 3. Every room shall have a name and number identifying the use of the space with ceiling heights notated for each space or group of spaces throughout the design.

4. Indicate and/or notate door swings, glass walls, half walls, floor to ceiling windows, skylights, and other openings, projections, ceiling features, elevation changes, et cetera that affect the placement of alarm devices.
5. Locate and label all components of the system, label and indicate circuit routing, cable type, and gauge. The system panels location and all device locations shall be clearly identified by symbols matching the symbol legend. The labeling of circuits and devices shall correspond with the riser diagram.
6. Riser diagrams showing all components of the system. Show control panels, power supply panels, and network interfaces. Partial or typical riser diagrams are not acceptable.
7. When multiple buildings make up the system, provide a block diagram of the project site showing all buildings to be covered by the system and detailing the route and type of connection between buildings. Note building entry points, conduit type and size, and routing pathway (underground or over canopy installation).
8. Shop or coordination drawings shall include information that will allow the Contractor to coordinate interdisciplinary work and when necessary guide the manufacturer or fabricator in producing the product.
9. Resubmittals shall include revision notation and clouded changes.

1.8 QUALIFICATIONS OF A PROPOSED CONTRACTOR

- A. Proposed contractors who do not currently possess the necessary qualifications, trained and experienced personnel, financial capacity, and meet the other requirements herein described will be disqualified.
- B. The contractor and employees shall be licensed, by the governing authority, sell, install, and service video surveillance security systems.
- C. The Contractor shall not have any grievances or complaints of record regarding workmanship, code compliance, or service response with a licensing authority. A proposed contractor that has any prior finding(s) of a code or license violation, or has any litigation in process concerning the installation of a system is unacceptable.
- D. The Contractor shall employ full-time, factory-trained, licensed, local technicians and installers for product installation, maintenance, support, service and warranty.
- E. All work associated with the installation of the video surveillance system shall be under the direct supervision of a licensed and factory-trained technician. A certificate of this training shall be provided with the contractor's submittal.
- F. The proposed contractor, as a business entity, shall be an authorized distributor and designated representative of the video surveillance and camera system manufacturer, with full warranty privileges, and shall have been actively engaged in the business of selling, installing, and servicing commercial building video surveillance systems for a period of at least 5 years.
- G. Recently formed companies are acceptable only if specific pre-approval is requested, and granted by the Owner's Representative, based on experience of key personnel, current and completed projects, and all licensing requirements are met ten (10) working days prior to the contract proposal date.
- H. No contract employees are allowed unless they have been to the factory-training school within the last eighteen (18) months. A certificate of this training shall be provided with the Contractors submittal.
- I. The proposed Contractor shall have an office within 150-miles of the job site, staffed with factory-trained technicians who are qualified and licensed to supervise the installation, to be responsible that the system is installed as submitted, to conduct system start up, and perform a 100 percent operational audit of all installed devices. The technicians shall instruct the Owners' representatives in the proper operation of the system, and to provide service throughout the warranty period. The contractor shall be capable of dispatching technicians to repair a system within six (6) hours of a service request.
- J. The proposed contractor shall be fully experienced in the design and installation of the type of security system, herein specified, and shall furnish with the contract proposal an itemized list of the installations of the type specified herein. The list shall include the name of two (2) projects, date of completion, the amount of the contract, the name, and telephone number of a qualified person to contact for reference.

Each reference project listed must utilize equipment by the same manufacturer as the proposed system.

- K. The ability of a proposed Contractor to obtain plans and provide a performance bond shall not be regarded as the sole qualification of the Contractors' competency and responsibility to meet the requirements and obligations of the contract.
- L. The Builder shall be satisfied that a proposed contractor meets all the requirements expressed herein before including the Contractor's proposal in the project.
- M. The Owner's Representative or the Owner may investigate, as they deem necessary, to determine the ability of the proposed Contractor to perform the work. The proposed Contractor shall furnish to the Owner with any information or data requested for this purpose.
- N. The Owner's Representative or the Owner reserves the right to reject any contract proposal if the evidence submitted, or their investigation, fails to indicate that the Contractor is qualified to fulfill of any part of the contract or to complete the work contemplated therein.
- O. The Owner's Representative or the Owner reserves the right to reject the proposal of any Contractor who has previously failed to perform properly, or complete on time, contracts of a similar nature.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide a complete and satisfactorily operating Video Surveillance System as described herein, using materials and equipment of types, sizes, ratings, and performances as indicated. Use materials and equipment that comply with referenced standards and manufacturers' standard design and construction, in accordance with published product information. Coordinate the features of all materials and equipment so they form a functional system, with components and interconnections matched for optimum performance of specified functions.
- B. The system provided shall be fully compatible and integrated with the Owners existing system hardware and software.
- C. Refer to Video Surveillance System schedule on drawings for part numbers and additional information.
- D. All equipment and components shall be installed in strict compliance with manufacturers' recommendations and the requirements of the components UL listing. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, electrical requirements, cable types, and physical equipment sizes, etc., before beginning system installation. Refer to the manufacturers' riser / connection diagrams for all specific system installation/termination/wiring data.
- E. The control units, power supplies, batteries, subassemblies, software, firmware, cable, and all accessories provided shall be listed and labeled by Underwriters Laboratories, Inc. for commercial security system use under the latest appropriate testing standard. Provide all equipment and components required to provide a complete and operating system.
- F. All date keeping hardware, firmware, and software provided shall be fully compliant with the calendar year designated in four-digit date format. Any time equations must function normally, leap year, and daylight savings time must be supported.
- G. The system and all components shall be tested and found suitable for the specified purpose as part of a commercial building security system by a nationally recognized approvals agency acceptable to the AHJ.
- H. All equipment and components shall be new, and the manufacturer's current model. All like devices shall be of the same manufacturer and model number.
- I. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., cameras shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

- J. Equipment devices, make/model numbers, accessories, and comments have been shown on the contract drawings. Specific wiring between equipment has not been shown.

2.2 VIDEO SURVEILLANCE SYSTEM INSTALLATION REQUIREMENTS

- A. Contractor shall provide all material, labor, tools, and equipment required to perform the work described and make complete, safe, and functional systems.
- B. Contractors shall pay for and acquire all permits and inspections required by the Authority Having Jurisdiction and/or other controlling authorities.
- C. All work shall be installed in accordance with state, local, and national codes.
- D. All work shall be done by mechanics skilled in the particular trade involved, under responsible supervision.
- E. Contractors shall warrant his workmanship and materials for a period of one year from the date of acceptance upon completion of the project.
- F. No surface mounted raceway or conduit will be accepted on any new construction job.
- G. Seal all wall and floor penetrations with approved sealant at a fire rating equal to, or better, than the original or current fire rating.
- H. All cabling must be suspended up off the ceiling grid.
- I. The Video Surveillance Contractor shall provide and install all required parts and local cabling to get the system online and operational; this includes power supplies required.
- J. The Video Surveillance Contractor must provide the Owner with all security equipment MAC addresses and network drop information.

2.3 RELATED WORK - NETWORK CONNECTIVITY

- A. The system shall be utilizing the customer's Ethernet system backbone for all security devices communications.
- B. No Ethernet cabling, network RJ-45 jacks, or patch cords are included in the scope of this Specification Section.
- C. The Owner will provide this Contractor with a terminated network drop at security devices, and the required TCP/IP configuration settings: static IP address, domain, gateway, and subnet mask.
- D. This contractor will program and test all video surveillance system devices for connection to the network.
- E. This contractor will provide complete programming of all device parameters in accordance with the Owners requirements.

2.4 ACCEPTABLE MANUFACTURER

- A. Descriptions and details, acceptable manufacturers' names listed, and specific manufacturer and model number items indicated in the plans and specifications shall establish a standard of quality, function, and design. Manufacturers and model numbers listed "no exceptions" shall not be substituted without specific notice in an addendum. Otherwise, where a specific manufacturer's product is indicated, products of other manufacturers listed as acceptable may be submitted for approval based on the substitute product being, in the opinion of the Engineer, of equivalent or better quality than that of the product specified.
- B. Proposed contractors wishing to propose any product substitution must do so in writing to the specifying authority at least ten (10) days prior to the proposal opening.
- C. For manufacturers equipment or models other than that specified, the proposed contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality

of the specified equipment. Proposals must include detailed information showing all deviations from the system as specified.

- D. Substitute products for which the proposed contractor does not obtain prior approval will not be considered acceptable for this project. Final approval of alternate products shall be based on the decision of the Owner and Architect. Prior approval to make a proposal for this project does not automatically insure products will be an acceptable equivalent.
- E. It is the responsibility of the Contractor to provide all features and functions as outlined in these specifications. The functions and features specified are vital to the operation of this facility; therefore, inclusion in the list of acceptable manufacturers does not release the contractor from strict compliance with the requirements of this specification.
- F. The manufacturers model numbers, functions, and features described in this specification section are those of Video Insight with iPro IP Cameras and this shall constitute the quality, compatibility, and performance of the equipment to be furnished, no exceptions.

2.5 LICENSE AND SUPPORT

- A. Provide licensing for software and all new IP cameras.
- B. The VMS manufacturer shall license the software on a per video channel basis only, in such a way that there are no license fees associated with client applications, site installation, user accounts, add-on features or other license fees. The licensing program characteristics are:
 - 1. IP camera license shall not be tied to a hardware address (MAC Address).
 - 2. The VMS Server software shall not be tied to the server hardware.
 - 3. Camera licenses may be moved between servers.
 - 4. All server and camera licenses are moveable without requiring manufacturer action of any type.
 - 5. All VMS Client software modules shall be included in the base VMS software cost.
 - 6. Client applications can be installed an unlimited number of times and may be running simultaneously without additional licensing cost.

2.6 HARDWARE

- A. Utilize Owner furnished data storage devices.

2.7 POLE MOUNTED IP CAMERA SOLUTION

- A. Provide for each pole mounted camera location indicated on the project plans an outdoor rated extended coax solution of IP video cameras and other IP compatible and PoE network devices. The solution shall be the Nitek EtherStretch Pro. The system shall be a Nitek EL1500CWS receiver, NEMA 4X/ IP66 rated weather resistant enclosure (Enclosure size 2.165"H x 5.74"W x 9.92"D), and an indoor transmitter unit set and surge protection. Provide BNC connectors and an indoor/outdoor Aquaseal direct burial rated RG59U coaxial cable (West Penn Wire AC815 RG59/U with West Penn CN-BNC59MCV Universal RG59/U BNC Connectors or equivalent), Coax cable length shall not exceed 500 meters (1,640 feet) and shall transmit IP network signal and PoE power to a network device. The system shall feature auto configuring 10/100Base-TX RJ45 PoE Ethernet ports.
 - 1. Provide a Nitek IP1054 PoE Inserter (48vdc @ 15.4watts) for each location when PoE from the Ethernet Switch is not sufficient.

2.8 12 VDC CAMERA POWER SUPPLY/CHARGERS

- A. Provide general purpose low voltage power supply/chargers as required for CCTV camera power, UL listed and labeled. The filtered and electronically regulated power output supply shall supply up to sixteen (16) individually fused 12 VDC output circuits to provide operating power to the surveillance cameras. The power supply shall provide a minimum total output of 10 amps at 12 VDC with battery backup. Provide a UL listed cabinet suitable for surface mounting. Cabinet dimensions 13" high x 13.5" wide x 3.25" deep. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and a painted standard finish. The back box and door shall be constructed of 0.060" minimum steel with provisions for electrical conduit connections into the sides and top. All components shall be securely mounted, all cable routed, and tie wrapped in a neat, professional manner. Power supply/chargers shall draw up to 1.45 amps at 115VAC / 60Hz input and 12 VDC @ 10-amp continuous supply current to 16

fuse protected regulated 12VDC outputs rated @ 3.5 amperes each. Unit shall include a built-in .7-amp charger for sealed lead acid or gel type batteries. Provide as required Altronix model SMP10PM12P16, or equivalent supervised power supply/chargers, each with two 12VDC/7AH batteries.

2.9 ALL EQUIPMENT SHALL BE LOCATED AND INSTALLED AS FOLLOWS

- A. Mount all equipment firmly in place. Route cable in a professional, neat, and orderly installation.
- B. All equipment shall be placed with regard to the environment, EMI/RFI interference, and its effect on communication signal transmission.
- C. Do not place any equipment within two feet of any light fixture, HVAC unit, service access area, electric panel, or any device containing a motor or transformer.
- D. No terminations, splices, or equipment shall be installed in or above ceilings.
- E. Provide for adequate ventilation for all equipment and take precautions to prevent electromagnetic or electrostatic hum.

PART 3 - EXECUTION

3.1 OPERATION OF NEW EQUIPMENT PRIOR TO PROJECT COMPLETION

- A. When the phasing of a project requires that electronic safety and security systems be operable in certain areas and the Owner needs to operate the equipment the contractor shall make such provisions. The warranty period shall commence on new equipment when it is operated for the beneficial use of the Owner. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, properly adjust, and complete all punch list items before final acceptance by the Owner. In these cases, the date of acceptance and the start of the warranty may be different dates.

3.2 PROTECTION OF EQUIPMENT AND MATERIALS

- A. The Contractor shall take such precautions as may be necessary to protect his apparatus from damage.
- B. This shall include the creation of all required temporary shelters to protect any apparatus above the floor of the construction and the covering of apparatus in the completed building with tarpaulins or other protective covering.
- C. Failure to comply with the above to the satisfaction of the Owner's inspector will be sufficient cause for the rejection of the equipment in question and its complete replacement by the Contractor.

3.3 FINAL OBSERVATION

- A. It shall be the duty of the Contractor to make careful observation of the entire project, assuring themselves that the work on the project is ready for final acceptance before calling upon the Owner's Representative to make a final observation.
- B. To avoid delay of final acceptance of the work, the Contractor shall have all necessary bonds, warranties, receipts, affidavits, etc., called for in the various articles of these specifications, prepared and signed in advance, together with a letter of transmittal, listing each paper included, and shall deliver the same to the Owner's Representative at or before the time of said final observation. The Contractor is cautioned to check over each bond, receipt, etc., before preparing for submission to verify that the terms check with the requirements of the specifications.
- C. The following and other provision of Division 1 General Conditions will be required at time of final completion:
 - 1. Final clean up completed.
 - 2. All systems are fully operational, all material and devices installed.
 - 3. As built (as installed) drawings and operations manuals.

3.4 CUTTING AND PATCHING

- A. The video surveillance system contractor shall notify the Builder sufficiently ahead of construction of any floors, walls, ceiling, roof, etc., of any openings that will be required for his work.
- B. The Contractor shall see that all sleeves required for his work are set at proper times to avoid delay of the job.
- C. All necessary cutting of walls, floors, partitions, ceilings, etc., as required for the proper installation of the work under this Contract shall be done at the Subcontractor or at the Subcontractor's expense in a neat and workmanlike manner, and as approved by the Owner's Representative.
- D. Patching of openings and/or alterations shall be provided by the video surveillance system contractor or at the subcontractor's expense in an approved manner.
- E. No joists, beams, girders, or columns shall be cut by any Contractor without first obtaining written permission of the Owner's Representative.
- F. All openings in firewalls and floors shall be completely sealed after installation for a completely airtight installation. Sealing material shall be non-combustible and UL approved. The installed sealing assembly shall not cause the fire rating of the penetrated structure to be decreased.
- G. All openings in exterior walls shall be sealed watertight.
- H. Seal voids around conduits penetrating fire-rated assemblies and partitions using fire stopping materials and methods in accordance with NFPA and local codes.

3.5 TESTING, WARRANTY, SERVICE

- A. A factory trained representative of the manufacturer shall supervise the final connections and testing of the system and it shall be subject to the final acceptance of the Architect/Engineer and Owner.
- B. The Video Surveillance System Contractor shall make a thorough inspection and test of the complete installed system including all components such as motion detectors, and controls, to ensure the following:
 - 1. Complete and functional system.
 - 2. Installed in accordance with manufacturer's instructions.
 - 3. Confirm at the headend, with an ohmmeter, that each cable run is not open or shorted prior to connection of equipment.
 - 4. Confirm that each camera is located, properly aimed, and focused for the intended coverage area.
 - 5. Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
 - 6. Rectify deficiencies indicated by tests and completely re-test work affected by such deficiencies at Contractor's expense.
 - 7. Verify by the system test that the total system meets the Specifications and complies with applicable standards.
- C. The Contractor shall provide a single written document outlining the warranty of the manufacturers products to be free from defects in materials and workmanship for a period of no less than three (3) years, starting with the date of substantial completion.
- D. The manufacturer shall provide any software maintenance patches and version updates or upgrades at no-additional cost to Owner for a period of at least five (5) years, starting with the date of substantial completion.
- E. The contractor shall provide a warranty of the installed system against defects in material or workmanship for a period of one (1) year from the date of substantial completion. Any equipment or wiring shown to be defective shall be replaced, repaired, or adjusted free of charge. All labor and materials shall be provided at no expense to the Owner. All equipment will carry a one year warranty or manufacturer's warranty whichever is greater.

3.6 DRAWINGS, MANUALS, AND TRAINING

- A. As-built drawings and operating and maintenance manuals may be electronically transmitted in PDF file format (preferred) or paper copies may be provided in quantities indicated in Division 1. Paper copies shall be organized including index tabs in a 3-ring black binder of sufficient size.
- B. Upon completion of the installation, and prior to final inspection, the Contractor shall furnish as-built drawings.
- C. In addition, the contractor shall furnish complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets. Manuals shall include wiring diagrams to indicate internal wiring for each device and the interconnections between the items of equipment. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system. Provide a parts list with manufacturer and model number for commonly replaced parts. Include complete instructions for the inspection, testing, and maintenance of the system. Include copies of all programming sheets used to configure the system.
- D. Provide the Owner a copy of the system software including the licensed program, site specific data file, and passwords that the Owner may require to maintain the system.
- E. Formal on-site training sessions shall be conducted by the Video Surveillance System contractor. It shall be the responsibility of the Contractor to coordinate time and location of training sessions with the Owner. Provide documented general instruction as follows:
 - 1. Provide instruction to the maintenance personnel to include the location, inspection, normal maintenance, testing, and operation of all system components. Provide a minimum of four (4) hours-two 2-hour sessions separated by a minimum of two weeks.
 - 2. Provide instruction to designated personnel on the functions and operation of the system provided including capabilities, limitations, and the meaning of status messages. State the proper procedure for testing, routine maintenance, and request for service. Provide detailed instruction on the operation of the system operation. Provide a minimum of four (4) hours-two 2-hour sessions separated by a minimum of two weeks.

END OF SECTION

SECTION 28 31 24

PREMISES INTRUDER ALARM SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1, apply to this Section.
- B. This specification and the drawings provides requirements for the installation of a new Premises Intruder Alarm System that shall serve the areas as indicated on the project drawings. Provide new cable, new Napco panels and keypads throughout. Utilize existing devices where possible.
- C. Provide all new panels, equipment, materials, labor, software, licensing, supervision, and services necessary for or incidental to the installation of a Premises Intruder Alarm System, as specified and as shown on the contract drawings and schedules. The Intruder Alarm System Contractor shall be responsible for identifying requirements for permits from the Authority Having Jurisdiction (AHJ) for the installation of the premises intruder alarm system specified herein and shall assist the Owner in obtaining the relevant alarm use permits.
- D. Refer to the Premises Intruder Alarm System schedule on drawings for part numbers and additional information.
- E. An Access Control System card reader activation shall disarm the Intruder Alarm System at specific points of entry. Coordinate with the District on the card readers that will disarm the Intrusion Alarm System.
- F. Provide Building Access Control System integration. See Section 28 13 27 - Building Access Control System.
- G. Equipment specified herein is designed to provide specific functional and operational characteristics. It is the responsibility of the Contractor to provide all features and functions as outlined in these specifications.
- H. Furnish and install all equipment, accessories, materials, tools, scaffolding, man lifts, labor, and transportation in accordance with these specifications to provide a complete and operating Premises Intruder Alarm System.
- I. Provide and install, prior to cable installation, plastic snap in bushings at each box opening, passage through a metal stud, and at the end of all open conduit stubs or sleeves to protect the cabling from damage.
- J. It is the intent of the specifications and the drawings to provide a complete installation, although every item necessary may not be specifically mentioned or shown.
- K. This project shall include preparation of construction plans locating the premises intruder alarm system devices and having the plans reviewed by Owner, the Owner's Representative, and local AHJ for permitting.
- L. It shall be the responsibility of this Contractor to obtain all required approvals and certifications from Authorities Having Jurisdiction (AHJ).
- M. It shall be the responsibility of the Electrical contractor to provide and install all conduit systems, standard electrical boxes, and operating power for the Intruder Alarm System as outlined on the project drawings. The Intruder Alarm System Contractor shall coordinate all system requirements with and provide special back boxes to the Electrical Contractor prior to installation of conduit.

- N. The Division 26 Electrical Contractor shall provide:
1. Dedicated 120VAC power to the control units, maximum 20-amps each. Each electrical disconnect device shall be labeled "PREMISE INTRUSION PANEL".
 2. Provide and install all conduit and standard electrical boxes for the premises intruder alarm system as specified herein. The premises intruder alarm system contractor shall coordinate all conduit and box requirements and locations with, and provide special back boxes to, the electrical contractor prior to installation.
 3. Cabling in all open ceiling areas shall be enclosed in conduit.
 4. Provide required conduit for accessibility to attic or plenum space.
 5. Installation of special back boxes supplied by Division 28 contractor.
 6. Provide equipment mounting boards as indicated on the drawings.
 7. Provide conduit to remote areas outside of the building as outlined on the drawings.
 8. Coordination of requirements of Division 28 with the Builder.

1.2 WORK NOT INCLUDED

- A. Contractors shall make no agreement that obligates the Owner to pay any company providing communications, monitoring, or other services.
- B. Contractors shall not make selection, purchase, or installation of interconnect instruments and/or equipment to be used on this project.

1.3 RELATED SECTIONS

- A. Section 26 00 00 - Electrical
- B. Section 28 13 27 - Building Access Control System

1.4 PRESCRIPTIVE CODES, STANDARDS AND REGULATIONS

- A. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards, except when requirements are exceeded by the contract documents.
- B. In addition to requirements outlined in other sections of the specifications these codes and standards are imposed as applicable to the work in each instance.
- C. The equipment, materials, and installation shall conform to the latest version of all applicable codes, standards and regulations, of authorities having jurisdiction.
- D. Nothing in the Contract Documents shall be construed to permit work not conforming to these codes and standards.
- E. When two or more codes or standards are applicable to the same work, then the stricter code or standard shall govern.
- F. The date of the code or standard is that in effect on the date of issue stated on the contract documents, except when a particular publication date is specified.
- G. The Contractor shall comply with all State, Federal, NFPA, local codes and ordinances that may alter any part of the plans or specifications. The Contractor shall bear all costs for correcting any deficiencies due to non-compliance.
- H. Where local codes and ordinances are not in writing or on record, but local precedence have been set, the Owner shall pay for any additional resulting cost.

1.5 PLANS AND SPECIFICATIONS

- A. The intent of the project drawings is to establish the types of systems and functions, but not to set forth, each item essential to the functioning of the system.
- B. The drawings are generally diagrammatic and show approximate location and extent of work.

- C. Install the work complete including minor details necessary to perform the function indicated. Provide premise intruder alarm system, including all connections, complete in every respect and ready to operate.
- D. If clarification is needed, consult the Owner's Representative.
- E. Review pertinent drawings and adjust the work to conditions shown. Where discrepancies occur between drawings, specifications, and actual field conditions, immediately notify the Owner's Representative for his interpretation.
- F. The Owner's Representative reserves the right to make any reasonable change in the location of any part of this work without additional cost to the Owner.

1.6 SITE VISIT

- A. Before submitting a proposal, each proposed contractor shall examine all plans and specifications relating to the work, shall visit the site of the project, and become fully informed of the extent and character of the work required, including all required utilities and work to remote areas.
- B. No consideration will be granted for any alleged misunderstanding of the materials to be furnished, or the amount of work to be done. It being fully understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying plans, or required by nature of the site of which may be fairly implied, as essential to the execution and completion of any and all parts of the work.

1.7 SUBMITTALS

- A. Submit a complete submittal package within 30 calendar days after award of this work for approval. Equipment is not to be ordered without approval. Partial submittals are not acceptable for review. Each submittal shall include a dated transmittal.
- B. Submittal shall be electronically transmitted in PDF file format.
- C. For each submittal provide a cover sheet with the name and location of the project, the name, address and telephone number of the Contractor, and the name, address, and telephone number of the submitting sub-contractor. Include on or after the cover sheet sufficient space for review stamps.
- D. Quality Assurance Submittal:
 - 1. Letter from manufacturer stating that the Contractor is an Authorized Factory Distributor for the area where the project is located.
 - 2. The Contractor and Manufacturer shall supply sufficient information to indicate that the proposed premises intruder alarm system is based on the latest hardware, software technology available.
 - 3. Current copy of the Contractor's Alarm Company license issued by the governing authority.
 - 4. Calculations for device circuit current drop and battery backup calculations.
- E. Product Data Submittal including special boxes, cable, and other material as requested by the Owner's Representative including:
 - 1. An indication of any deviations from Contract Document requirements, including variations and limitations. Show any revisions to equipment layout required by use of selected equipment.
 - 2. A product data index and complete equipment list including for each product submitted for approval the manufactures name and part number, including options and selections.
 - 3. Cut-sheets or catalog data illustrating the physical appearance, size, function, compatibility, standards compliance, and other relevant characteristics of each product on the equipment list.
 - 4. Indicate by prominent notation (an arrow, circle, or other means) on each sheet the exact product and options being submitted.
 - 5. Submit design data, when the scope of work requires, including calculations, schematics, risers, sequences, or other data.
 - 6. If not included in the Shop Drawings, calculations for circuit current drop, conductor size, and battery backup for each unit.
 - 7. Resubmittal shall include a complete revised equipment list and any product data that is revised with revision notation and clouded changes.

- F. Shop Drawings Submittal to include:
1. A cover page that includes project name and address, index of drawings, scope of work description, code editions designed under, local AHJ information, a sequence of operation Input/Output matrix, bill of material, device and cable legends, typical device connections and installation height details, schedules, and location map.
 2. Produce accurate to scale (min. 1/8" = 1') drawings showing equipment and device layouts prepared using a CAD or BIM engineering drawing program. When CAD background files are not available for existing buildings the Contractor shall inspect the site and collect information to create a floor plan. Walls shall be double line showing the thickness, single line diagrams are not acceptable.
 3. Every room shall have a name and number identifying the use of the space with ceiling heights notated for each space or group of spaces throughout the design.
 4. Indicate and/or notate door swings, glass walls, half walls, floor to ceiling windows, skylights, and other openings, projections, ceiling features, elevation changes, et cetera that affect the placement of alarm devices.
 5. Locate and label all components of the system, label and indicate circuit routing, cable type, and gauge. The system's panel locations, and all device locations shall be clearly identified by symbols matching the symbol legend. The labeling of circuits and devices shall correspond with the riser diagram.
 6. Riser diagrams showing all components of the system. Show control panels, power supply panels, and network interfaces. Partial or typical riser diagrams are not acceptable.
 7. If not included in the Product Data Submittal, include calculations device circuit current drop, conductor size, and battery backup for all panels.
 8. When multiple buildings make up the system, provide a block diagram of the project site showing all buildings to be covered by the system and detailing the route and type of connection between buildings. Note building entry points, conduit type and size, and routing pathway (underground or over canopy installation).
 9. Shop or coordination drawings shall include information that will allow the Contractor to coordinate interdisciplinary work and when necessary guide the manufacturer or fabricator in producing the product.
 10. Resubmittals shall include revision notation and clouded changes.

1.8 QUALIFICATIONS OF A PROPOSED CONTRACTOR

- A. Proposed contractors who do not currently possess the necessary qualifications, trained and experienced personnel, financial capacity, hold required current licenses, or meet the other requirements herein described will be disqualified.
- B. The contractor and employees shall be licensed by the governing authority to sell, install, and service premises intruder alarm systems.
- C. The Contractor shall not have any grievances or complaints of record regarding workmanship, code compliance, or service response with a licensing authority. A proposed contractor that has any prior finding(s) of a code or license violation or has any litigation in process concerning the installation of a premises intruder alarm system is unacceptable.
- D. The Contractor shall employ full-time, factory-trained, licensed, local technicians and installers for product installation, maintenance, support, service and warranty.
- E. All work associated with the installation of the premises intruder alarm system shall be under the direct supervision of a licensed and factory-trained technician. A certificate of this training shall be provided with the contractor's submittal.
- F. The proposed contractor, as a business entity, shall be an authorized distributor and designated representative of the premises intruder alarm system manufacturer, with full warranty privileges, and shall have been actively engaged in the business of selling, installing, and servicing commercial premises intruder alarm systems for a period of at least five (5) years.
- G. Recently formed companies are acceptable only if specific pre-approval is requested, and granted by the Owner's Representative, based on experience of key personnel, current and completed projects, and all

licensing requirements are met ten (10) working days prior to the contract proposal date.

- H. No contract employees are allowed unless they have been to the factory training school within the last 18 months. A certificate of this training shall be provided with the Contractors submittal.
- I. The proposed Contractor shall have an office within 150-miles of the job site, staffed with factory-trained technicians who are qualified and licensed to supervise the installation, to be responsible that the system is installed as submitted, to conduct system start up, and perform a 100 percent operational audit of all installed devices. The technicians shall instruct the Owners' representatives in the proper operation of the premises intruder alarm system, and to provide service throughout the warranty period. The contractor shall be capable of dispatching technicians to repair a premises intruder alarm system within six (6) hours of a service request.
- J. The proposed contractor shall be fully experienced in the design and installation of the type of security premises intruder alarm system, herein specified, and shall furnish with the contract proposal an itemized list of the installations of the type specified herein. The list shall include the name of two (2) projects, date of completion, the amount of the contract, the name, and telephone number of a qualified person to contact for reference. Each reference project listed must utilize equipment by the same manufacturer as the proposed premises intruder alarm system.
- K. The ability of a proposed Contractor to obtain plans and provide a performance bond shall not be regarded as the sole qualification of the Contractors' competency and responsibility to meet the requirements and obligations of the contract.
- L. The Builder shall be satisfied that a proposed Contractor meets all the requirements expressed herein before including the Contractor's proposal in the project.
- M. The Owner's Representative or the Owner may investigate, as they deem necessary, to determine the ability of the proposed Contractor to perform the work. The proposed Contractor shall furnish to the Owner with any information or data requested for this purpose.
- N. The Owner's Representative or the Owner reserves the right to reject any contract proposal if the evidence submitted, or their investigation, fails to indicate that the Contractor is qualified to fulfill of any part of the contract or to complete the work contemplated therein.
- O. The Owner's Representative or the Owner reserves the right to reject the proposal of any Contractor who has previously failed to perform properly, or complete on time, contracts of a similar nature.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide a complete and satisfactorily operating Premises Intruder Alarm System as described herein, using materials and equipment of types, sizes, ratings, and performances as specified. Use materials and equipment that comply with referenced standards and manufacturers' standard design and construction, in accordance with published product information. Coordinate the features of all materials and equipment so they form a functional premises intruder alarm system, with components and interconnections matched for optimum performance of specified functions.
- B. Refer to Premises Intruder Alarm System schedule on drawings for part numbers and additional information.
- C. All equipment and components shall be installed in strict compliance with manufacturers' recommendations and the requirements of the components UL listing. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, electrical requirements, cable types, and physical equipment sizes, etc., before beginning premises intruder alarm system installation. Refer to the manufacturers' riser / connection diagrams for all specific premises intruder alarm system installation/termination/wiring data.
- D. The control units, power supplies, batteries, subassemblies, software, firmware, cable, and all accessories provided shall be listed and labeled by Underwriters Laboratories, Inc. for commercial

premises intruder alarm system use under the latest appropriate testing standard. Provide all equipment and components required to provide a complete and operating premises intruder alarm system.

- E. All date keeping hardware, firmware, and software provided shall be fully compliant with the calendar year designated in four-digit date format. Any time equations must function normally, leap year, and daylight savings time must be supported.
- F. The premises intruder alarm system and all components shall be tested and found suitable for the specified purpose as part of a commercial building premises intruder alarm system by a nationally recognized approvals agency acceptable to the AHJ.
- G. All equipment and components shall be new, and the manufacturer's current model. All like devices shall be of the same manufacturer and model number.
- H. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.
- I. Equipment devices, make/model numbers, accessories, and comments have been shown on the contract drawings. Specific wiring between equipment has not been shown.

2.2 PREMISES INTRUDER ALARM SYSTEM INSTALLATION REQUIREMENTS

- A. Contractors shall provide all material, labor, tools, and equipment required to perform the work described and make complete, safe, and functional premises intruder alarm system.
- B. Contractors shall pay for and acquire all permits and inspections required by the Authority Having Jurisdiction and/or other controlling authorities.
- C. All work shall be installed in accordance with state, local, and national codes.
- D. All work shall be done by mechanics skilled in the particular trade involved, under responsible supervision.
- E. Contractors shall warrant his workmanship and materials for a period of one year from the date of acceptance upon completion of the project.
- F. No surface mounted raceway or conduit will be accepted on any new construction job.
- G. Seal all wall and floor penetrations with approved sealant at a fire rating equal to, or better, than the original or current fire rating.
- H. All cabling must be suspended up off the ceiling grid.
- I. The Premises Intruder Alarm System Contractor shall provide and install all required parts and local cabling to get the premises intruder alarm system online and operational; this includes power supplies required to operate the electrified exit devices.
- J. The Premises Intruder Alarm System Contractor must provide the Owner with all security equipment MAC addresses and network drop information.
- K. The Electrical Contractor shall provide 110-volt electrical connection to accommodate control panels, expansion panels, power supplies of the premises intruder alarm system.

2.3 RELATED WORK - NETWORK CONNECTIVITY

- A. The premises intruder alarm system shall be utilizing the customer's existing Ethernet system backbone for all security devices communications.
- B. No Ethernet cabling, network RJ-45 jacks, or patch cords are included in the scope of this Specification Section.

- C. The Owner will provide this Contractor with a terminated network drop at security devices, and the required TCP/IP configuration settings: static IP address, domain, gateway, and subnet mask.
- D. This contractor will program and test all premises intrusion system devices for connection to the network.
- E. This contractor will provide complete programming of all device parameters in accordance with the Owners requirements.

2.4 ACCEPTABLE MANUFACTURERS

- A. Descriptions and details, acceptable manufacturers` names listed, and specific manufacturer and model number items indicated in the plans and specifications shall establish a standard of quality, function, and design. Manufacturers and model numbers listed "no exceptions" shall not be substituted without specific notice in an addendum. Otherwise, where a specific manufacturer`s product is indicated, products of other manufacturers listed as acceptable may be submitted for approval based on the substitute product being, in the opinion of the Owner's Representative, of equivalent or better quality than that of the product specified.
- B. Proposed contractors wishing to propose any product substitution must do so in writing to the specifying authority at least ten (10) days prior to the proposal opening.
- C. For manufacturers' equipment or models other than that specified, the proposed contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment. Proposals must include detailed information showing all deviations from the system as specified.
- D. Substitute products for which the proposed contractor does not obtain prior approval will not be considered acceptable for this project. Final approval of alternate products shall be based on the decision of the Owner and Owner's Representative. Prior approval to make a proposal for this project does not automatically ensure products will be an acceptable equivalent.
- E. It is the responsibility of the Contractor to provide all features and functions as outlined in these specifications. The functions and features specified are vital to the operation of this facility; therefore, inclusion in the list of acceptable manufacturers does not release the contractor from strict compliance with the requirements of this specification.
- F. The model numbers used in this specification are those of NAPCO Security Systems, this shall constitute the quality, compatibility, features, and performance of the equipment to be furnished, no exceptions.

2.5 KEYPADS

- A. Provide remote alphanumeric LCD keypads for arming and disarming the Intruder Alarm System. Locate as indicated on plans.
- B. Each keypad shall feature a 16-character LCD display to provide individual zone alarm display with English language zone descriptions and status messages.
- C. Each keypad shall include a built-in audible signal and programmable panic switches.
- D. Keypads shall be surface mounted and include a built-in tamper switch for supervision. Keypads shall feature an addressable four-wire connection to the control panel and shall not require an individual home run to the panel for each keypad.

2.6 PREMISES INTRUDER ALARM SYSTEM INTEGRATION

- A. When a valid credential is read requesting access to an ARMED zone of the Premises Intruder Alarm System, access shall be DENIED unless all of the following conditions are met:
 - 1. The controlled entry is located at a Premises Intruder Alarm System keypad.
 - 2. The credential holder is in an access group authorized for armed Premises Intruder Alarm System zone access.

3. The time and day match the group schedule are for armed Premises Intruder Alarm System zone access.

- B. When the Premises Intruder Alarm System zone is armed, the door contacts or motion sensors shall initiate an alarm condition, activate the local siren, log the event, and transmit the alarm to the security system monitoring service. The monitoring service will then alert security personnel or the police to evaluate the situation.

2.7 LOCAL AUDIBLE ALARM SIGNAL (SIREN)

- A. Audible alarm shall be an electronic siren with tamper and weatherproof enclosure. Interior alarms shall be mounted concealed above the lay-in ceiling or as required.
- B. The siren tone produced shall be distinctly different from the building fire alarm or other local emergency signals.
- C. For outdoor locations, provide a heavy gauge steel enclosure with baked enamel textured finish. Enclosure shall feature two built-in tamper switches and a silicon fiber screen foam inhibiting device.

2.8 DOOR SWITCHES

- A. Provide door switches as indicated on floor plans with conduit run to a nearby, accessible, junction box located concealed above finished ceiling. Door switches shall be dual contact double pole-double throw (DPDT) switches with wire leads to provide support both access and security system connections.
- B. Overhead doors/roof hatches provide industrial wide gap surface mount magnetic contacts, aluminum housing armored cable, wide gap, 1.5" gap size, DPDT or as required.

2.9 MOTION DETECTORS

- A. Provide dual technology, false alarm resistant - passive infrared and microwave sensors, surface, wall, or ceiling mount with brackets as required. All motion detectors shall combine heat and motion sensitive detection technologies, alarm activation only upon simultaneous activation of both fields of protection.

2.10 COMBINATION GLASS BREAK SENSOR/MOTION DETECTORS

- A. Provide 6-conductor, three circuit wired ceiling-mount combination passive infrared motion detectors with an integral glass break detector in one housing. The PIR element shall be a 360° pattern quad element with microprocessor-based multi-level signal processing and specially designed lenses to deliver superior premises intruder detection and reliable long-term operation while minimizing false alarms. Detectors shall have form `A` alarm contact (motion), form `C` contact (glass break).

2.11 EMERGENCY/PANIC SWITCHES

- A. Provide only where indicated on plans emergency/panic/hold up switches. This type switch shall include a mechanical guard to prevent false alarms and shall be located as indicated on the drawings. Coordinate final location with the Owner's Representative or Owner.

2.12 AUXILIARY POWER SUPPLY

- A. Provide as required auxiliary power supply(s) with battery backup, UL listed and labeled for alarm systems.
- B. The filtered and electronically regulated power output supply/charger and batteries shall supply additional power limited 12/24 VDC operating and emergency power to the premises intruder alarm system when the load from detectors or local alarms exceeds the capability of the power supply built in the main panel. Power supply shall provide a minimum output of 4 amps at 12 VDC. Provide AC power failure and low battery reporting. Provide low battery disconnection. Standby battery operation time shall equal or exceed the standby operation time of the main panel, in any case provide a minimum of 12-amp hours battery backup.

- C. Provide a UL listed cabinet suitable for surface mounting. The cabinet shall provide storage for backup batteries. The door shall provide a key lock to premises intruder alarm system components. The cabinet shall be attack resistant and fitted with front and back tamper switches. All components shall be securely mounted, all cable routed, and tie wrapped in a neat, professional manner.
- D. Electrical Contractor to provide power through a 120 VAC, 20-amp breaker.

2.13 CABLE

- A. All wiring shall be NEC type CMP (plenum rated) or equivalent rating low voltage cable.
- B. All exterior cabling shall be exterior/underground rated and installed in threaded rigid metallic conduit.
- C. Avoid if at all possible, junctions or splicing - all junctions in cable shall be made by proper splicing techniques in a junction box.
- D. All cabling is to be concealed where construction permits.
- E. This contractor shall provide and install new and unused ASTM bare stranded copper conductor wire per ANSI/NEMA codes. Follow the manufacturer's instructions. All wire shall be the type recommended by the manufacturer for Intruder Alarm System applications.
- F. All cable shall have a machine printed label located within 2" from every terminal block and within 6" from all other connections utilizing self-laminating flexible vinyl film labels.
- G. Wire gauge shall be selected per circuit based on cable length and current requirements.

2.14 CABLE TIES

- A. HALAR Fluoropolymer plenum rated cable ties shall be furnished and installed to attach wire bundles to supports and for appropriate wire management as required.

2.15 BUSHINGS

- A. Provide a plastic snap in bushing at each box opening, passage through a metal stud, and at the end of all open conduit stubs or sleeves prior to cable installation to protect the cabling from damage.

2.16 CEILING MOUNTED DEVICE BOX HANGERS

- A. All ceiling mounted devices including when mounted in a drop ceiling shall be supported by an electrical box hanger. Box hangers shall be attached to the ceiling grid only for lateral stabilization, separate support wires shall be provided. The required support wires for the ceiling grid or light fixtures shall not be utilized. The backbox shall be flush and level with the bottom of the ceiling tile and the hole neatly cut for a finished appearance when the device is installed.
- B. Device and box hanger assemblies shall not be supported solely by suspended ceilings. Fasteners and supports shall be adequate to support the required load.

2.17 J-HOOKS

- A. Attachments for cabling support shall be spaced at approximately 48 to 60 inches on center. The cable bundle shall not be allowed to sag more than 12 inches mid-span between attachments. Attachments shall be sized as recommended by the manufacturer. Single cables or bundles up to four cables may be supported directly by the building structure.
- B. Do not mix different signal strength cables on the same J-Hook (i.e. security/fire alarm system cable with telephone/data cable).

2.18 SURGE AND AMPERAGE PROTECTION

- A. Electrical surge protection shall be provided for all service entrance connections that power control panels, power supply panels, etc. Each copper pair that connects one building to another (i.e., any other

portion of a building complex not under one continuous roof) at both exit points, shall be protected by surge devices, to prevent damage to equipment.

- B. Security system circuit surge protectors shall be mounted in a standard grounded metallic electric box and be of the type with a permanently mounted base and a removeable/plug in type surge suppression device.

PART 3 - EXECUTION

3.1 PROJECT SEQUENCE OF OPERATION

- A. The premises intruder alarm system sequence of operation for this project shall be coordinated with the Owners requirements, but as a minimum shall include two partitions, the first the main building partition and the second being the kitchen/food storage area.

3.2 OPERATION OF NEW EQUIPMENT PRIOR TO PROJECT COMPLETION

- A. When the phasing of a project requires that electronic safety and security system be operable in certain areas and the Owner needs to operate the equipment the contractor shall make such provisions. The warranty period shall commence on new equipment when it is operated for the beneficial use of the Owner. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, properly adjust, and complete all punch list items before final acceptance by the Owner. In these cases, the date of acceptance and the start of the warranty may be different dates.

3.3 PROTECTION OF EQUIPMENT AND MATERIALS

- A. The Contractor shall take such precautions as may be necessary to protect his apparatus from damage.
- B. This shall include the creation of all required temporary shelters to protect any apparatus above the floor of the construction and the covering of apparatus in the completed building with tarpaulins or other protective covering.
- C. Failure to comply with the above to the satisfaction of the Owner's inspector will be sufficient cause for the rejection of the equipment in question and its complete replacement by the Contractor.

3.4 FINAL OBSERVATION

- A. It shall be the duty of the Contractor to make careful observation of the entire project, assuring themselves that the work on the project is ready for final acceptance before calling upon the Owner's Representative to make a final observation.
- B. To avoid delay of final acceptance of the work, the Contractor shall have all necessary bonds, warranties, receipts, affidavits, et cetera, called for in the various articles of these specifications, prepared and signed in advance, together with a letter of transmittal, listing each paper included, and shall deliver the same to the Owner's Representative at or before the time of said final observation. The Contractor is cautioned to check over each bond, receipt, et cetera, before preparing for submission to verify that the terms check with the requirements of the specifications.
- C. The following and other provision of Division 1 General Conditions will be required at time of final completion:
 - 1. Final clean up completed.
 - 2. All systems are fully operational, all material and devices installed.
 - 3. As built (as installed) drawings and operations manuals.

3.5 CUTTING AND PATCHING

- A. The Premises Intruder Alarm System contractor shall notify the Builder sufficiently ahead of construction of any floors, walls, ceiling, roof, etc., of any openings that will be required for his work.

- B. The Contractor shall see that all sleeves required for his work are set at proper times to avoid delay of the job.
- C. All necessary cutting of walls, floors, partitions, ceilings, etc., as required for the proper installation of the work under this Contract shall be done at the Subcontractor or at the Subcontractor's expense in a neat and workmanlike manner, and as approved by the Owner's Representative.
- D. Patching of openings and/or alterations shall be provided by the Premises Intruder Alarm System contractor or at the subcontractor's expense in an approved manner.
- E. No joists, beams, girders, or columns shall be cut by any Contractor without first obtaining written permission of the Owner's Representative.
- F. All openings in firewalls and floors shall be completely sealed after installation for a completely airtight installation. Sealing material shall be non-combustible and UL approved. The installed sealing assembly shall not cause the fire rating of the penetrated structure to be decreased.
- G. All openings in exterior walls shall be sealed watertight.
- H. Seal voids around conduits penetrating fire-rated assemblies and partitions using fire stopping materials and methods in accordance with NFPA and local codes.

3.6 CABLE ROUTING, INSTALLATION, AND SUPPORT

- A. System wiring and equipment installation shall be in accordance with good engineering practices as established by NEC, NFPA, and all applicable codes and standards. Wiring shall meet all state and local electrical code requirements.
- B. All cable shall have a label on both ends utilizing self-laminating, flexible vinyl film, non-smear, machine printed labels.
- C. All conduit, ducts, track, and raceways shall be supported from the structure at industry standard intervals for the size specified, utilizing proper anchoring devices. Cable fill may not exceed the manufacturers' instructions for each type of support.
- D. Mount all equipment firmly in place such that vibration or jarring will not interfere with system operation. Route cable in a professional, neat, and orderly installation.
- E. Cables shall be run in bundles above accessible ceilings and supported from building structure by j-hooks, conduit, or cable tray. Cabling shall be loosely bundled with cable ties randomly spaced at 30 to 48 inches on center, cable ties shall not be tight enough to deform cabling and shall not be used to support the cabling.
- F. Support shall be provided by mounting appropriate fasteners that may be loaded with multiple cables. If the weight load is carried by the support rod or wire, the support assembly may attach to the ceiling grid for lateral stabilization. The required support wires for the ceiling grid or light fixtures shall not be utilized. Any fastener attached to the ceiling grid shall not interfere with inserting or removing ceiling tiles. The cable pathway of supports must be positioned at least 12 inches above the ceiling grid.
- G. Do not attach any supports to joist bridging or other lightweight members. The support system shall provide a protective pathway to eliminate stress that could damage the cabling.
- H. Cable must not be fastened to electrical conduits, mechanical ductwork / piping, sprinkler pipes, or routed to obstruct access to hatches, doors, utility access panels, or service work areas. Do not route cables through fire doors, ventilation shafts, grates, or parallel for more than four-feet with line voltage electrical conductors. Cables shall not be run loose on ceiling grid or ceiling tiles.
- I. In all exposed areas, premises intruder alarm system cable shall be fully enclosed in conduit.
- J. Cables shall be run in conduit stubs from wall boxes to accessible areas above finished ceilings. Conduit shall be required only within walls and concealed spaces to provide access. Provide bushings to protect

the cable from damage for conduit ends, box openings, and passage through metal studs.

- K. All conduit, duct, track, and raceway runs shall be spaced apart to allow for maintenance, such as the installation of couplings, without disturbing adjacent pathways.
- L. Cable pathways, conduit, and cable support systems shall be complete with bushings, de-burred, cleaned, and secure prior to installation of cable.
- M. Cable will not be installed in the same conduit, duct, or track with line voltage electrical cable.
- N. Each cable run shall be free of splices. No terminations, splices, or equipment will be installed in or above ceilings.
- O. The cable shall not be crushed, deformed, skinned, crimped, twisted, or formed into tight radius bends that could compromise the integrity of the cabling.
- P. Each cable run shall include a three-foot service loop with wire tie located in the ceiling above the control unit panel. This is to allow for future re-termination or repair.
- Q. Provide for adequate ventilation to all equipment housings and take precautions to prevent electromagnetic or electrostatic hum.
- R. All cabling will be placed with regard to the environment, EMI/RFI interference, and its effect on communication signal transmission.
- S. Do not route any cable within two feet of any light fixture, HVAC unit, service access area, electric panel, or any device containing a motor or transformer.
- T. Before energizing the premises intruder alarm system check all cables for correct connections and test for short circuits, ground faults, continuity, and insulation.
- U. Maximum cable pulling tension should not exceed 25 pound-force (110 N) or the manufactures recommendation, whichever is less.
- V. Any pulling compounds utilized must be approved by the cable manufacturer and shall not degrade the strength or electrical characteristics of the cable.

3.7 TERMINATION PRACTICES

- A. Strip back only as much cable jacket as required to terminate.
- B. Do not "loop" over wiring terminals, the cable could come loose, and the condition not be detected as an open circuit or disconnected device.
- C. Preserve wire twists as closely as possible to point of termination (0.5" maximum) to keep signal impairment to a minimum.
- D. Avoid twisting cable jacket during installation.

3.8 FIRE STOPPING, DRAFT/NOISE STOPPING, PENETRATIONS, AND CORING

- A. UL Listed fire stopping methods that match the fire rating of the wall or floor being penetrated are to be used at all fire barrier penetrations. Seal the interior of the conduit sleeve around the cables and around the outside of the sleeve on each side of the penetration with fire-stop caulk or putty, install according to the manufacturers' instructions.
- B. All penetrations through fire rated walls or floors shall feature a suitable length of metal conduit. Hole diameter shall not exceed 1/2" larger than the conduit or sleeve to be installed. The hole shall be neatly cut and not oversize or irregular. Do not share wall/floor penetrations with ductwork, piping, line voltage electrical conduits, et cetera.
- C. All gypsum board or plaster penetrations shall tool cut using an appropriate hole saw / mandrel or manufactured assembly.

- D. Draft/Noise Stopping - All penetrations through non-rated walls shall include draft/noise stopping to minimize the transfer of air and sound between enclosed areas. This shall include but not limited to:
 - 1. Neatly cutting all non-rated wall penetrations with a 1" maximum clearance. All gypsum board or plaster penetrations shall be tool cut using an appropriate hole saw / mandrel or manufactured assembly. The hole shall be neatly cut and not oversize or irregular. Do not share wall penetrations with other types of ductwork, piping, line voltage electrical conduits, communications cabling, etc.
 - 2. Provide and install non-combustible mineral wool, fiberglass, cellulose insulation, caulk, and/or sealant as required. Seal the interior of conduit sleeves around the cables and around the outside of the sleeve on each side of the penetration with caulk or putty, install materials according to the manufacturers' instructions.
- E. The Contractor shall make every effort to coordinate with the building Architect, Engineer, Builder, and Electrical Contractor to have sleeves placed in new construction so that later coring or drilling of building structural members will not be required. The Contractor must consult with the building Architect, Engineer, and Builder prior to drilling, coring, or sawing of any wall, floor, et cetera. All penetrations shall be made at approved, appropriate, locations.
- F. Upon approval, the contractor shall be required to supply all labor, equipment, tools, and materials to create any additional penetrations, and shall provide the sleeve, temporary and final fire stopping. Exceptional care shall be taken not to stress, overheat, or penetrate any building support member. Coring shall be made with equipment appropriate for the dry penetration of concrete and block materials. Under no circumstances shall penetrations be made utilizing a chisel or percussion type equipment. Concrete, block, or plaster cores shall be made by dry saw/core methods only.

3.9 TESTING, WARRANTY, SERVICE

- A. A factory trained representative of the manufacturer shall supervise the final connections and testing of the system and it shall be subject to the final acceptance of the Owner's Representative and Owner.
- B. The Intruder Alarm System Contractor shall make a thorough inspection and test of the complete installed Intruder Alarm System including all components such as motion detectors, and controls, to ensure the following:
 - 1. Complete and functional premises intruder alarm system.
 - 2. Installed in accordance with manufacturer's instructions.
 - 3. Confirm at the panel, with an ohmmeter, that each zone has an end of line resistor properly installed.
 - 4. Each of the alarm conditions that the system is required to detect should be introduced on the system, including disconnection to the telephone line.
 - 5. A walk test to confirm that each detector is located and properly aimed for the intended coverage area.
 - 6. Verify that all tripped devices display the correct zone identification at the keypads.
 - 7. Verify the proper processing of the signal at the panel and the correct activation of local alarms and the digital communicator.
- C. The contractor shall provide a warranty of the installed premises intruder alarm system against defects in material or workmanship for a period of one (1) year from the date of substantial completion. Any equipment or wiring shown to be defective shall be replaced, repaired, or adjusted free of charge. All labor and materials shall be provided at no expense to the Owner. All equipment will carry a one-year warranty or manufacturer's warranty whichever is greater.

3.10 DRAWINGS, MANUALS, AND TRAINING

- A. As-built drawings and operating and maintenance manuals shall be electronically transmitted in PDF file format.
- B. Upon completion of the installation, and prior to final inspection, the Contractor shall furnish as-built drawings.
- C. In addition, the contractor shall furnish complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets. Manuals shall include wiring diagrams to indicate internal wiring for each device and the interconnections between the items of equipment.

Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system. Provide a parts list with manufacturer and model number for commonly replaced parts. Include complete instructions for the inspection, testing, and maintenance of the system. Include copies of all programming sheets used to configure the system.

- D. Provide the Owner a copy of the panel control software including the licensed program, site specific data file, and passwords that the Owner may require to maintain the system.
- E. Formal on-site training sessions shall be conducted by the Intruder Alarm System contractor. It shall be the responsibility of the Contractor to coordinate time and location of training sessions with the Owner. Provide documented general instruction as follows:
 - 1. Provide instruction to the maintenance personnel to include the location, inspection, maintenance, testing, and operation of all system components. Provide a minimum of four (4) hours—two 2-hour sessions separated by a minimum of two weeks.
 - 2. Provide instruction to designated personnel on the functions and operation of the Intruder Alarm System including zoning, capabilities, limitations, monitoring, and the meaning of status messages. State the proper procedure for testing, routine maintenance, and request for service. Provide detailed instruction on the operation of the keypad including arming, disarming, adding users, deleting users, and changing passwords. Provide a minimum of four (4) hours—two 2-hour sessions separated by a minimum of two weeks.

END OF SECTION

SECTION 28 46 21

FIRE DETECTION AND ALARM SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1, apply to this Section.
- B. This specification and the drawings provides requirements for the installation of a new addressable fire detection and alarm system with voice evacuation notification. Remove the fire detection and alarm system from the existing high school. Install a new fire detection and alarm system to the entire building. This work does not include the Athletic Complex or portables. The specification reflects the intent of the design and installation.
- C. The Athletic Complex and portables fire detection and alarm system shall be connected to the High School fire detection and alarm system. Activation of an alarm, supervisory, or trouble condition shall report to the High School main FACP. An alarm condition at the High School FACP shall activate an alarm condition at the Athletic Complex and portables.
- D. Remove the entire existing fire alarm system including the panel, power supplies, cabling and all devices including, but not limited to, door hold open devices, auxillary relays, remote indicator/test devices, tamper/damage covers, unused raceways/conduits, etc.
- E. Refer to the Fire Detection and Alarm System schedule on the drawings for part numbers and additional information.
- F. Provide Emergency Responder Radio Coverage System integration. See Section 28 05 44 - Emergency Responder Radio Coverage System.
- G. Equipment specified herein is designed to provide specific functional and operational characteristics. It is the responsibility of the Contractor to provide all features and functions as outlined in these specifications.
- H. Furnish and install all equipment, accessories, materials, tools, scaffolding, man lifts, labor and transportation in accordance with these specifications to provide a complete and operating fire alarm system.
- I. It is the intent of these specifications and drawings to provide complete installations although every item necessary may not be specifically mentioned or shown.
- J. This project shall include preparation of construction plans locating the fire alarm system devices and having the plans reviewed by the Engineer, Owner, and local AHJ for permitting.
- K. It shall be the responsibility of this Contractor to obtain all required approvals, permits, and certifications from Authorities Having Jurisdiction (AHJ).
- L. The Division 26 Electrical Contractor shall provide:
 - 1. Dedicated 120VAC power to the fire alarm control units maximum 20 amps each. Each electrical disconnect device shall be labeled "FIRE ALARM". An access key to the disconnect device shall be stored in the fire alarm control panel. Secure disconnect in the "ON" position with a lockout clip, Space Age Electronics model Elock or equivalent.
 - 2. Provide and install all conduit and standard electrical boxes for the fire alarm system as specified herein. The fire alarm contractor shall coordinate all conduit and box requirements and locations with, and provide special back boxes to, the electrical contractor prior to installation.
 - 3. Cabling in all open ceiling areas shall be enclosed in conduit.
 - 4. Provide required conduit for accessibility to attic or plenum space.

5. Installation of special back boxes supplied by Division 28 contractor.
 6. Provide equipment mounting boards as indicated on the drawings.
 7. Provide utility services conduit as outlined on the drawings.
 8. Coordination of requirements of Division 28 with the Builder.
- M. Fire safety control devices and equipment installed by others:
1. Include any function that is designed to make the building occupants safer from the impact of fire and smoke during evacuation. For each controlled device, the contractor providing the device shall wire it internally for fail-safe shut-down and provide a labeled 3' coil of cable outside the unit to allow the fire alarm contractor to make final connection to the controlling relay. These may include but are not limited to:
 - a. Fire/smoke curtains, shutters and doors.
 - b. Air handler shutdown.
 - c. Fire/smoke damper control.
 - d. Elevator fire service functions and cab recall.
 - e. Automatic door unlocking.
 2. Each Fire Safety Control Function circuit controlled device shall be configured such that when the fire alarm system safety control circuit is re-energized, by the fire alarm control panel, the device shall return to normal operation (e.g. re-start or be ready to re-start) without a need for manual or environmental control system intervention. Line voltage, 120 VAC fire safety control function circuits shall be wired by a qualified electrical contractor and shall be standard non-supervised line voltage circuits in conduits.

1.2 FIRE ALARM SYSTEM CONTROL UNIT POWER

- A. Line voltage for each fire alarm system control unit shall be provided as follows:
1. Through individual dedicated branch circuits.
 2. Each fire alarm control unit cabinet shall be grounded securely to the building grounding system.
 3. Each branch circuit shall not be supplied through ground-fault circuit interrupters or arc-fault circuit interrupters.
 4. Circuit breakers shall be labeled in red as FIRE ALARM.
 5. Secure the "ON" breaker handle with a lockout clip that is red and clearly labeled "FIRE ALARM"
 6. A breaker panel key shall be stored within the locked cabinet of each fire alarm control unit served by the breaker panel.
 7. The location of the circuit breaker panel serving each fire alarm control unit shall be posted in the fire alarm control unit cabinet.

1.3 ADDITIONAL MATERIALS: INCLUDE IN THE BASE CONTRACT PROPOSAL

- A. All costs to provide five (5) additional initiation devices installed, including cable and device, as directed by the Owner's Representative. Conduit and standard back boxes by Division 26 Electrical Contractor.
- B. All costs to provide five (5) additional notification devices installed, including cable and device, as directed by the Owner's Representative. Conduit and standard back boxes by Division 26 Electrical Contractor.

1.4 EXISTING FIRE DETECTION AND ALARM SYSTEMS

- A. The fire detection and alarm systems contractor shall be responsible for complete demolition of the existing fire detection and alarm systems. Demolition shall include:
1. Disconnection and removal of all fire detection and alarm devices not to remain in service in walls, floors, and ceilings.
 2. Identification and verification of abandoned wiring and equipment. All disconnected or abandoned devices that are visible shall be removed, i.e., non-functional fire pulls, bells, speakers, signals, et cetera. Remove abandoned wiring to the source of the supply everywhere possible, the accessible portions of all inaccessible abandoned cabling shall be removed.
 3. Demolition of devices, cabling, back boxes, and conduit previously abandoned.
 4. Removal of exposed surface ceiling and surface wall back boxes, boxes, raceway, conduit and supports including brackets, stems, hangers, and other accessories located on walls and above accessible finished ceilings.

5. Provide a blank cover for abandoned device backboxes that are impractical to remove from masonry construction without unnecessary damage.
6. Confirm with Owner/Architect regarding the handling and disposal/reuse of removed material, equipment, devices, et cetera.
7. Off-site disposal in a legal manner of all materials not requested to be turned over to the Owner. Comply with government regulations pertaining to environmental protection, and disposal of materials and equipment. Do not burn any materials on the site.
8. Repair of any finishes or adjacent construction damaged during modification, extension, and demolition work.

1.5 WORK NOT INCLUDED

- A. Contractors shall make no agreement that obligates the Owner to pay any company providing communications, monitoring, or other services.
- B. Contractors shall not make selection, purchase, or installation of interconnect instruments and/or equipment to be used on this project.

1.6 RELATED SECTIONS

- A. Section 26 00 00 - Electrical
- B. Section 28 05 44 - Emergency Responder Radio Coverage System

1.7 PRESCRIPTIVE CODES, STANDARDS, AND REGULATIONS

- A. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards except when requirements are exceeded by the contract documents.
- B. In addition to requirements outlined in other sections of the specifications these codes and standards are imposed as applicable to the work in each instance.
- C. The equipment, materials, and installation shall conform to the latest version of all applicable codes, standards and regulations of authorities having jurisdiction.
- D. Nothing in the Contract Documents shall be construed to permit work not conforming to these codes and standards.
- E. When two or more codes or standards are applicable to the same work, then the stricter code or standard shall govern.
- F. The date of the code or standard is that in effect on the date of issue stated on the contract documents, except when a particular publication date is specified.
- G. The Contractor shall comply with all State, Federal, NFPA, local codes and ordinances that may alter any part of the plans or specifications. The Contractor shall bear all costs for correcting any deficiencies due to non-compliance.
- H. Where local codes and ordinances are not in writing or on record but local precedence have been set, the Owner shall pay for any additional resulting cost.

1.8 PLANS AND SPECIFICATIONS

- A. The intent of the project drawings is to establish the types of systems and functions, but not to set forth each item essential to the functioning of the system.
- B. The drawings are generally diagrammatic and show approximate location and extent of work.
- C. Install the work complete including minor details necessary to perform the function indicated. Provide fire alarm systems (including all connections) complete in every respect and ready to operate.
- D. If clarification is needed, consult the Owner's Representative.

- E. Review pertinent drawings and adjust the work to conditions shown. Where discrepancies occur between drawings, specifications, and actual field conditions, immediately notify the Owner's Representative for his interpretation.
- F. The Owner's Representative reserves the right to make any reasonable change in the location of any part of this work without additional cost to the Owner.

1.9 SITE VISIT

- A. Before submitting a proposal, each proposed contractor shall examine all plans and specifications relating to the work, shall visit the site of the project, and become fully informed of the extent and character of the work required, including all required utilities and work to remote areas.
- B. No consideration will be granted for any alleged misunderstanding of the materials to be furnished or the amount of work to be done, it being fully understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying plans or required by nature of the site of which may be fairly implied as essential to the execution and completion of any and all parts of the work.

1.10 SUBMITTALS

- A. Submit a complete submittal package within 30 calendar days after award of this work for approval. Equipment is not to be ordered without approval. Partial submittals are not acceptable for review. Each submittal shall include a dated transmittal.
- B. Submittal shall be electronically transmitted in PDF file format.
- C. For each submittal provide a cover sheet with the name and location of the project, the name, address and telephone number of the Contractor, and the name, address and telephone number of the submitting sub-contractor. Include on or after the cover sheet sufficient space for review stamps.
- D. Quality Assurance Submittal including special boxes, cable, and other material as requested by the Owner's Representative:
 - 1. Letter from manufacturer stating that the Contractor is an Authorized Factory Distributor for the area where the project is located.
 - 2. The Contractor and Manufacturer shall supply sufficient information to indicate that the proposed system is based on the latest hardware, software technology available.
 - 3. Current copy of the contractors State issued license for sales, service, and installation of fire detection and alarm systems.
 - 4. Current copy of the fire detection and alarm system designer's commercial (non-residential) State issued license of the person responsible for the design of the system submitted.
- E. Product Data Submittal to include special boxes, cable, and other material as requested by the Owner's Representative including:
 - 1. An indication of any deviations from Contract Document requirements, including variations and limitations. Show any revisions to equipment layout required by use of selected equipment.
 - 2. A product data index and complete equipment list including for each product submitted for approval the manufactures name and part number, including options and selections.
 - 3. Cut-sheets or catalog data illustrating the physical appearance, size, function, compatibility, standards compliance, and other relevant characteristics of each product on the equipment list.
 - 4. Indicate by prominent notation (an arrow, circle, or other means) on each sheet the exact product and options being submitted.
 - 5. Submit design data, when the scope of work requires, including schematics, risers, sequences, or other data.
 - 6. If not included in the Shop Drawings, calculations for notification device circuit current drop, conductor size, and battery backup for each unit.
 - 7. Resubmittals shall include a complete revised equipment list and any product data that is revised with revision notation and clouded changes.
- F. Shop Drawings Submittal to include:

1. A cover page that includes project name and address, index of drawings, scope of work description, code editions designed under, local AHJ information, a sequence of operation input/output matrix, bill of material, device and cable legends, typical device connections and installation height details, schedules and location map.
2. Produce accurate to scale (min. 1/8" = 1') drawings showing equipment and device layouts prepared using a CAD or BIM engineering drawing program. When CAD background files are not available for existing buildings the Contractor shall inspect the site and collect information to create a floor plan. Walls shall be double line showing the thickness, single line diagrams are not acceptable.
3. Every room shall have a name and number identifying the use of the space with ceiling heights notated for each space or group of spaces throughout the design.
4. Indicate and/or notate door swings, glass walls, half walls, floor to ceiling windows, skylights, and other openings, projections, ceiling features, elevation changes, et cetera that affect the placement of alarm devices.
5. Show fire-rated walls, fire/smoke rated doors, fire rated shutters, fire rated rolling doors.
6. Locate and label all components of the system, label and indicate circuit routing, cable type, and gauge. The fire alarm panel location and all device locations shall be clearly identified by symbols matching the symbol legend. The labeling of circuits and devices shall correspond with the riser diagram.
7. Riser diagrams showing all components of the system. Show control panels, power supply panels, amplifiers, annunciators, network interfaces, all initiation and notification devices. Partial or typical riser diagrams are not acceptable.
8. If not included in the Product Data Submittal, include calculations for notification device circuit current drop, conductor size, and battery backup for all panels.
9. When multiple buildings make up the system, provide a block diagram of the project site showing all buildings to be covered by the fire alarm system and detailing the route and type of Signaling Line Circuit (SLC) connection between buildings. Note building entry points, conduit type and size, and routing pathway (underground or over canopy installation). Provide a separation in the outgoing and return conductors for all building connections as required for Class A circuits per NFPA 72, 12.3.8.
10. Shop or coordination drawings shall include information that will allow the Contractor to coordinate interdisciplinary work and when necessary guide the manufacturer or fabricator in producing the product.
11. Resubmittals shall include revision notation and clouded changes.

1.11 QUALIFICATIONS OF A PROPOSED CONTRACTOR

- A. Proposed contractors who do not currently possess the necessary qualifications, trained and experienced personnel, financial capacity, hold required current licenses, or meet the other requirements herein described will be disqualified.
- B. The Contractor shall be currently licensed by the State Fire Marshal to sell, install, and service commercial fire alarm systems.
- C. The Proposed Contractor shall not have any grievances or complaints of record regarding workmanship, code compliance, or service response with a licensing authority. A Proposed Contractor that has any prior finding(s) of a code or license violation or has any litigation in process concerning the installation of a system is unacceptable.
- D. The Contractor shall employ a full-time employee who is licensed by the State to design commercial fire alarm systems. They shall be responsible for the design of the system submitted and shall sign all submittal drawings.
- E. All work associated with the installation of the fire alarm system shall be under the direct supervision of a State licensed and factory trained technician. A certificate of this training shall be provided with the contractors' submittal.
- F. The proposed contractor, as a business entity, shall be an authorized and designated representative of the fire alarm panel equipment manufacturer, with full warranty privileges, and shall have been actively engaged in the business of selling, installing, and servicing commercial building fire alarm systems for a period of at least five (5) years.

- G. Recently formed companies are acceptable only if specific pre-approval is requested, and granted by the Owner's Representative, based on experience of key personnel, current and completed projects, and all licensing requirements are met 10 working days prior to the contract proposal date.
- H. No contract employees are allowed unless they have been to the factory-training school within the last 18 months. A certificate of this training shall be provided with the Contractor's submittal.
- I. The proposed Contractor shall have an office within 150-miles of the job site, staffed with factory trained technicians who are qualified and licensed to supervise the installation, to be responsible that the system is installed as submitted, to conduct system start up and perform a 100 percent operational audit of all installed devices. The technicians shall instruct the Owners representatives in the proper operation of the system, and to provide service throughout the warranty period. The contractor shall be capable of dispatching technicians to repair a system within four (4) of a service request.
- J. The proposed contractor shall be fully experienced in the design and installation of the type of Fire Alarm System herein specified and shall furnish with the contract proposal an itemized list of the installations of at least two (2) projects of the type specified herein. The list shall include the name of two (2) projects, date of completion, the amount of the contract, the name, and telephone number of a qualified person to contact for reference. Each reference project listed must utilize equipment by the same manufacturer as the proposed system.
- K. The ability of a proposed Contractor to obtain these specifications and provide a performance bond shall not be regarded as the sole qualification of the Contractors' competency and responsibility to meet the requirements and obligations of the contract.
- L. The Builder shall be satisfied that a proposed Contractor meets all the requirements expressed herein before including the Contractor's proposal in the project.
- M. The Owner's Representative or the Owner may investigate, as they deem necessary, to determine the ability of the proposed Contractor to perform the work. The proposed Contractor shall furnish to the Owner with any information or data requested for this purpose.
- N. The Owner's Representative or the Owner reserves the right to reject any contract proposal if the evidence submitted, or their investigation, fails to indicate that the Contractor is qualified to fulfill of any part of the contract or to complete the work contemplated therein.
- O. The Owner's Representative or the Owner reserves the right to reject the proposal of any Contractor who is unqualified, has previously failed to perform properly, or complete on time, contracts of a similar nature.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide a complete and satisfactorily operating 24 VDC, closed circuit, electrically supervised, analog addressable, intelligent reporting, microprocessor-controlled fire detection and alarm system as described herein, using materials and equipment of types, sizes, ratings, and performances as specified. Use materials and equipment that comply with referenced standards and manufacturers' standard design and construction, in accordance with published product information. Coordinate the features of all materials and equipment so they form a functional system, with components and interconnections matched for optimum performance of specified functions.
- B. The system shall meet all requirements for a protected premises and supervising station fire alarm system per NFPA 72.
- C. Refer to Fire Detection and Alarm System schedule on the drawings for part numbers and additional information.
- D. All equipment and components shall be installed in strict compliance with manufacturers' recommendations and the requirements of the components UL listing. Consult the manufacturer's

installation manuals for all wiring diagrams, schematics, electrical requirements, cable types, and physical equipment sizes, etc., before beginning system installation. Refer to the manufacturers' riser/connection diagrams for all specific system installation/termination/wiring data.

- E. The control units, power supplies, batteries, subassemblies, software, firmware, cable, and all accessories provided shall be listed and labeled by Underwriters Laboratories, Inc. for commercial system use under the latest appropriate testing standard. Provide all equipment and components required to provide a complete and operating system.
- F. All date keeping hardware, firmware, and software provided shall be fully compliant with the calendar year designated in four-digit date format. Any time equations must function normally, leap year, and daylight savings time must be supported.
- G. The system and all components shall be tested and found suitable for the specified purpose as part of a protected premises protective signaling (fire alarm) system by a nationally recognized approvals agency acceptable to the local AHJ.
- H. All equipment and components shall be new and the manufacturer's current model. All like devices shall be of the same manufacturer and model number.
- I. All equipment and components shall be installed in strict compliance with manufacturers' recommendations and the requirements of the components UL listing.
- J. Equipment devices, make/model numbers, accessories, and comments have been shown on the contract drawings. Specific wiring between equipment has not been shown.
- K. The contractor shall be responsible for sizing, verifying and supplying proper power supply(s) necessary to operate the system and audible/visual signals.
- L. All equipment shall be attached to walls and ceiling/floor assemblies utilizing a structured cabling system and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.2 ACCEPTABLE MANUFACTURER

- A. Descriptions and details, acceptable manufacturers' names listed, and specific manufacturer and model number items indicated in this specification shall establish a standard of quality, function, and design. Manufacturers and model numbers listed "no exceptions" shall not be substituted without specific notice in an addendum. Otherwise, where a specific manufacturer's product is indicated, products of other manufacturers listed as acceptable may be submitted for approval based on the substitute product being, in the opinion of the Owner's Representative, of equivalent or better quality than that of the product specified.
- B. Proposed contractors wishing to propose any product substitution must do so in writing to the specifying authority at least ten (10) days prior to the proposal opening.
- C. For manufacturers equipment or models other than that specified, the proposed contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment. Proposals must include detailed information showing all deviations from the system as specified.
- D. Substitute products for which the proposed contractor does not obtain prior approval will not be considered acceptable for this project. Final approval of alternate products shall be based on the decision of the Owner and Architect. Prior approval to make a proposal for this project does not automatically ensure products will be an acceptable equivalent.
- E. It is the responsibility of the Contractor to provide all features and functions as outlined in these specifications. The functions and features specified are vital to the operation of this facility; therefore, inclusion in the list of acceptable manufacturers does not release the contractor from strict compliance with the requirements of this specification.

- F. The manufacturers model numbers, functions, and features described in this specification section are those of Autocall, and this shall constitute the quality and performance of the equipment to be furnished, no exceptions.

2.3 CIRCUIT TYPES

- A. General: All low voltage fire alarm circuits shall be power limited, electrically or electronically supervised, and of the correct cable type and gauge. Low voltage fire alarm cables of various types are to be permitted within the same raceway or conduit. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box, or raceway containing these conductors, as per NEC Article 760. T-taps in any electrically supervised circuit are prohibited by this specification. All junction boxes and conduit ends shall be marked red for all low voltage fire alarm circuits.
- B. All fire alarm systems shall be installed in such a manner that the failure of any single alarm-actuating or alarm-indicating device will not interfere with the normal operation of any other such devices. All circuit types shall comply with NFPA 72 Chapter 12.
1. Signaling Line Circuit (SLC): SLC circuits shall be wired Class A redundant path. Class A separation of outgoing and return cable routing shall be observed per NFPA 72, Chapter 12.
 2. Voice Evacuation Notification Appliance Circuits (Voice NAC): Speaker circuits may be 25 or 70 VRMS to be determined by the contractor. Shielded cable shall be utilized to minimize electrical noise interference with voice transmission. These circuits shall be wired Class B with electrical supervision and end of line devices.
 3. Audio/Visual and Visual Notification Appliance Circuit (NAC): These circuits shall be wired Class B with electrical supervision and end of line devices.
 4. Initiating Device Circuits (IDC): Initiating device circuits shall be arranged to serve like categories (beam detectors, heat detectors, tamper switches). Mixed category circuitry shall not be permitted in a single IDC. A two-wire IDC shall contain only devices that require point-contact to operate. A four-wire IDC shall include an additional supervised circuit to supply 24 VDC operating power to devices that require it. These circuits shall be wired Class B with electrical supervision and end of line devices for circuits less than 10 feet in length, otherwise, the circuit shall be Class A redundant path. Class A separation of outgoing and return cable routing shall be observed per NFPA 72, Chapter 12.
 5. Low voltage, 24 VDC, device power circuits provide power to fire alarm system devices that are not powered by the SLC or the IDC circuit. These circuits have backup power and are supervised by an end of line relay and monitor module combination. These types of circuits are required to remotely power devices such as detector sounder bases, stand-alone CO detectors, etc.
 6. Low voltage, 24 VDC, fire safety control function circuits shall in all cases feature Class D "fail safe" operation and shall not have power backup. These circuits shall be controlled by a fire alarm system activated addressable control relay located within three feet of the device controlled and on activation, or loss of power, the connected device shall actuate to its fire safety condition (i.e. HVAC blower control circuits shall open).
 7. Line voltage, 120 VAC, fire safety control function circuits shall in all cases feature Class D "fail safe" operation and shall not have power backup. These circuits shall be controlled by a fire alarm system activated addressable control relay and auxiliary relay pair located within three feet of the device controlled and on activation, or loss of power, the connected devices shall actuate to their fire safety condition (i.e. fire door holders shall release, smoke dampers and fire/smoke dampers shall close). Line voltage fire safety control function circuits shall be wired by the Electrical Contractor and shall be standard non-supervised line voltage circuits in conduit, utilizing the type of conductors specified in Division 26 for light and power circuits.

2.4 FIRE ALARM CONTROL PANEL

- A. Type: Microprocessor based modular design, analog intelligent, addressable fire alarm control panel (FACP) with integrated in-building voice evacuation notification, as herein specified. Size the panel to allow space for the addition of subassemblies (contained within the panel housing) to provide coverage by addressable devices plus a 30% expansion of all devices at a future date. Each signaling line circuit (SLC) shall be limited to 80% of its total device capacity during the initial installation.

- B. Locate the fire alarm control panel as indicated on the electrical drawings. An area smoke detector shall be located at the fire alarm control panel.
- C. The following are required system components and functions:
1. Provide a UL listed cabinet suitable for semi-flush mounting. The door shall include a transparent opening for viewing of all alarm, supervisory, and trouble indicators on an LCD display. When the door is opened all operator controls shall be accessible and all internal components shall be enclosed (i.e. dead front panel). All components shall be securely mounted, all cable shall be routed, and tie wrapped in a neat, professional manner. Conduit shall enter the fire alarm control panel only where conduit entry is specified by the FACP manufacturer.
 2. The microprocessor shall provide a real-time clock for time annotation of system displays, printer, and history file. The time-of-day and date shall not be lost if system primary and secondary power supplies fail. The real time clock may also be used to control non-fire functions at programmed time of day, day of week, and day of year.
 3. The fire alarm panel shall provide for a custom alphanumeric message location identifier to be associated with each addressable device hardware address. For any event or alarm, the alphanumeric display will show the devices hardware address and a custom message clearly identifying the location of the device involved.
 4. Fire alarm, supervisory alarm, trouble, and maintenance alert conditions, with device hardware address and custom message location identifier, shall be displayed on an 80-character minimum Liquid Crystal Display (LCD). The chronological event history of alarm and trouble conditions may also be displayed.
 5. Keypad for functions and programming, buttons for scrolling data on the LCD, front panel switches for RESET, ALARM SILENCE, TROUBLE SILENCE, and DRILL/ALL CALL and LEDs for Normal, Fire Alarm, Supervisory Alarm, Trouble, and Test/Program. When multiple devices are reporting alarm condition, there shall be a visual indication that other devices are in alarm.
 6. Power supply/charger and batteries to supply power limited 24 VDC operating and emergency power to the system. The charger shall be capable of maintaining batteries in a fully charged state without damage and of bringing batteries from a fully discharged to a fully charged state within 48 hours of normal operation. Provide audible alarm and diagnostic LEDs to indicate AC power failure, brown out, control unit CPU failure, low battery detection, battery disconnection, and system ground fault detection. Upon AC power failure, the power supply shall automatically transfer the system to battery backup. Provide sufficient battery capacity for operation without AC power for twenty-four hours of normal supervision and fifteen minutes alarm operation at the end of this period; include a 20% safety factor in battery calculations to ensure adequate performance for the service life of batteries.
 7. An integrated UL approved IP and digital communicator transmitter control unit with the option of adding a cellular module. The communicator shall report system status signals to a remote UL listed monitoring service with the option of multiple transmission protocols including Contact ID and SIA.
 8. The FACP shall check for the presence of ground faults in field wiring and report results on the LCD readout, is it a violation of this specification for any ground fault detection system to be disabled.
 9. A single ground or open on any system SLC, IDC, NAC, or fire safety control function circuit shall not cause a system malfunction or the loss of ability to report an alarm.
 10. The FACP shall have 20% spare capacity on the power supply, the signaling line circuit and all input and output circuits at final acceptance to allow for future expansion by the Owner.
 11. All field wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, removal of any internal modules, or any open circuits in the field wiring; a trouble signal will be activated until the system and its associated field wiring are restored to normal condition. The FACP shall check for the presence of ground faults in field wiring and report results on the LCD readout, is it a violation of this specification for any ground fault detection system to be disabled.
 12. Walk test, the Fire Alarm Control Panel shall permit testing by manually placing each initiating device in alarm. The control panel shall pulse the system audible devices on detection of each such alarm and automatically reset the panel, permitting a single technician to perform a function test of the entire system.
 13. Provide a digital communicator for UL Central Station monitoring. The communicator paths and protocols for monitoring shall be per Owner's requirements and standards.

2.5 NETWORK GRADE CABLING FOR DIGITAL COMMUNICATOR SERVICE

- A. Provide two parallel runs of Ethernet network grade cabling as required to support the digital communicator systems in this specification section. Category listing of the cable shall be by the Owner's and/or the Facility's current Network Standards. Extend from the drop location inside the digital communicator panel to the building Telco Demarcation Point/Main Distribution Frame location and terminate at each end in a surface mount block. Coordinate Telco or Data termination location with the owner prior to installation. Cable runs shall be tested to industry standards to verify performance.

2.6 INTERFACE FOR OPTIONAL PUBLIC ADDRESS INPUT

- A. The system shall include a line level audio input that has the lowest priority, below any fire alarm function, and may be used for connecting to a telephone paging or similar system. The paging system is not included in the scope of work for this section. When used, the audio signal shall be interfaced through a low priority input to all the interior Fire Detection and Alarm System speakers, which would include corridors, classrooms, offices, and special use areas.

2.7 FIRE ALARM REMOTE ANNUNCIATOR

- A. Provide as indicated on the drawings, a remote annunciator, flushed mounted. Architect to determine color.

2.8 FIRE ALARM FLOOR PLAN MAP

- A. Provide adjacent to the fire alarm control panel a plan view of all building areas covered by the fire alarm system meeting the following requirements:
 1. Framed and secured to the wall and plan covered with clear acrylic panel, SpaceAge Electronics Inc. model SSU52003 Display Frame or equivalent.
 2. Size plan to clearly show all required information.
 3. Orient building to place the entry nearest to control panel at the bottom of plan.
 4. "YOU ARE HERE" indicator with arrow.
 5. Logical alarm zones.
 6. Room names and numbers. (Verify with Owner)
 7. Show each initiating device with symbol and identification number programmed in the panel. Do not show audio/visual devices.
 8. Symbol legend.
 9. True north arrow.
 10. Scale indicator.

2.9 SYSTEM RECORD DOCUMENT CABINET

- A. Provide, in accordance with NFPA 72, an adequately sized record documentation cabinet located at the system control unit or at an on-premises location approved by the AHJ and identified at the system control unit. Printed and/or electronic documentation shall include an owner's manual, published instructions, a design narrative and layout, record drawings, site specific software, passwords, and a record of installed software and firmware version numbers. The record documentation cabinet shall be 18-gauge minimum cold rolled steel with a red powder coat finish, a stainless steel-piano hinge, and keyed door lock. The cover shall be permanently screened with 1" high lettering stating "SYSTEM RECORD DOCUMENTS" in white letters. The interior shall accommodate as required standard 8.5" x 11" manuals and loose document records, a permanently mounted digital flash drive with USB-B connector, a business card holder, and key ring hooks.

2.10 POWER SUPPLY PANELS

- A. Provide additional power supplies for notification appliance circuits and devices or as a remote power supply.
- B. The primary locations shall be in IDF/MDF rooms, electrical rooms, wiring closets, custodial closets, or storage rooms. An area smoke detector shall be located at each fire alarm power supply location.
- C. An area smoke detector shall be located at the power supply panel locations.

- D. Each power supply shall individually report a trouble condition including battery charging failure, battery failure, NAC loss, AC power loss (delay acceptable), power brownout, or ground fault detection.
- E. A trouble condition on a power supply shall not interfere with normal operation the rest of the system.
- F. In the event of a trouble condition, each power supply shall provide location annotated individual point supervisory incident reporting to the main fire alarm control panel. This may be accomplished using one addressable module per power supply or via power supplies with multiplexed system bus communication or an integrated addressable interface.
- G. Provide sufficient battery capacity for operation without AC power for twenty-four hours of normal supervision and fifteen minutes of alarm operation at the end of this period; include a 20% safety factor in battery calculations to ensure adequate performance for the service life of batteries.
- H. Each power supply shall be labeled in a visible area with its device hardware address utilizing self-laminating, flexible vinyl film, non-smear, machine printed labels.
- I. Conduit shall enter the power supply backbox only where conduit entry is specified by the manufacturer.

2.11 VOICE EVACUATION SPEAKER AMPLIFIERS

- A. Provide additional amplifiers for notification appliance circuits and speakers.
- B. An area smoke detector shall be located at remote speaker amplifier locations.
- C. Each speaker amplifier shall individually report a trouble condition including battery charging failure, battery failure, NAC loss, AC power loss (delay acceptable), power brownout, or ground fault detection.
- D. A trouble condition on an external power supply shall not interfere with normal operation of the remainder of the system.
- E. In the event of a trouble condition, each speaker amplifier shall provide location annotated individual point supervisory incident reporting to the main fire alarm control panel. This may be accomplished using one addressable module per amplifier or via amplifier with multiplexed system bus communication or an integrated addressable interface.
- F. Provide sufficient battery capacity for operation without AC power for twenty-four hours of normal supervision and fifteen minutes alarm operation at the end of this period; include a 20% safety factor in battery calculations to ensure adequate performance for the service life of batteries.
- G. Each speaker amplifier shall be labeled in a visible area with its device hardware address utilizing self-laminating, flexible vinyl film, non-smear, machine printed labels.
- H. Conduit shall enter the amplifier backbox only where conduit entry is specified by the manufacturer.

2.12 EMERGENCY ALARM OCCUPANT NOTIFICATION APPLIANCES

- A. Provide as indicated below and as required per NFPA, federal, state and local code and ADA standards, notification appliances that alert the building occupants to an emergency.
- B. Refer to the Fire Detection and Alarm System schedule on the drawings for part numbers and additional information.
- C. NFPA 72 prescribes the use of both ceiling and wall mounted audible/visual notification appliances. Provide notification appliances per the drawings.
- D. Notification appliance circuits serving employee work areas shall be initially installed with a minimum of 20% spare capacity for visible notification appliances to facilitate future additional device installation to accommodate hearing-impaired employees.
- E. Audible signals shall be designed to provide at least 15 dB above ambient sound levels measured at 5 feet above the floor in the occupied area. Sound levels shall not exceed 110 dbA at the minimum hearing

distance from the audible appliance.

- F. Strobe intensity (candela output) and audible decibel level shall be sized for the room size and area of coverage per ADA and NFPA/ANSI and local codes and standards.
- G. All interior strobe flashing shall be synchronized. Provide synchronization control such that all strobe circuits are synchronous, for all notification appliance circuits. Note that signal appliances that can synchronize on a single circuit, but not across all circuits are not acceptable.
- H. Signal housings and grilles shall be red in color, imprinted `FIRE` and the strobe lens shall be clear.
- I. Each strobe/horn shall include IN and OUT wiring terminals, each designed to accept two #12 to #18 AWG wires at each terminal, with standard reverse polarity DC NAC circuit supervision.
- J. Each speaker shall include audio IN and OUT wiring terminals, each designed to accept two #12 to #18 AWG wires at each terminal and a 10 uF, or as required, blocking capacitor for compatibility with standard reverse polarity DC voice NAC circuit supervision.
- K. Provide where indicated on plans or as required protective polycarbonate or wire Device Guards. Minimum of 1/8" thick clear polycarbonate or 10-gauge welded steel wire constriction with a corrosion resistant finish.
- L. Waterflow notification appliance shall be wall mounted above the fire department connection (Siamese Port) and shall be non-silenceable while water is flowing through the fire sprinkler system. Flush mount exterior devices when possible. For surface mount applications provide manufacturer furnished backbox.
- M. For waterflow notification appliance provide a weatherproof sign approximately 12" wide x 6" high, white with red letters reading, "WATERFLOW FIRE ALARM SIGNAL". Configure fire alarm system to activate this strobe signal on waterflow alarm only and be non-silenceable while the sprinkler system is active (water flowing). Center signal and sign directly over Fire Department Connection (Siamese Port).

2.13 MANUAL PULL STATIONS

- A. Provide manual fire alarm pull stations as shown on the drawings.
- B. Manual stations shall be double action and provide a visible indication they have been operated. Manual stations shall require a key to be returned to normal condition, key alike to FACP. It is the responsibility of the Fire Alarm Contractor to ensure that the pull stations provided allow key reset with the station protector frame/spacer in place.
- C. Provide a tamper-proof clear Lexan shield with horn station protector over each pull station. For potentially wet areas, provide the cover with weather gasket.
- D. Each manual station shall be labeled in a visible area with its device hardware address utilizing self-laminating, flexible vinyl film, non-smear, machine printed labels.

2.14 SMOKE DETECTORS

- A. Analog spot type photoelectric smoke detectors shall be low profile, analog addressable, and UL listed. The photoelectric smoke detector shall use one address on the SLC,
- B. Except for temporary testing, smoke detectors shall not be installed until the building is ready for occupancy and cleaned as dust free as possible.
- C. Each detector head shall be labeled in a visible area with its device hardware address utilizing self-laminating, flexible vinyl film, non-smear, machine printed labels.

2.15 CARBON MONOXIDE ALARMS

- A. CO Alarm units shall be listed and rated for commercial occupancies and be connected to an alarm control panel (system-connected). CO Alarm units shall be UL Listed and installed in accordance with IBC/IFC and NFPA requirements.

- B. CO Alarm units shall be installed as Single-Station Carbon Monoxide Alarms (non-tandem operation) and they shall be zoned on a Class A (Style D) four-wire IDC circuit (six-wire interface (4+2) total between CO Alarm Units including power circuit). Zoned as indicated on the plans, provide at least one zone per floor.
- C. Each zone of CO Alarm units shall be supervised for Alarm and Trouble conditions through interconnection with an addressable monitor module, which in turn is supervised through an SLC loop on the main control panel. Each CO Alarm unit shall be operate as a stand-alone detection and notification subsystem and the function of each shall not be impaired by any alarm or trouble condition on the other CO Alarm units in the same zone.
- D. All system connected CO Alarm units function as a single system providing zone notification at the control panel for reporting of CO Alarm or CO Trouble conditions. CO Trouble includes integral supervision for loss of power.
- E. If a dangerous level of Carbon Monoxide gas is detected by a CO Alarm unit, the red LED alarm light will come on and stay on, the temporal-four pattern audible alarm will sound, and the Alarm relay will be activated. The CO Alarm unit will automatically reset when CO is no longer detected. If the test/hush button in pushed during an alarm, it will silence the integral sounder for five minutes, the red LED alarm light will stay on, and if CO is still present after five minutes, the detector will once again sound the audible alarm.
- F. If there is a problem identified within a CO Alarm unit, on loss of power, or if the end of unit life indicator expires, the Trouble relay will be activated, in addition to the various LED blink rates will indicate the exact trouble.
- G. The status of each zone of CO Alarm units shall be descriptively annunciated at the main control panel by zone and shall be distinct from fire alarm status conditions. CO Alarm signals must take precedence over a CO Trouble signals. CO zone status signals shall be indicated visually (alphanumeric display description and/or indicator lights) and audibly (sounder) at the control panel, and at a constantly attended location in the building, and distinctly transmitted to the supervising station. In addition to each CO Alarm unit shall include a test/hush button, multicolored LED status indicator, and a built-in 85 dB Code-4/TC4 (temporal-four pattern) audible alarm.
- H. Each zone of CO Alarm units, as indicated on the plans, shall be a complete functional interconnected system of devices that includes supervised interface circuits to the main control panel. These circuits shall be arranged to monitor and annunciate the status of the CO Alarms and to initiate the appropriate response to those conditions. The power circuit shall be monitored via the CO Trouble relay when it indicates loss of power. The power source must be a regulated, filtered, power-limited, non-resettable, output from a system main or auxiliary control unit, providing 24 VAC operating power with primary (AC Main) and secondary (Battery Backup) capacity sufficient for operation without AC power for twenty-four hours of normal supervision and two hours of emergency operation at the end of this period.
- I. Each CO Alarm unit shall be labeled in a visible area with its device zone identification utilizing self-laminating, flexible vinyl film, non-smear, machine printed labels.
- J. Provide IDC four-conductor wiring, shall be NEC type FPLP Plenum rated, 16 AWG or 14 AWG, solid four conductor signaling cable. Equivalent by Atlas, Belden, BSCC, or Remeo and provide power circuit two-conductor wiring, shall be NEC type FPLP Plenum rated, 16 AWG or 14 AWG, solid two conductor signaling cable. Equivalent by Atlas, Belden, BSCC, or Remeo.

2.16 HEAT (THERMAL) DETECTORS

- A. Analog spot type heat detectors shall be provided as shown on the drawings. Rate-of-rise heat detector element shall operate when the rate of temperature rise exceeds 15° Fahrenheit per minute.
- B. Analog fixed temperature heat detector shall be rated at 135° Fahrenheit for areas where ambient temperatures do not exceed 100° Fahrenheit.
- C. In areas where the ambient temperature does not exceed 150° Fahrenheit the analog fixed temperature heat detector shall be rated at 190° Fahrenheit.

- D. Each detector head shall be labeled in a visible area with its device hardware address utilizing self-laminating, flexible vinyl film, non-smear, machine printed labels.
- E. Heat detectors shall be provided where smoke detector coverage is prescribed by this specification, but ambient conditions prohibit installation due to the likelihood of nuisance alarms, such as:
 - 1. Very dusty or dirty areas, wood/metal shops.
 - 2. Damp or very humid areas, next to showers.
 - 3. Near furnaces, hot water heaters, or gas space heaters.
 - 4. Near large fresh air inlets, air returns, or excessively drafty areas.
 - 5. Insect-infested areas.
 - 6. Garages or cart parking areas.
 - 7. Outdoor elevator lobbies.
 - 8. Unheated buildings or outdoor rooms subject to extreme temperature changes.

2.17 ISOLATOR MODULE

- A. Isolator modules protect the SLC circuit and inactivate sections of an SLC circuit that become inoperable, protecting the remaining sections. Isolator modules shall be placed between every 25 or less addressable devices.

2.18 MONITOR MODULE

- A. Addressable Monitor Modules shall be provided where an interface is required to supervise wiring and monitor contact alarm devices. The alarm circuit shall be supervised with an end-of-line device.
- B. Monitor Module to supervise an IDC zone interface for compatible 2 or 4-wire circuit powered 24 volt normally open conventional smoke or heat detectors.
- C. Mini-monitor modules concealed in an electrical box with a blank cover are not acceptable.
- D. Each monitor module shall be labeled in a visible area with its device hardware address utilizing self-laminating, flexible vinyl film, non-smear, machine printed labels.

2.19 CONTROL MODULE

- A. Addressable Control Modules shall be provided where a NAC control interface for fire alarm signal functions are required. Control modules shall require an auxiliary power input with the NAC circuit being supervised with an end-of-line device.
- B. Each control module shall be labeled in a visible area with its device hardware address utilizing self-laminating, flexible vinyl film, non-smear, machine printed labels.

2.20 CONTROL RELAY

- A. Addressable Control Relays shall be provided where required to provide a control interface for fire alarm system functions such as damper, auxiliary handler, fire doors and curtains, etc. with loads less than 0.5 amps.
- B. Addressable Control Relays shall be located within three feet of the controlled device or unit and the relay output (load) wiring shall be configured a fail-safe Fire Safety Control Function circuit.
- C. Each Fire Safety Control Function circuit-controlled device shall be configured such that when the fire alarm system safety control function circuit is re-energized, by the fire alarm control panel, the device shall return to normal operation (e.g. re-start or be ready to re-start) without a need for manual or environmental control system intervention.
- D. Addressable Control Relays shall be used to directly control only pilot duty loads, those not exceeding 0.5 amps, up to 120 volts, and without transient voltage spikes. For all applications exceeding these parameters also provide with an Auxiliary Relay to handle the load.

- E. Each control relay shall be labeled in a visible area with its device hardware address utilizing self-laminating, flexible vinyl film, non-smear, machine printed labels.

2.21 AUXILIARY RELAY

- A. Provide a hardwired Auxiliary Relay paired with the addressable Control Relay for all fire safety control function applications in which the load exceeds 0.5 amps, 120 volts, or with high transient voltage spikes.
- B. Each relay shall be mounted in a surface mount red metal enclosure with conduit knockouts. Relays shall be UL recognized and rated for ten million mechanical operations.
- C. Auxiliary relays shall be labeled in a visible area with its device function utilizing self-laminating, flexible vinyl film, non-smear, machine printed labels.
- D. Single pole standard duty Auxiliary Relays shall be operated by a multi-voltage coil (24 VDC, 24 VAC, 120 VAC, or 230 VAC), feature SPDT dry Form C contacts rated 10 Amps @ 120 VAC, and a status LED to indicate that the relay is energized.
- E. Double pole standard duty Auxiliary Relays shall be operated by a multi-voltage coil (24 VDC, 24 VAC, 120 VAC, or 230 VAC), feature DPDT dry Form C contacts rated 10 Amps @ 120 VAC, and a status LED to indicate that the relay is energized.
- F. Double pole heavy duty Auxiliary Relays shall be operated by a 24 VDC or a 120 VAC coil and feature DPDT dry Form C contacts rated at 30A @ 240VAC; 20A @ 277VAC; 2HP @ 240VAC / 1.5HP @ 120VAC.

2.22 DUCT MOUNTED SMOKE DETECTORS

- A. Refer to mechanical system drawings and schedules and site visit observation for air handler sizes to determine the locations and quantities of addressable duct smoke detectors and addressable modules required to monitor and/or control HVAC units, dampers, smoke control systems, etc.
- B. It shall be the sole responsibility of the fire alarm system contractor to furnish and install all of the fire alarm system devices that are required by the code and the AHJ for the mechanical systems.
- C. Provide the duct smoke detector housing with included photoelectric detector head and relay. Provide with sample tube length 2.5', 5', 10' according to duct width. The duct smoke detector shall have a remote indicator visible from the finished floor.
- D. Duct mounted smoke detector housings and sample tubes shall be furnished by the Fire Alarm Contractor and mounted by the Mechanical Contractor. Coordinate with the mechanical contractor.
- E. When smoke is detected by a duct mounted smoke detector it shall activate a supervisory fire alarm condition at the fire alarm control panel unless an alarm condition is required by the AHJ.
- F. Install duct smoke detector in the supply or return duct of units supplying greater than 2000 cfm per local AHJ requirements. Install duct smoke detectors in the supply and return duct of units supplying greater than 15,000 cfm.
- G. Each HVAC unit for which a duct mounted smoke detector is installed shall also have a blower shutdown relay.
- H. The activation of any duct mounted smoke detector shall actuate all related fire safety control functions: air handler shut down relays, smoke fire damper motors, fire door release devices, et cetera.
- I. Each duct mounted detector housing shall be labeled in a visible area with its device hardware address utilizing self-laminating, flexible vinyl film, non-smear, machine printed labels.
- J. Each detector shall be provided with a remote power/status LED and remote testing function. The remote LED indicator shall be located in the nearest corridor ceiling unless otherwise directed.

- K. The status LED shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. The LED shall be placed into steady illumination when a supervisory fire alarm condition has been detected.
- L. Each remote LED faceplate shall have a self-laminating, flexible vinyl film, non-smear, machine printed label indicating the HVAC unit number, type, and device identification number as programmed in panel.

2.23 HVAC UNIT BLOWER SHUT-DOWN AND SMOKE DAMPER OR FIRE/SMOKE DAMPER OPERATION

- A. Refer to the mechanical system drawings, schedules and site visit observation to determine the locations and quantities of addressable modules required to control HVAC blowers, dampers, smoke control systems, etc.
- B. It shall be the sole responsibility of the fire alarm system contractor to furnish and install all of the fire alarm system devices that are required by the code and the AHJ for the mechanical systems.
- C. The contractor providing the device shall wire it internally for fail-safe shut-down and provide a labeled 3' coil of cable outside the unit to allow the fire alarm contractor to make final connection to the dry contacts on the controlling relay.
- D. Provide an addressable control relay to control air handler shutdown of each unit without smoke dampers or fire/smoke dampers located in that unit's duct system as indicated on the project mechanical plans.
- E. Provide an addressable control relay, a double pole auxiliary relay, and a line voltage 120 VAC, fire safety control function circuit to control air handler shutdown of each unit with smoke dampers or fire/smoke dampers located in that unit's duct system as indicated on the project mechanical plans.
- F. Units with at least one supply grille serving a major path of egress (corridors, open concept classroom groups) shall have a shut-down control relay, even if unit is less than 2,000 CFM capacity. The shut-down will be activated on general alarm, which shall include any alarm from the smoke detectors in the corridor.
- G. Duct detector supervisory alarm condition shutdown function shall be limited to a single unit or group of units as required. A shutdown of all the facility's units on a single duct detector supervisory alarm shall be prohibited.

2.24 AUTOMATIC FIRE SUPPRESSION SYSTEMS

- A. All automatic fire suppression systems shall be monitored by the fire alarm system. The activation of any automatic fire suppression system shall produce an alarm condition. Refer to the drawings and site visit observation to determine quantities and locations of the kitchen hood suppression system controls.
- B. The kitchen ventilation hood suppression system shall provide contacts to monitor activation of system, coordinate with existing conditions and the Food Service Equipment Contractor. Provide monitor modules as required for alarm functions

2.25 BUILDING LIGHTING CONTROL SYSTEM

- A. Provide a fire alarm addressable control relay, located at the FACP, configured to activate on general alarm building illumination per NFPA 101 Section 7.8 Illumination of Means of Egress. The lighting control system contractor shall provide all associated hardware and wiring from this single fire alarm output to the lighting control system.

2.26 SOUND SYSTEM AND HOUSE LIGHTING CONTROLS

- A. When required, provide a fire alarm addressable control relay, located at the a sound system or public address head-end equipment location, to activate on general alarm, that shall override stage, theater, or gymnasium sound and lighting equipment. Configure one set of contacts to provide a dry contact input to the sound system to shut down the sound, and the second set of contacts to provide an input to override the theatrical and/or arena lighting and to turn on or turn up the house lighting to normal levels. The

theatrical and/or public address equipment system contractor shall provide all associated hardware and wiring from the fire alarm addressable control relay output to the sound and lighting system equipment.

2.27 EMERGENCY RESPONDER RADIO COVERAGE SYSTEM MONITORING

- A. The Emergency Responder Radio Coverage System's bi-directional amplifier (BDA) shall have status condition supervised by the building fire alarm system. Provide addressable monitor modules to supervise the status condition of the BDA per IFC 510.

2.28 ELECTROMAGNETIC DOOR HOLD OPEN AND RELEASE

- A. Refer to the Architectural drawings, door and door hardware schedules and site visit observation to determine the locations and quantities of electromagnetic door hold open devices required.
- B. Provide required devices and connections for holdbacks integrated into door systems when supplied.
- C. The fire alarm contractor shall verify voltages, exact style, and quantity required with architectural plans and door schedules.
- D. Secure hardware to door drilled through with "Chicago Bolts" (barrel nut/mating screw with a low-profile head on each side to prevent pull out).
- E. Provide adequate blocking in wall for the magnet installation. The backbox and magnet installation shall withstand the force of the door being separated from the magnet while energized.
- F. Operating power shall be 24VDC and power shall be from a fire alarm power supply panel. Program an output circuit on the fire alarm power supply panel as a "door holder power" circuit.
- G. A "door holder power" circuit shall provide a constant 24VDC to the electromagnetic door hold open devices in a system "normal" state. On any alarm the "door holder power" circuit shall discontinue power to the electromagnetic door hold open devices allowing the doors to close. The 24VDC will be restored to the circuit on a fire alarm system reset.
- H. When AC power to the fire alarm power supply panel is off for more than 15 seconds the "door holder power" will be discontinued to conserve the battery backup power.

2.29 SPRINKLER RISER WATERFLOW AND TAMPER SWITCHES

- A. Refer to fire protection drawings, specifications and site visit observation to determine quantities of fire sprinkler devices that requiring monitoring and supervision. It shall be the sole responsibility of the fire alarm system contractor to furnish and install all fire alarm system devices required by the code and the AHJ to monitor and supervise the fire protection systems.
- B. Waterflow switches shall be provided and installed by the sprinkler system contractor. Provide an addressable monitor module for each sprinkler waterflow switch on a riser zone. The monitor module shall be programmed for a fire alarm condition.
- C. Sprinkler and standpipe valve supervisory switches shall be provided and installed by the sprinkler system contractor. Provide an addressable monitor module for each sprinkler system water supply control valve riser or zone control valve, and each standpipe system riser control valve shall be equipped with a supervisory switch device with a normally open dry contact for supervision by the fire alarm system. The addressable monitor module shall be programmed for a supervisory condition.
- D. Each Post Indicator Valve (PIV) or main gate valve shall be equipped with a supervisory switch and shall be provided and installed by the sprinkler system contractor. Provide an addressable monitor module for each PIV or gate valve. The addressable monitor module shall be programmed for a supervisory condition.
- E. When applicable, provide dry contact input fire alarm system monitor modules for individual additional sprinkler system alarm and supervisory conditions such as fire pump controller, pre-action sprinkler riser and dry pipe system air pressure status supervision.

- F. All wiring, monitor modules, end of line devices, and connection to the fire alarm system shall be by the fire alarm contractor.
- G. All sprinkler system alarm and supervisory conditions shall be annunciated at the panel and transmitted to the monitoring service by the digital communicator.
- H. Valve tamper switches and other supervisory devices as required shall initiate a supervisory condition and may be grouped up to twenty devices per IDC when acceptable to the AHJ. Grouping shall be limited to risers within the same room by this specification. Coordinate with Section 21 13 14.

2.30 ELEVATOR RECALL FOR FIRE FIGHTER'S SERVICE

- A. Elevator recall functions are to be activated by the presence of smoke only in the elevator lobby, elevator hoistway, elevator machine room, elevator control room, and elevator control space. This shall be accomplished by smoke detectors at the locations mentioned and control relays or circuits to activate the elevator recall functions. The fire alarm system shall be programmed or circuited to activate the appropriate control circuit when smoke is detected at these specific locations only. The functions shall be elevator control circuit (designated level recall), elevator control circuit (alternate level recall), and elevator warning signal (warning that the elevator is not safe to use). Refer to NFPA 72 Section 21.3.13 and ASME A17.1 Section 2.27 (Electric Elevators) or 3.27 (Hydraulic Elevators) for control sequence. Smoke Detectors shall be installed in each elevator lobby. Smoke detectors shall be located at the top of the elevator hoistway when sprinklers are located above the lowest level of recall. Where sprinklers are located in the bottom of the hoistway, a smoke detector listed for the environment shall be installed within the pit. Smoke detectors shall be located in the elevator machine room if the machine room is sprinklered. Elevator equipment room smoke detectors and any smoke detectors in a sprinklered elevator shaft shall be programmed at the fire alarm panel to alert fire fighters when elevators are not safe to use. Provide control relays programmed for each recall function at the elevator controls.

2.31 ELEVATOR SHUTDOWN

- A. When an elevator shaft or equipment room is sprinklered, a shunt-trip breaker shall be provided on the elevator main power line circuit. The shunt-trip shall be activated by heat detectors prior to the application of water and the means shall not be self-resetting. The activation of sprinklers outside of the hoistway or equipment room shall not disconnect the main line power supply. Refer to NFPA 72 Section 21.4 and ASME A17.1 Section 2.8 (2.8.2.3.2) for control requirements. Means shall be provided to automatically disconnect the main power supply line to the affected elevator upon or prior to the application of water from sprinklers located in the machine room or in the hoistway more than 24 inches above the pit floor.
- B. The heat detectors provided shall feature both a lower temperature rating and a higher sensitivity than the sprinkler heads located these areas. Coordinate with the sprinkler system contractor. A heat detector shall be located within two feet of each sprinkler head in the elevator equipment room and hoistway.
- C. Provide fixed temperature heat detectors, they may be either addressable type attached to a SLC or point contact type devices on a dedicated two-wire IDC zone wired Class B with electrical supervision and end of line device. Provide a control relay to activate the shunt-trip breaker control circuit only when these particular heat detectors detect an alarm condition.
- D. Provide a monitor module for the Fire Alarm Voltage Monitoring Relay of the power disconnection interface (to monitor shunt trip voltage). Main line power disconnection shunt trip breaker operating power shall be monitored for the presence of operating voltage, per NFPA 72 - 2016 Section 24.4.4, and initiate a supervisory condition on detection of power loss.
- E. Local Authorities Having Jurisdiction may have amended code requirements for elevator systems in their jurisdiction. Reference local amended code requirements and provide elevator fire alarm controls per the local AHJ requirements.

2.32 CABLE

- A. The fire alarm contractor shall provide and install new and unused ASTM bare solid or stranded copper conductor cable per ANSI/NEMA, NEC and NFPA codes. Follow the manufacturer's instructions. All

cable shall be UL listed for fire protective, power limited applications. All cable exposed in plenum attic spaces shall comply with UL 910, UL 1424, and UL 1581 vertical tray flame test.

- B. Cabling shall be in accordance with local, state, and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for initiating device circuits and signaling line circuits, and 14 AWG (1.63 mm) for notification appliance circuits.
- C. Cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLP).
- D. Signaling Line Circuit (SLC): Use shielded, or unshielded cabling as recommended by the FACP manufacturer. When recommended, shielded cable should be utilized to minimize electrical noise interference with data transmission. Shield drain wire to be grounded at one end only.
- E. Between Building Signaling Line Circuit (SLC) or Network Node Circuits: Cabling between buildings shall be enclosed in conduit, including underground and over canopy installations. Cable installed in conduit between buildings shall be rated for direct burial. Use shielded or unshielded cabling as recommended by the FACP manufacturer.
- F. Notification Appliance Circuit (NAC): All audible/visual signaling circuits shall be NEC type FPLP as required. Equivalent by West Penn, Atlas, Belden, BSCC, or Remece.
- G. Initiating Device Circuits (IDC): All conventional contact alarm circuits and low voltage control circuits shall be NEC type FPLP as required. Equivalent by West Penn, Atlas, Belden, BSCC, or Remece.
- H. Remote, supervised, 24 volt fire alarm device power: Two-conductor unshielded wiring, shall be NEC type FPLP, 16 AWG, 14 AWG, or 12 AWG, solid two conductor signaling cable. Equivalent by West Penn, Atlas, Belden, BSCC, or Remece.

2.33 CEILING MOUNTED DEVICE BOX HANGERS

- A. All ceiling mounted devices including smoke detectors, heat detectors, remote power/status LEDs, ceiling mounted strobes and horn/strobes, et cetera, when mounted in a drop ceiling shall be supported by an electrical box hanger (Caddy #512 or #512A for deep boxes - 24" span), or equivalent. Box hangers shall be attached to the ceiling grid only for lateral stabilization, separate support wires shall be provided. The required support wires for the ceiling grid or light fixtures shall not be utilized. The backbox shall be flush and level with the bottom of the ceiling tile and the hole neatly cut for a finished appearance when the device is installed.
- B. Device and box hanger assemblies shall not be supported solely by suspended ceilings. Fasteners and supports shall be adequate to support the required load.

2.34 SURGE PROTECTION

- A. Each incoming 120VAC power circuit shall be provided with an electrical surge protection module. Provide one for each fire alarm control unit, this shall include every fire alarm control panel, digital communicator, signal power expander and any other 120VAC powered fire alarm control units. Each power circuit surge protector module shall be Ditek DTK-120SRD or equivalent.
- B. Surge protection shall be provided for all exterior devices, communications service or antenna entrance connections, and for each circuit that connects one building to another (i.e. any other portion of a building complex not under one continuous roof) at both entry/exit points to prevent damage to equipment. Each surge protector shall be UL listed and mounted in a standard grounded metallic electric box or equipment backboard with a separate ground wire ran directly to the ground bus bar or equipment panel ground stud, do not daisy chain ground wires.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Cooperation with trades of adjacent, related or affected materials or operations, and or trades performing continuations of this work under subsequent contracts are considered a part of this work. In order to effect timely and accurate placing of work and to bring together, in the proper and correct sequence, the work of such trades, including work provided under a Division 1 allowance.
- B. The Electronic Safety and Security Contractor shall coordinate installation of the fire detection and alarm systems with the Builder, Electrical, Mechanical, and Plumbing Contractors to insure a complete working system for the Owner.
- C. Where required for accessibility all conduit and boxes shall be provided by the Electrical Contractor as specified, including systems in Division 28, any and all allowances shall be included. Normally low voltage wiring shall run open and supported in accessible attic space. All low voltage wiring in exposed areas such as gyms, stages, shops, and field houses shall be enclosed in conduit. Coordinate with, and verify with Division 26 to provide required conduit and boxes at locations and heights as required.
- D. Conduit, innerduct, track, or raceway shall conceal and protect wiring in exposed areas, within walls, through in- accessible areas, floors, chases, under slab, crawlspaces, or underground.
- E. All conduit, duct, track, and raceway runs shall be spaced apart to allow for maintenance, such as the installation of couplings, without disturbing adjacent pathways.
- F. All work must be performed by workers skilled in their trade. The installation must be complete whether the work is concealed or exposed.
- G. Coordinate the actual locations of devices and outlets and equipment with building features and mechanical equipment as indicated on architectural, structural, and mechanical drawings. Review with the owner representative any proposed changes in outlet or equipment location. Relocation of devices, before installation, of up to 3 feet from the position indicated, may be directed without additional cost. Remove and relocate outlets placed in an unsuitable location when so requested by the Architect.

3.2 CABLE ROUTING, INSTALLATION

- A. The system cable, support and raceway installation shall be in accordance with good engineering practices and as established by the NFPA and NEC. Wiring shall meet all state and local electrical code requirements.
- B. All cable shall have a label on both ends utilizing self-laminating, flexible vinyl film, non-smear, machine printed labels.
- C. Fire alarm cables shall be run in bundles above accessible ceilings and supported from building structure building structure by j-hooks, conduit or cable tray.
- D. No terminations or splices shall be installed in or above ceilings.
- E. Fire alarm cables shall not be run loose on ceiling grid or ceiling tiles.
- F. Each cable run shall include a three-foot service loop with wire tie located in the ceiling above the control unit panel. This is to allow for future re-termination or repair.
- G. All cabling shall be placed with regard to the environment, EMI/RFI interference, and its effect on fire alarm signal transmission.
- H. Do not route any fire alarm cable within two feet of any light fixture, HVAC unit, service access area, electric panel, or any device containing a motor or transformer.
- I. Fire alarm cable must not be fastened to electrical conduits, mechanical ductwork/piping, sprinkler pipes.
- J. Plenum rated Velcro hook cable ties shall be furnished and installed to attach wire bundles to supports and for appropriate wire management as required. Tie wraps made of hard plastic or metal will not be allowed.

- K. Cabling shall be loosely bundled with cable ties randomly spaced at 30 to 48 inches on center, cable ties shall not be tight enough to deform cabling and shall not be used to support the cabling.
- L. Attachments for cabling support shall be spaced at approximately 48 to 60 inches on center. The cable bundle shall not be allowed to sag more than 12 inches mid-span between attachments. Provide J-hooks as follows:
 - 1. Bundles up to 1/2" diameter - 3/4" J-Hook
 - 2. Bundles up to 1" diameter - 1-1/2" J-Hook
 - 3. Bundles up to 1-1/2" diameter - 2" J-Hook
 - 4. Bundles greater than 1-1/2" diameter - provide cable tray.
- M. Do not mix different signal cables on the same J-Hook (i.e. fire alarm with telephone/data cable).
- N. Cable shall not be installed in the same conduit or surface track raceway with line voltage electrical cable without a metallic barrier meeting NEC requirements.
- O. Cable bends shall not be tighter than the manufacturers' suggested bend radius.
- P. The cable shall not be crushed, deformed, skinned, crimped, twisted, or formed into tight radius bends that could compromise the integrity of the cabling.
- Q. Maximum cable pulling tension should not exceed 25 pound-force (110 N) or the manufacturer's recommendation, whichever is less.
- R. Any pulling compounds utilized must be approved by the cable manufacturer and shall not degrade the strength or electrical characteristics of the cable.
- S. The cable pathway supports of ceiling installed devices must be positioned at least 12 inches above the ceiling grid. The required support wires for the ceiling grid or light fixtures shall not be utilized for support attachment.
- T. Cable routing must not obstruct hatches, doors, utility access panels, fire doors, ventilation shafts, grates, service work areas or parallel for more than four-feet with line voltage electrical conductors.

3.3 CONDUIT, SURFACE TRACK RACEWAY, ROUTING, INSTALLATION

- A. Conduit and surface track raceway and support installation shall be in accordance with good engineering practices and as established by the NFPA, and NEC. Conduit installation shall meet all state and local electrical code requirements.
- B. It shall be the responsibility of the electrical contractor to provide and install all conduit systems and standard electrical boxes for the fire alarm system.
- C. The fire alarm contractor shall coordinate all requirements with, and provide special back boxes to, the electrical contractor prior to installation of conduit.
- D. In all exposed and open ceiling areas such as gymnasiums, shops, field houses, janitors' closets, elevator hoist ways, and mechanical / electrical rooms all fire alarm cable shall be fully enclosed in conduit.
- E. Definitions:
 - 1. Electrical metallic tubing (EMT) for indoor applications. Compression fittings for EMT shall be used. Set screw fittings are not acceptable.
 - 2. Rigid metallic tubing (RMT) for outdoor applications. Threaded fittings shall be used for RMT conduit.
 - 3. Flexible metallic conduit (FMC) for indoor applications. FMC is approved for short protected cable connections to the device. Support FMC per NEC.
 - 4. Surface track raceway shall be Wiremold® or equivalent. Surface track raceway shall be utilized for indoor finished surfaces where concealed cable is impracticable or impossible. Back boxes of the same manufacturer and color shall be installed.

5. Polyvinyl chloride (PVC) for underground installations. Follow burial depth, protection and conduit fill per NEC.
- F. Conduit and surface track raceway shall be complete with bushings, de-burred, cleaned, and secure prior to installation of cable.
- G. Conduit and surface track raceway bends shall not be tighter than the manufacturers' suggested bend radius.
- H. All conduit and surface track raceway shall be supported from the structure at industry standard intervals for the size specified, utilizing proper anchoring devices. Cable fill may not exceed the standard set forth by the NEC.
- I. All conduit and surface track raceway runs shall be spaced apart to allow for maintenance without disturbing adjacent pathways.
- J. Conduit and surface track raceway shall not obstruct hatches, doors, utility access panels, fire doors, ventilation shafts, grates or service work areas.
- K. Conduit stubs from wall boxes to accessible areas above finished ceilings shall be provided for wall mounted devices. Provide bushings to protect the cable from damage from metal openings.

3.4 PROTECTION OF EQUIPMENT AND MATERIALS

- A. The Contractor shall take such precautions as may be necessary to protect his apparatus from damage.
- B. This shall include the creation of all required temporary shelters to protect any apparatus above the floor of the construction and the covering of apparatus in the completed building with tarpaulins or other protective covering.
- C. Failure to comply with the above to the satisfaction of the Owner's inspector will be sufficient cause for the rejection of the equipment in question and its complete replacement by the Contractor.

3.5 OPERATION PRIOR TO COMPLETION

- A. When the phasing of a project requires that fire alarm systems are operable in certain areas and the Owner needs to operate the equipment, such provisions shall be made by the contractor. The warranty period shall commence when the equipment is operated for the beneficial use of the Owner. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, properly adjust, and complete all punch list items before final acceptance by the Owner. The date of acceptance and the start of the warranty may not be the same date.

3.6 CUTTING AND PATCHING

- A. Notify the Builder sufficiently ahead of construction of any floors, walls, ceiling, roof, et cetera, of any openings that will be required for his work.
- B. The Contractor shall see that all sleeves required for his work are set at proper times to avoid delay of the job.
- C. All necessary cutting of walls, floors, partitions, ceilings, et cetera, as required for the proper installation of the work under this Contract shall be done at the Subcontractor or at the Subcontractor's expense in a neat and workmanlike manner, and as approved by the Owner's Representative.
- D. Patching of openings and/or alterations shall be provided by the Electronic Safety and Security Subcontractor or at the Subcontractor's expense in an approved manner.
- E. No joists, beams, girders, or columns shall be cut by any Contractor without first obtaining written permission of the Owner's Representative.
- F. All openings in firewalls and floors shall be completely sealed after installation for a completely airtight installation. Sealing material shall be non-combustible and UL approved. The installed sealing assembly

shall not cause the fire rating of the penetrated structure to be decreased.

- G. All openings in exterior walls shall be sealed watertight.
- H. Seal voids around conduits penetrating fire-rated assemblies and partitions using fire stopping materials and methods in accordance with NFPA and local codes.

3.7 FIRE STOPPING, DRAFT/NOISE STOPPING, PENETRATIONS, CORING

- A. UL Listed fire stopping methods that match the fire rating of the wall or floor being penetrated are to be used at all fire barrier penetrations. Seal the interior of the conduit sleeve around the cables and around the outside of the sleeve on each side of the penetration with fire-stop caulk or putty, install according to the manufacturers' instructions.
- B. All penetrations through fire rated walls or floors shall feature a suitable length of metal conduit. Hole diameter shall not exceed $\frac{1}{2}$ " larger than the conduit or sleeve to be installed. The hole shall be neatly cut, not oversize or irregular. Do not share wall/floor penetrations with ductwork, piping, line voltage electrical conduits, et cetera.
- C. Penetrations through non-rated walls shall include draft/noise stopping to minimize the transfer of air and sound between enclosed areas. Provide the penetration as in the rated wall instructions and install non-combustible mineral, wool, fiberglass, cellulose insulation, caulk, and/or sealant as required.
- D. Sleeves placed for new construction shall be coordinated with the building Architect, Engineer, Builder and Electrical Contractor so that later coring or drilling of building structural members will not be required. The Contractor must consult with the building Architect, Engineer, and Builder to place sleeves at approved, appropriate locations.
- E. Any concrete coring required this Contractor shall supply all labor, equipment, tools, materials and pay for the X-ray and concrete coring contractor to create any additional penetrations. Approval shall be required by the Owner's Representative before coring can take place. Under no circumstances shall penetrations be made without approval. Care shall be taken not to stress, overheat, or penetrate any building support member. Utilizing a chisel or percussion type equipment is forbidden.

3.8 SIGNAL TYPES (SYSTEM STATUS)

- A. General: The Fire Alarm Control Panel shall indicate various conditions or signals depending on system inputs. In all instances, a more severe signal shall override all less severe signals. All events are to be recorded with time and date in an electronic event history log maintained by the fire alarm control panel. The following is a short description of conditions that the Fire Alarm Control Panel is required to indicate in order of severity.
 - 1. WATERFLOW FIRE ALARM: A waterflow signal is a special alarm condition that is only applicable when an automatic building sprinkler or similar system is monitored. It indicates that at least one sprinkler head is open, so in addition to a fire, the premises are subject to water damage. This signal is transmitted on a special channel on the digital communicator. This is a fire alarm condition and all actions listed under fire alarm shall take place.
 - 2. FIRE ALARM: This alarm signal is indicative of fire. Such a signal indicates an emergency requiring immediate action. All premises audible and visual notification appliances shall operate and the protected premises evacuated. A local audible alert shall sound, the alarm LED illuminate, and descriptive message appear on the LCD display at the panel and any remote annunciators until the panel is reset. The digital communicator transmits a fire alarm signal.
 - 3. SUPERVISORY ALARM: A supervisory signal indicates the need for action concerning a duct mounted smoke detector, or the maintenance of related systems. An audible alert shall sound, the supervisory LED illuminate, and descriptive message appear on the LCD display at the panel and any remote annunciators until silenced. The digital communicator transmits a supervisory signal.
 - 4. TROUBLE: A trouble signal indicates a fault in a monitored circuit or component of the fire alarm system. This could be a short, open, or ground in a supervised circuit. It could also indicate a device or battery failure. A local audible alert shall sound, the trouble LED illuminate, and descriptive message appear on the LCD display at the panel and any remote annunciators until silenced. The digital communicator transmits a trouble signal.

5. MAINTENANCE ALERT: A maintenance alert is an early warning of a condition before a device becomes inoperable. This is often a smoke detector that needs cleaning or other normal maintenance item. The maintenance alert shall display on the panel and any remote annunciator LCD display until acknowledged. No audible alert shall sound and no signal transmitted, in order that this condition not be confused with a supervisory or trouble condition.
6. NORMAL: All systems and supervised circuits functioning normally.

3.9 SEQUENCE OF OPERATION

- A. Alarm Condition: When a fire alarm condition is indicated by any manual pull station, heat detector, area smoke detector shall cause the following actions or effects to take place:
 1. At the panel and any remote annunciators, a system alarm LED shall flash and a local sounding device shall activate.
 2. The 80-character LCD display shall indicate all pertinent information associated with the alarm condition and its location.
 3. The digital communicator shall activate and transmit a GENERAL ALARM signal to the monitoring company.
 4. All audible and visual signal devices shall activate and operate until silenced manually, or until automatically silenced, by the control panel. Any subsequent alarm from another device shall automatically reactivate all audible and visual signal devices.
 5. Fire safety control functions related to providing free egress from the facility shall be activated on general alarm, including the automatic opening of any controlled motorized security grills and automatic unlocking for egress of any controlled non-fire rated security doors or gates.
 6. Fire safety control functions conditional on the detection of an alarm condition in one or more designated adjacent area smoke detectors shall be activated independently on a one-for-one basis, these functions may include air handler shutdown of units without a duct mounted smoke detector, electromagnetic door hold back release, release of overhead coiling or hinged fire or smoke rated doors or shutters (those designed to close in order to control the spread of fire or smoke), high volume low speed (HVLS) fan shut down, and any other conditional operations such as elevator recall.
 7. Each Fire Safety Control Function circuit controlled device shall be configured such that when the fire alarm system safety control function circuit is re-energized, by the fire alarm control panel, the device shall return to normal operation (e.g. be ready to re-start) without a need for manual or environmental control system intervention.
 8. The FACP event history storage equipment shall log the information associated each new fire alarm control panel condition, along with time and date of occurrence.
- B. When a dangerous accumulation of Carbon Monoxide gas is detected on any CO detection unit zone the following actions or effects shall take place:
 1. At the individual initiating CO detection unit, the red LED alarm light will come on and stay on, the temporal-four pattern audible sounder base alarm will sound.
 2. At the panel and any remote annunciators, a system alarm LED shall flash and a local sounding device shall activate.
 3. The 80-character LCD display shall indicate Carbon Monoxide Alarm, the zone number, and its location.
 4. The digital communicator shall activate and transmit a Carbon Monoxide Alarm, the zone number, and its location to the monitoring company.
 5. The FACP event history storage equipment shall log the information associated each new fire alarm control panel condition, along with time and date of occurrence.
- C. The detection of any system internal or external trouble condition or the actuation of any supervisory alarm condition, as applicable, including any duct mounted smoke detector shall automatically cause the following actions to take place:
 1. At the panel and any remote annunciators, a system supervisory alarm LED or trouble LED shall flash as appropriate and a local sounding device shall activate. Audible supervisory or trouble alerts that have been silenced shall automatically resound every twenty-four hours or less until repairs are made.
 2. The 80-character LCD display shall indicate all pertinent information associated with the trouble or supervisory condition and its location; however, unacknowledged alarm messages shall have priority over trouble messages.

3. The digital communicator shall activate and transmit a SUPERVISORY or TROUBLE signal to the monitoring company.
4. Conditional activation on supervisory alarm of any automatic programs assigned to the supervisory alarm point shall be executed and the associated indicating devices and relays shall be activated. When duct mounted smoke detectors indicate a supervisory alarm provide instantaneous activation of related fire safety control functions including any electromagnetic door hold back and release devices and any air handler shut down relays and smoke fire damper motors.
5. Detection of a supervisory alarm in a duct mounted smoke detector shall initiate shutdown of the associated air handler and closing of any smoke dampers or fire/smoke dampers located in that unit's duct system, on a conditional one-for-one basis.

3.10 BASIC SETUP AND TESTING

- A. The completed system is to be tested for compliance with the specifications.
- B. The System Contractor shall make a thorough inspection of the complete installation to ensure the following:
 1. Complete and functional system.
 2. Installed in accordance with manufacturer's instructions.
- C. Prior to the testing, ensure that the system is free of short circuits, ground loops, excessive system noise beyond published specifications of the equipment, hum, RF interference, or instability of any form.
- D. The testing work shall be performed after installation has been completed, but prior to any use of the system.
- E. All audio inputs, including live microphone, automated evacuation messages, temporary testing signal, and any additional low priority inputs such as an intercom/public address, telephone system paging, and background music (if approved by the LAHJ), shall be adjusted and matched to the produce proper effective volume output from the system.
- F. Always operate audio amplifiers and speakers within their specified ratings. Excessive input may distort sound quality and may damage audio equipment. Do not exceed +130% of speaker input voltage per UL 1480. Improper input voltage can damage speaker. If distortion is heard, check for clipping of the audio appliance with an oscilloscope and reduce the amplifier input level or gain level to eliminate any clipping.
- G. Check the installation instructions of the manufacturers of other equipment used in the system for any guidelines or restrictions on wiring and/or locating Voice Notification Appliance Circuits (Voice NAC) and notification appliances. Some system communication circuits and/or audio circuits, for example, may require special precautions to assure electrical noise immunity (e.g. audio crosstalk).
- H. The system shall be set up for a general occupancy and at no point in the testing or operation of the system shall output be allowed to exceed 95 dB at any occupiable position to prevent possible hearing damage, and system damage. It is prohibited at any time to "ring out" the system by turning it up until it distorts.
- I. The installer shall maximize the gain structure and balance each system component to provide the least possible variation in sound level and frequency response in each area as required. The testing shall be performed with a minimum of the following equipment:
 1. Professional 1/3 octave Real Time Analyzer (RTA) and Type One sound pressure level (SPL) meter - Ivie IE-30A or PC-40 with calibrated microphone or equivalent by Crown or White Instruments.
 2. Pink Noise Generator - Ivie IE-20B or equivalent by Crown or White Instruments.

3.11 PERFORMANCE TESTING

- A. After basic setup and testing, the sound system shall meet or exceed the following specifications:
 1. System shall be free of short circuits, ground loops, parasitic oscillation, excessive system noise, hum, and instability of any form, including RF interference.
 2. Maximum SPL with band-limited pink noise input to the system shall be 95 dB before audible distortion occurs.

- B. Acoustic response of the system shall be plus or minus 1.5 dB along a line which is flat from 100 Hz to 1250 Hz and which rolls off at 2 dB per octave to 8 kHz.

3.12 VOICE INTELLIGIBILITY TESTING

- A. Once the basic setup is complete, the gain structure is maximized, and the performance testing as outlined above is completed, this contractor shall conduct voice intelligibility testing as prescribed in the NFPA 72, the local AHJ, and as follows:
1. The building shall be divided into Acoustically Distinguishable Spaces for testing by basic areas of the building and single rooms.
 2. Final voice intelligibility testing shall be conducted in accordance with the test instrument manufactures written instructions and during normal hours of operation and under normal building occupancy conditions including all final room finishes, furnishings, and with a nominal number of occupants at their normal activity level, or as near as these conditions can be simulated. Simulation may include taking sample background noise measurements or "captured curves" for each designated ADS with stand in personnel for use in the testing process.
 3. From each designated fixed-point test location in each ADS, the technician shall calibrate the test instrument, measure, and record the STI value while the test signal is played through the entire building emergency communication system.
 4. Voice intelligibility test results for this emergency communication system will be acceptable if at least 90% of the measurement locations within each ADS has a measured STI of not less than 0.45 (CIS of not less than 0.65), and an average STI of not less than 0.50 (an average CIS of not less than 0.70). The contractor shall make any system adjustments or modifications needed for each ADS to pass the indelibility testing.
 5. If an ADS does not meet the above requirements due to low readings, the testing procedures shall be verified, and adjustments made that may include increasing the volume of individual speakers, changing types or adding additional speakers, or working with the Architect to provide acoustical treatments that will reduce inordinate background noise and/or reverberation.
 6. The final acceptance of the system by the Owner/Architect/Engineer will be based upon the proper performance of the completed system.

3.13 SYSTEM RECORD OF COMPLETION, INSPECTION AND TESTING, WARRANTY, SERVICE

- A. A factory-trained representative of the manufacturer shall supervise the final connections and testing of the system and it shall be subject to the final acceptance of the Architect, Engineer, and local authorities. Testing shall be per NFPA 72, Chapter 7 Documentation. Provide applicable forms for each Record of Completion, Inspection and Testing and other documents from NFPA 72, Chapter 7. Testing shall include, but not be limited to, the following:
1. Before energizing the system check all cables for correct connections and test for short circuits, ground faults, continuity, and insulation.
 2. Close each sprinkler system valve with a tamper switch, when applicable, and verify proper supervisory alarm at the FACP.
 3. Verify alarm activation of waterflow switches by operation of the test port valve on each riser (when applicable).
 4. Open each initiating device circuit and verify that the trouble signal actuates.
 5. Open and short each signaling line circuit and verify that the trouble signal actuates.
 6. Open and short each notification appliance circuit and verify that trouble signal actuates.
 7. Individually ground each circuit and verify response of trouble signals.
 8. Check for presence of strobe signal and audibility of tone at all alarm notification devices.
 9. Check installation, supervision, and operation of all area detectors using the walk test.
 10. Check installation, configuration, and operation of all duct mounted smoke detectors. Verify that there is adequate airflow through the sample tubes and housing to activate the detector when smoke is present in the duct.
 11. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
 12. Verify proper operation of all fire safety control functions including when applicable fire door hold open/release, coiling fire door release, air handler shutdown, smoke damper or fire/smoke damper control, high volume low speed (HVLS) fan shut down, and the automatic opening of any controlled motorized security grills and automatic unlocking for egress of any controlled non-fire rated

- security doors or gates.
13. Check operation of elevator recall and shunt-trip when applicable.
 14. Ensure that all dust covers are removed from smoke and heat detectors at substantial completion.
- B. The Fire Alarm Contractor shall be ultimately responsible for safe and complete operation of the system. Any issues affecting proper operation of the system relating to the Electrical, Mechanical, Fire Protection, Fire Suppression or other contractors shall be resolved by the Fire Alarm Contractor, at no additional cost to, and without requesting intervention by the Owner.
- C. The Fire Alarm Contractor shall provide a complete, dated, installation certificate meeting state requirements for each installation including a System Record of Completion and an Emergency Communications Systems Supplementary Record of Completion. A Fire Alarm Installation Record sticker listing the; installation firm's name, address, and telephone number; signature of Licensee and license number; Fire Alarm Planning Superintendents name and license number; and the installation date, meeting state requirements shall be attached to the main fire alarm control panel. The Fire Alarm Contractor shall submit a copy of the installation certificate, final testing forms with final results and speech intelligibility testing results to the Architect at the time of substantial completion.
- D. The contractor shall provide a labor warranty of the installed system against defects in material or workmanship for a period of one (1) year from the date of substantial completion. Provide the equipment manufacturer's warranty information with the operating and maintenance (O&M) manual.
- E. Equipment or cabling shown to be defective shall be replaced, repaired, or adjusted free of charge. All equipment will carry a one-year warranty or manufacturer's warranty whichever is greater. All labor and materials shall be provided at no expense to the Owner.
- F. Immediately prior to the end of the warranty period, the system shall be inspected and certified for the following year at no additional cost to the Owner.

3.14 AS-BUILT DRAWINGS, MANUALS, TRAINING

- A. As-built drawings and operating and maintenance (O&M) manuals may be electronically transmitted in PDF file format (preferred) or paper copies may be provided in quantities indicated in Division 1. Paper copies shall be organized including index tabs in a 3-ring black binder of sufficient size.
- B. Upon completion of the installation, and prior to final inspection, the fire alarm Contractor shall furnish as-built drawings.
- C. In addition, the fire alarm contractor shall furnish complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets. Manuals shall include wiring diagrams to indicate internal wiring for each device and the interconnections between the items of equipment. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system. Provide a parts list with manufacturer and model number for commonly replaced parts. Include complete instructions for the inspection, testing, and maintenance of the system.
- D. Provide fire alarm testing frequency information to the owner in the O&M manual per NFPA 72, Section 14.4.4.
- E. Provide the Owner a copy of the panel control software including the licensed program, site specific data file, and passwords that the Owner may require to maintain the system.
- F. The fire alarm contractor shall conduct formal on-site training sessions. It shall be the responsibility of the Contractor to coordinate time and location of training sessions with the Owner. Provide documented general instruction as follows:
1. Provide instruction to the maintenance personnel to include the location, inspection, maintenance, testing, and operation of all system components. Provide a minimum of four (4) hours-two 2-hour sessions separated by a minimum of two weeks.
 2. Provide instruction to designated personnel on the functions and operation of the FIRE DETECTION AND ALARM SYSTEM including capabilities, limitations, monitoring, and the meaning of status messages. State the proper procedure for fire drills, routine maintenance, and request for service. Provide a minimum of four (4) hours-two 2-hour sessions separated by a

minimum of two weeks.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.1 SCOPE

- A. Furnish all labor, materials, tools, equipment, and services for site clearing and grubbing, and stripping topsoil as required, in accord with provisions of Contract Documents.
- B. Completely coordinate with work of all other trades.
- C. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation. Also included in this section is the preparation of the "Storm Water Pollution Prevention Plan" (SWPPP), installation of the erosion control devices per the SWPPP, completion of the "Notice of Intent" (NOI), and submittal of the NOI per the Environmental Protection Agency (EPA) and City requirements.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 22 00 - Grading
- B. Section 31 22 19 - Finish Grading

1.3 QUALITY ASSURANCE

- A. Perform work in accord with OSHA, EPA, state and local requirements.

PART 2 - EXECUTION

2.1 SUBMITTALS

- A. Complete EPA "Notice of Intent" and submit per the EPA and City requirements.

2.2 PROTECTION

- A. Provide barricades, coverings, and other protection necessary to prevent damage to existing improvements to remain.
 - 1. Protect improvements on adjoining properties as well as those on Owner's property.
 - 2. Restore improvements damaged by this work to original condition, as acceptable to Owner, other parties, and authorities having jurisdiction.
- B. Protect existing vegetation, including trees, to remain against damage.
- C. Repair or replace vegetation, including trees, damaged by construction operations.

2.3 IMPROVEMENTS ON ADJOINING PROPERTY:

- A. Owner will obtain authority for performing removal and alteration work, if any, on adjoining property.

2.4 SITE CLEARING - GENERAL

- A. Install Erosion Control Devices
- B. Remove vegetation, improvements, or obstructions that interfere with new construction.
 - 1. Removal includes stumps of the trees and their roots.
 - 2. Removal includes all structures that interfere with new construction to a depth of two feet below finished grade outside of proposed building areas and to a depth of five

feet below finished grade in proposed building areas.

3. All open structures below grade, shall be filled to finish grade. Backfill of open structures shall meet the requirements as specified in Section 31 22 00.

C. Remove other items when specifically indicated.

2.5 CLEARING

A. Clear from above surface of existing ground all brush, downed timber, rotten wood, heavy growth of grass and weeds, vines, rubbish, debris that interferes with new construction and legally dispose of offsite. Remove stones larger than 4 inches in any dimension and all tree roots larger than 2 inches in diameter and legally dispose of offsite.

B. Limits of clearing to include all areas that are disturbed in the course of work.

2.6 REMOVAL OF IMPROVEMENTS

A. Remove surfacing and pavements, including bases, concrete slabs, concrete and masonry walls, structures, buildings, posts, poles, fences, and other items on the property.

2.7 STRIPPING SITE

A. Strip all vegetated areas that are to be disturbed by construction to a depth of two inches.

1. Strip to prevent intermingling with underlying topsoil.

2. Strippings shall be removed from the site.

2.8 TOPSOIL REMOVAL AND SALVAGE

A. DEFINITIONS

Topsoil: A layer of organic material typically 6 to 12 inches thick below the two inches of material to be stripped. Topsoil should be friable, fertile, dark, loamy soil, free of clay lumps, subsoil stones, and other extraneous material and reasonably free of weeds and foreign grasses.

B. Remove topsoil under proposed pavements, extending 2 ft. minimum beyond the pavement edge. Remove to prevent intermingling with underlying subsoil or objectionable material.

C. Stockpile the amount of topsoil required to complete the work specified in Section 31 22 19.

D. Stockpile topsoil in areas as indicated by the Engineer.

1. Maximum stockpile height shall be 8 feet.
2. Maximum stockpile side slopes shall be 3 (horizontal) to 1 (vertical).
3. Construct storage pile to freely drain surface water.
4. Seed or cover storage piles to prevent erosion.

2.9 DISPOSAL OF WASTE MATERIALS

A. Burning of materials is not allowed.

B. Remove all waste materials from site and dispose of in a legal manner.

C. Remove concrete and masonry from site and dispose of in a legal manner.

END OF SECTION

SECTION 31 22 00

GRADING

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all work required to complete the project as indicated by the Contract Documents and furnish all supplementary items necessary for the completion of all work specified in this Section.
- B. The work included in this Section shall include furnishing all labor, tools, materials and incidentals required to complete the work; excavate and fill to the lines, elevations and limits shown on the drawings as per the drawings for all pavements, landscape areas, etc. as indicated below and cleaning up. Earthen areas shall be graded to an elevation 6 inches below finished grade allowing for topsoil placement. Pavement areas shall be graded to an elevation below finished grade allowing for select fill and/or and pavement placement. Also included in this section is the maintenance of erosion control devices per the "Storm Water Pollution Prevention Plan" (SWPPP) and the "Notice of Intent" (NOI) per the E.P.A. requirements. The Contractor shall comply with all requirements of the geotechnical investigation, the E.P.A. requirements and with the standards and specifications stated herein. The most stringent shall apply.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 10 00 - Site Clearing
- B. Section 31 22 19 – Finish Grading
- C. Section 33 00 00 – Utilities
- D. Section 33 40 00 – Storm Drainage Utilities

1.3 QUALITY ASSURANCE

- A. Codes and Standards
 - 1. Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.
 - 2. All work shall comply with the recommendations set forth in the Geotechnical Engineering Report prepared for this project.
- B. Testing and Inspection Service
 - 1. The Owner will engage a soil testing and inspection service for quality control testing during earthwork operations to inspect and test all soil materials proposed for use in all excavation and fill operations.

1.4 JOB CONDITIONS

- A. Site Information
 - 1. Test borings and other exploratory operations may be made by the Contractor at no cost to the Owner.
- B. Existing Utilities
 - 1. It shall be the Contractor's responsibility to verify the location (horizontal and vertical depth) of all utilities prior to beginning earthwork operations. If utilities are to remain in place, provide protection from damage during construction operations.
 - 2. Should uncharted or incorrectly charted piping or other utilities be encountered

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- during excavation, consult Owner immediately for directions as to proceed. Cooperate with Owner, public and private utility companies in keeping services and facilities in operation. Repair damaged utilities to satisfaction of utility Owner.
3. Do not interrupt existing utilities serving facilities occupied and used by Owner, except when permitted in writing by Owner and then only after temporary utility services have been provided.
- C. Use of Explosives
1. The use of explosives is not permitted.
- D. Protection of Persons and Property
1. Barricade open excavations occurring as part of this work and post with warning lights. Operate warning lights as recommended by authorities having jurisdiction.
 2. Provide sheeting, shoring and bracing, whenever the excavation or trench is more than five feet in depth. When sheeting and bracing are necessary the trench or excavation shall be dug to such width that proper allowance is made for the space occupied by the sheeting. All sheeting, shoring and bracing shall have sufficient strength and rigidity to withstand the pressure exerted and protect all persons and property from injury or damage. Neither sheeting nor shoring shall be left in place, but shall be removed in such a manner as not to endanger or damage new or existing structures. All holes or voids left by the removal of sheeting shall be backfilled.
 3. Protect structures, utilities, sidewalks, pavements, and other facilities from damages caused by settlement, lateral movement, undermining, washout and other hazards created by excavation operations.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Fill Material (General site grading):
1. Onsite excavated soils free from deleterious matter, vegetation, rocks or soil particle larger than 4 inches in diameter or other objectionable material.
- B. Imported Fill Material (General site grading):
1. Similar to onsite soils preferably with a liquid limit less than 50.
 2. Imported fill material, if required, shall be obtained offsite at no additional expense to the owner.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

- A. Examine the areas and conditions under which earthwork and site grading operations are to be performed. All areas to receive fill and the subgrades of excavations shall be proofrolled with a heavy pneumatic tired roller, loaded dump truck or similar equipment weighing approximately 25 tons or greater to help compact pockets of loose soil and expose additional areas of weak, soft or wet soils in the presence of the Owner's Representative. Proof rolling shall not be performed within 10 feet of the existing building in order to not damage the existing structure. Notify the Owner in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.

3.2 EXCAVATION

- A. The Contractor shall excavate to the lines and elevations shown on the Drawings, and as previously indicated herein, regardless of the type, condition, or moisture content of the material encountered. The Owner does not guarantee that materials other than those shown on the Drawings will be encountered, or that the proportions of various materials will not vary from those shown or indicated in the subsurface investigation. Conduct excavation operations to provide positive drainage, at Contractor's expense, at all times during construction.
- B. All areas shall be cut accurately to the indicated grades. Care shall be taken to prevent excavation below the grades indicated and any bottoms or slopes that have been undercut shall be backfilled with approved materials and compacted to the required fill density.
- C. Excavation required for rough grading shall be finished within a tolerance of 0.10 foot above or below the rough grade and in no case shall depressions be left that will not completely drain. All excavated clay soils shall be used for the construction of fills and embankments and no material shall be wasted without the authority of the Owner.
- D. If rock is encountered in the subgrade it shall be loosened to a depth of 6 inches below the required subgrade elevation. It shall then be replaced with suitable materials and compacted as specified. The surface shall be shaped to the grades and slopes shown on the plans.
- E. All excavation and preparation in building areas and within ten feet of building areas shall be performed per the recommendations in the geotechnical investigation and the structural engineer's specifications and drawings.

3.3 FILLING – (OUTSIDE OF BUILDING AREAS)

- A. Remove all vegetation, organic materials and debris prior to placing fill. If granular/sandy material is encountered, it may require removal and/or blending with more clayey soils or cement to provide subgrade that can be properly placed and compacted.
- B. Areas to receive fill or pavement shall be scarified to a depth of six (6) inches and compacted to 95% to 100% maximum dry density as defined by ASTM D698, with the moisture content between optimum and -2% and +5% of optimum.
- C. Compaction outside building areas shall be obtained by use of sheeps foot rollers, rubber-tired rollers, or other approved equipment capable of obtaining the required density. Track type equipment such as bulldozers or front-end loaders are not acceptable for compaction. Compaction in sidewalk and flat work areas shall be obtained by use of small sheeps foot compactors or similar portable equipment capable of obtaining the required density without damaging adjacent walls and buildings. In the event the embankment material is too wet or too dry for adequate compaction, Contractor shall add moisture or dry the material as required to the extent necessary to obtain the required density.
- D. Place subsequent lifts of fill in thin, loose layers eight (8) inches or less in thickness with the maximum particle size being 4 inches in diameter prior to compaction.
- E. Uniformly compact each lift to 95% to 100% maximum dry density as defined by ASTM D698, with the moisture content between optimum and -2% and +5% of optimum pavement and landscape areas.
- F. In cases where mass fill or utility line backfills are over ten (10) feet deep, the portion of the fill/backfill below ten (10) feet deep shall be compacted to a minimum 98% of maximum dry density as defined by ASTM D698, with the moisture content between two (2) percent below and two (2) percent above in pavement and landscape areas.

- G. In areas where new fill is placed over sloping ground steeper than 6 horizontal to 1 vertical, the fill shall be "tied in" to the underlying soils with benches a minimum five (5) feet in width, depending upon the steepness of the slope. The fill shall then be placed and compacted as specified above.
- H. All fill placement in building areas and within ten feet of the building structure shall be performed per the recommendations in the geotechnical investigation and the structural engineer's specifications and drawings.

3.4 MOISTURE CONTROL

- A. Where soil material must be moisture conditioned before compaction, uniformly apply required amount of water to surface of soil material in such manner as to prevent free water appearing on surface during, or subsequent to, compaction operations.
- B. Remove and replace, or scarify and air dry soil material that is too wet to permit compaction to specified percentage of maximum density.
- C. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread on surface where directed by Owner's Representative and permitted to dry. Assist drying by disking, harrowing or pulverizing, until moisture-density relation tests fall within the herein specified range.

3.5 FIELD QUALITY CONTROL

- A. Quality Control Testing During Construction
 - 1. Allow testing service to inspect and approve subgrades and fill layers before further construction work is performed.
 - 2. If, in the opinion of the testing lab, based on testing service and inspection, the subgrade or fills, which have been placed below the specified density, provide additional compaction and testing at no additional expense to the Owner.
 - 3. The results of density tests will be considered satisfactory when they are in each instance equal to or greater than the specified density, and if not more than 1 density test out of 5 has a value greater than 2% below the required density.

3.6 MAINTENANCE

- A. Protection of Graded Areas
 - 1. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
 - 2. Repair and re-establish grades in settled, eroded, and rutted areas to the specified tolerances.
- B. Reconditioning Compacted Areas
 - 1. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction. Use hand tamping for recompaction over underground utilities.

3.7 DISPOSAL OF EXCESS AND WASTE MATERIALS

- 1. Remove all trash, debris and waste materials, and legally dispose of offsite at no additional expense to the Owner.
- 2. Excess earthwork material shall be disposed of offsite at no additional expense to the owner.

END OF SECTION

SECTION 31 22 19

FINISH GRADING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish all labor, materials, tools, equipment, and services for all topsoiling and finished grading, as indicated, in accord with provisions of Contract Documents.
- B. Completely coordinate with work of all other trades.
- C. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

1.2 LOCATION OF WORK

- A. All areas within limits of construction, areas of surplus material disposal, and all areas, which are disturbed in the course of the work.

1.3 RELATED SECTIONS

- A. Section 31 10 00 - Site Clearing
- B. Section 31 22 00 - Grading

1.4 QUALITY ASSURANCE

- A. Finish Grading Tolerance:
 - 1. Within 0.1 foot plus or minus from required elevations.

1.5 JOB CONDITIONS:

- A. Verify amount of topsoil stockpiled and determine amount of additional topsoil, if necessary to complete work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Topsoil:
 - 1. Topsoil: A layer of organic material typically 6 to 12 inches thick below the two inches of material to be stripped. Topsoil should be friable, fertile, dark, loamy soil, free of clay lumps, sub-soil stones, and other extraneous material and reasonably free of weeds and foreign grasses. Topsoil containing dallisgrass, nutgrass or weeds shall be rejected.
 - a. Use existing topsoil stockpiled under Section 02100.
 - b. Physical properties of topsoil should be as follows:
 - Clay - between 7-27 percent
 - Silt - between 28-50 percent
 - Sand - less than 52 percent

The soil shall be tested at a lab and the results, including suggested treatments for soil, sent to the landscape architect.

 - b. If amount of topsoil stockpiled is less than amount necessary for the work, furnish all additional topsoil required at no additional cost to the Owner.

- c. Contractor may import topsoil to the site with prior review and approval by the Engineer/Landscape Architect.
- B. Surplus Topsoil:
 - 1. Spread and compact to 90 percent maximum dry density in locations on site designated by the Owner.

PART 3 - EXECUTION

3.1 ROUGH GRADE REVIEW

- A. Rough grading reviewed by Engineer in Section 31 22 00, Rough Grading.

3.2 PREPARATION

- A. Correct, adjust and/or repair rough graded areas.
 - 1. Cut off mounds and ridges.
 - 2. Fill gullies and depressions.
 - 3. Perform other necessary repairs.
 - 4. Bring all sub-grades to specified contours, even and properly compacted.
- B. Remove all stones and debris over 2 in. in any dimension.

3.3 PLACING TOPSOIL

- A. Do not place topsoil when subgrade is either wet or frozen enough to cause clodding.
- B. Spread topsoil to minimum compacted depth of 6 in for all disturbed earth areas.
- C. Make finished surface free of stones, sticks, dirt clods or other material 1 in. or more in any dimension.
- D. Drag finish with harrow (or hand rake) to insure smooth finish to the lines and grades indicated.
- E. Restore areas occupied by stockpiles to condition of rest of finished work.

3.4 ACCEPTANCE

- A. Upon completion of topsoiling, obtain Engineer's acceptance of grade and surface.

END OF SECTION

SECTION 31 31 16
TERMITE CONTROL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Soil treatment.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components, and profiles for termite control products.
2. Include the EPA-Registered Label for termiticide products.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
B. Product Certificates: For each type of termite control product.
C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:
1. Date and time of application.
2. Moisture content of soil before application.
3. Termiticide brand name and manufacturer.
4. Quantity of undiluted termiticide used.
5. Dilutions, methods, volumes used, and rates of application.
6. Areas of application.
7. Water source for application.
D. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located and who employs workers trained and approved by manufacturer to install manufacturer's products.

1.6 FIELD CONDITIONS

- A. Soil Treatment:
1. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
2. Related Work: Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.7 WARRANTY

- A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work consisting of applied soil termiticide treatment will prevent infestation of subterranean termites, including Formosan termites (*Coptotermes formosanus*). If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain termite control products from single source from single manufacturer.

2.2 SOIL TREATMENT

- A. Termiticide: EPA-Registered termiticide acceptable to authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Corporation, Agricultural Products; Termidor.
 - b. Bayer Environmental Science; Premise 75.
 - 2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Prepare work areas according to the requirements of authorities having jurisdiction and according to manufacturer's written instructions before beginning application and installation of termite control treatment(s). Remove extraneous sources of wood cellulose and other edible materials, such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.
- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.
 - 1. Fit filling hose connected to water source at the site with a backflow preventer, according to requirements of authorities having jurisdiction.

3.3 APPLYING SOIL TREATMENT

- A. Application: Mix soil treatment termiticide solution to a uniform consistency. Distribute treatment uniformly. Apply treatment at the product's EPA-Registered Label volume and rate for maximum specified concentration of termiticide to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction.
 - 1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
 - 2. Foundations: Soil adjacent to and along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing.
 - 3. Crawlspace: Soil under and adjacent to foundations. Treat adjacent areas, including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.
 - 4. Masonry: Treat voids.
 - 5. Penetrations: At expansion joints, control joints, and areas where slabs and below-grade walls will be penetrated.
- B. Post warning signs in areas of application.
- C. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

3.4 PROTECTION

- A. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- B. Protect termiticide solution dispersed in treated soils and fills from being diluted by exposure to water spillage or weather until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

3.5 MAINTENANCE SERVICE

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12months' full maintenance by skilled employees of termite-control-treatment Installer. Include monthly maintenance as required for proper performance according to the product's EPA-Registered Label and manufacturer's written instructions. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
- B. Continuing Maintenance Proposal: Provide from termite-control-treatment Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.
 - 1. Include annual inspection for termite activity and effectiveness of termite treatment according to manufacturer's written instructions.

END OF SECTION

SECTION 31 63 29

DRILLED CONCRETE PIERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Drilling and cleaning pier holes
 - 2. De-watering of shafts and removal of spoil
 - 3. Casing pier holes
- B. Products Installed, Not Furnished Under This Section
 - 1. Concrete and reinforcing steel
 - 2. Anchor bolts, templates and dowels
- C. Basis for Bids
 - 1. Base Contract Price on number and base depth of piers as shown on Drawings.
 - 2. Include temporary casing in Base Contract Sum for drilled piers.
 - 3. Pay depth of straight shaft piers shall be calculated as the sum of the measured depth from ground surface to the top of the bearing stratum, plus the depth that casing is required to extend below the top of the bearing stratum, plus the required penetration into the bearing stratum.
 - 4. No additional depth of drilling will be included in the pay depth unless required in writing by the inspecting agency.
- D. Unit Prices
 - 1. Piers: provide add and deduct unit price per lineal foot shorter or longer than bid depth.
 - a. Above bearing stratum.
 - b. Within bearing stratum.
 - 2. Casings: provide add and deduct unit price per lineal foot for installation and removal of temporary steel casings. Unit price shall be based upon actual length of temporary steel casing as measured from ground elevation to bottom of casing.
 - 3. Unit prices shall be for complete unit of work including labor, materials, overhead, taxes and profit.

1.2 REFERENCES (Latest Edition)

- A. Specifications of the Association of Drilled Shaft Contractors.
- B. American Concrete Institute (ACI)
 - 1. ACI 336.1: "Standard Specification for Construction of End Bearing Drilled Piers"
 - 2. ACI 336.3: "Suggested Design and Construction Procedures for Pier Foundations"

1.3 SUBMITTALS

- A. Pier Log: for each pier record the following:
 - 1. Identification mark
 - 2. Shaft diameter
 - 3. Top of bearing stratum elevation
 - 4. Bottom of pier elevation
 - 5. Penetration of bearing stratum
 - 6. Pier reinforcing (vertical bars and ties)
 - 7. Steel cage length
 - 8. Depth and diameter of casing, where casing required
 - 9. Top of Pier Elevation
 - 10. Concrete quantity
 - 11. Date and time drilling completed
 - 12. Date and time concrete placement begun and completed
 - 13. Plumbness variation
 - 14. Condition of drilled hole before placement of concrete

1.4 QUALITY ASSURANCE

- A. Qualifications
 - 1. Contractor: at least 3 years of experience in similar applications.

- a. Experience shall be relevant to anticipated subsurface materials, water conditions, shaft sizes and special techniques required.
2. Demonstrate to Architect dependability of equipment and techniques to be used, when requested.
- B. Drilled pier construction shall conform to requirements of ACI 336.1, except as modified by requirements of this Section.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store reinforcing cages off of ground and protect from contamination of dirt, grease and corrosion.
- B. Deliver concrete to site in timely manner and in sufficient quantities to allow concreting of each pier as monolithic unit.
- C. Coordinate delivery of concrete to allow placement to begin within 8 hours of completion of drilling.

PART 2 PRODUCTS

2.1 MATERIALS - Refer to related sections for materials installed, not furnished under this section.

2.2 FABRICATION

- A. Prior to drilling pier holes, fabricate reinforcing cages in stock lengths suitable for cutting to required lengths. Bend reinforcing as detailed.
 1. Do not splice vertical reinforcing within top 30 feet of pier.
 2. Except as otherwise required, vertical reinforcing may be spliced provided that no more than one half of bars are spliced within a 6-foot length and a minimum bar lap of 40 bar diameters is provided. Lap and tie bars at splices.
 3. Where required, provide mechanical bar splices.
 4. Do not use cross wire ties that would interfere with tremie pipe or concrete free falling down the center of the cage.
 5. Spacers: provide steel band spacers or precast concrete spacers to maintain position of cages within pier holes.
 6. End blocks: provide precast concrete end blocks to maintain required clearance at bases of cages.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Prior to beginning installation, review the subsoil investigation report for site provided by Owner; become thoroughly familiar with anticipated subsoil conditions.
- B. Examine site for obstructions to drilling, such as power lines, utilities, material stockpiles, boulders and uneven surfaces. Report anticipated problems to Architect in timely manner so as not to delay schedule of Work.

3.2 PREPARATION

- A. Have ready at site equipment anticipated to be necessary for successful installation of piers, including power augers, core barrels, tremies, hoppers, chutes, and casing, as applicable.
- B. Maintain in ready condition dowels, templates, and anchor bolts required for pier installation.

3.3 INSTALLATION

- A. Drilling Straight Shaft Pier Holes
 1. Drill pier holes with power augers or core barrels suitable for subsoil conditions at site.
 2. Drill pier holes of required diameters to bearing stratum and penetrate bearing stratum to required depths below top of stratum.
 3. Where casing is required, increase pier hole diameter as necessary to accommodate casing having inside diameter not less than required shaft diameter to depth necessary to seal shaft.
 4. Where casing is required, measure required depth of penetration into bearing stratum from top of stratum or from bottom of casing, whichever is deeper from ground surface.
- B. De-watering Pier Holes
 1. Remove standing water from pier holes to within 3 inches of base of holes by bailing or pumping.
 2. Where flowing water is encountered, or required water level cannot be maintained, use casing.
- C. Casing Pier Holes
 1. Where flowing water or caving soil is encountered use temporary casings to seal sides of shaft.

2. Casings shall be steel, and of adequate strength to withstand handling stresses and concrete and earth pressures, and shall be watertight.
 3. Extend casings only to depth required to seal off water or caving soil.
 4. Extract casings in vertical lifts, maintaining adequate head of concrete to prevent caving of soils. Do not rotate casing during removal.
- D. Placing Reinforcing Cages, Dowels and Anchor Bolts
1. Place reinforcing steel cages accurately in shafts and hold in position during placement of concrete.
 2. Place dowels and anchor bolts in position, and maintain proper location and elevation with templates.
 3. Use steel bars and bands as required to maintain position of scheduled pier reinforcing within cage.
 4. Use spacers to maintain position of cage within shaft and to maintain minimum 3 inches of concrete cover.
 5. Use end blocks to support cage at required elevation maintaining proper clearance at base of pier.
- E. Placing and Consolidating Concrete
1. Clean pier shafts of accumulated loose material before concreting, and remove water to within 3 inches of base of shaft.
 2. Place concrete within 8 hours of drilling.
 3. Place concrete using a collection hopper with a steel outlet pipe to direct concrete down the center of the shaft. Placing concrete directly into the shaft from concrete truck chute is not allowed.
 4. Extend tremie pipe as required to limit concrete free fall height as follows:
 - a. Shaft diameter 18 inches or less: 10 feet max free fall
 - b. Shaft diameter 20 to 30 inches: 30 feet max free fall
 5. Place concrete in one continuous operation for each pier.
 6. Consolidate top 6 feet of each pier with concrete vibrator.
 7. Where water rises to top of pier during placement, remove over-wetted concrete and replace with sound, dense material.
 8. Remove and replace portions of concrete that become contaminated with mud or spoil material during placement.
 9. Where tops of pier holes become mushroomed during drilling or installation procedures, use round forms to maintain constant diameter.
- F. Tolerances
1. Maximum lateral variation off centerlines: 3 inches
 2. Plumbness of vertical piers within 1 ½ percent of shaft depth to bearing stratum.
 3. Shaft diameter: plus 2 inches, minus 0
 4. Top of pier elevation: plus one inch, minus 3 inches
 5. Penetration of bearing stratum: minus 0, plus 1 foot.
 6. Placement of vertical dowels at tops of piers: plus or minus 1 inch lateral, plus or minus 4 inches vertical.
 7. Placement of anchor bolts: plus or minus 1/4 inch lateral, plus or minus 1 inch vertical.

3.4 FIELD QUALITY CONTROL

- A. Testing Laboratory and Inspection Services
1. Inspect drilling of each pier hole.
 - a. Determine location of required bearing stratum, measure depth from ground surface.
 - b. Measure overlap of casing into the bearing stratum.
 - c. Measure depth of penetration into stratum.
 - d. Measure shaft diameters. Measure casing diameter where casing required.
 - e. Inspect condition of base prior to concreting.
 2. Inspect reinforcing cages
 - a. Check bar sizes and quantity.
 - b. Check tying and splicing of cages.
 - c. Monitor placement and securement techniques.
 3. Monitor concrete placement
 - a. Monitor time interval between drilling and placement.
 - b. Inspect placement techniques and conditions.
 - c. Inspect concrete quality at tops of shafts.
 4. Material Tests: refer to sections for products installed, not furnished under this section.
 5. Field Conditions: where un-anticipated subsurface conditions prevent proper installation of piers, do not proceed with work until directed by Architect.
- B. Adjusting

1. Piers for which time lapse between drilling and concreting exceeds maximum shall be reamed, or penetration re-drilled as determined by Architect at no additional cost to the contract.
 2. Piers installed without required inspection shall be replaced as directed by Architect at no additional cost to the contract.
 3. Pier installations suspect of deficient quality shall be tested and/or corrected as directed by Architect at no additional cost to Owner.
 4. Pier shafts drilled deeper than required penetration into bearing stratum shall be filled with unreinforced concrete to the required penetration depth at no additional cost to the contract.
 5. If pier shafts are larger than required diameter, except where casing is required, provide additional vertical reinforcing as may be instructed by Architect at no additional cost to the contract.
 6. Remove mushrooms - before concrete cures, remove excess concrete from tops of piers so that pier shafts are of constant diameter.
- C. Clean-up
1. Remove spoil and debris from the site and legally dispose.

END OF SECTION

SECTION 32 01 90

LANDSCAPE GROUNDS MAINTENANCE

The Contractor is to render the following Landscape maintenance services for all areas under construction or areas disturbed by construction activities during the term of the construction contract. The contractor shall continue maintenance until the project is accepted by the owner or owner's representative. After final acceptance, the owner shall take over maintenance of the project.

PART 1 - GENERAL

1.1 SCOPE

- A. Work included in project: Perform all work necessary utilizing acceptable horticultural practices for the exterior landscape maintenance of the project as required herein. Such work includes, but is not limited to the following:
1. Monitoring adjustment and minor repair of the landscape irrigation system.
 2. Protection of vacuum breakers against freeze damage.
 3. Mowing, edging and trimming of lawn areas.
 4. Pruning and trimming of trees and shrubs.
 5. Restaking and adjustment of stakes and guying if required.
 6. Application of fertilizers, insecticides and herbicides.
 7. Replacement of plant material (extra service if not under warranty).
 8. General site clean up; removal of trash, and products of maintenance.
- B. Extra Services: The intent of the contract is to provide a comprehensive maintenance program to include all required services, except those services specifically excluded, to perform the work for the stated time period.
1. All services not included in the base bid shall be considered "extra services" and will be charge for separately according to the nature of the item of work. The written consent and authorization of the Owner or their authorized representative must be obtained prior to the performance or installation of such "extra service" items and prior to purchase of any chargeable materials.
 2. Such work may include replacement of dead plant materials or major repairs of irrigation system created by acts of vandalism or other contractors working on other site related work.
 3. The Owner is not bound by the specification or contract to utilize the landscape maintenance contractor in the performance of "extra services work".
 4. The landscape maintenance contractor shall coordinate his activities with other contractors on the site so as to not hinder the performance of any work.

1.2 SCHEDULE

All work under this Contractor shall be performed in accordance with the Schedule included.

1.3 CONTRACTOR'S PERFORMANCE

- A. The Contractor's workmen shall be neat in appearance, perform their work in a professional manner, keep noise to a minimum and stage their work from a location on the site out of the way of the mainstream of the users.

1.4 NEGLECT AND VANDALISM

- A. Turf, trees or plants that are damaged or killed due to Contractor's operations, negligence or chemicals shall be replaced at no expense to the Owner. If plant damage or death is caused by conditions beyond the Contractor's control, replacement shall be at the Owner's expense.
- B. Sprinklers or structures that are damaged due to the Contractor's operations must be replaced by the Contractor promptly.
- C. All water damage, either natural or man-made, resulting from Contractor's neglect shall be corrected at the Contractor's expense.
- D. All damage to or thefts of landscaping and irrigation installations not caused or allowed by the Contractor shall be corrected by the Contractor.

1.5 JOB CONDITIONS

- A. Contractor shall acquaint himself with all site conditions. Should excavation be required the Contractor shall promptly notify the utility coordination committee for utility locations. Failure to do so will make Contractor liable for any and all damage thereto arising from his operations.
- B. Contractor shall take necessary precautions to protect site conditions, irrigation and plants. Should damage be incurred, this Contractor shall repair damage items to its original condition or furnish and install equal replacement at this expense.

1.6 EMERGENCIES

- A. The Contractor shall answer emergency or complaint calls within twelve (12) hours and corrective action shall be complete within 24 hours.
- B. The Contractor shall answer emergency calls regarding the landscape irrigation system failure or need of repair, and take corrective action within eight (8) hours. Such work, unless caused due to neglect on the part of the Landscape Maintenance Contractor, shall be considered "Extra Services".

1.7 RESTRICTION

- A. Do not use growth regulators or growth retardants on this job.

PART 2 - PRODUCTS

2.1 IRRIGATION SYSTEM MATERIALS

Replacement materials throughout the system shall be as specified and/or noted on the "Contract Documents", new and in perfect condition.

2.2 MATERIALS

Materials listed under this Section are expressly specified for use but does not prohibit or restrict the Contractor from providing other approved materials not listed in order to complete the work required herein. All materials shall be new and in perfect condition.

- A. Pre-Emergence Weed Control: Contractor option (granular).
- B. Post-Emergence Weed Control: Contractor option.
- C. Herbicide/Insecticide/Fungicide: Contractor option.
- D. Fire Ant Control: Shall be slow release applied at six (6) week intervals. Spot treat weekly with a contact product where mounds appear. Alternate products for effective control.

- E. Shrub Bed Fertilizer: Apply at manufacturer's recommended rates for each plant used. Shall be Osmacote Slow Release.
- F. Lawn Fertilizer: 15-5-10 with 50% sulphur coated urea and 4% iron.
- G. Tree Fertilizer: Davey Arborgreen: apply using the maximum manufacturer's recommended rate and procedures.
- H. Mulch: Shredded Hardwood mulch.

PART 3 - EXECUTION

3.1 LANDSCAPE IRRIGATION SYSTEM

The Contractor shall monitor and program the automatic controlling device for intervals equaling a total of 18 times a year to provide optimum moisture levels in all planted areas. This monitoring shall only be done by the contractor until the project is accepted.

- A. Irrigation cycles shall be set to take place prior to sunrise (usually 4:00 - 5:00 am unless otherwise instructed by the Owner).
- B. Do not program controllers operating on the same water meter to water during the same time period so as to prevent over-draft of water meters. Do not switch controller to "off" at any time, except as required for testing and for maintenance operations.
- C. Complete sprinkler system servicing shall be performed as required to maintain sprinklers in correct operating condition, including all required labor. April through September the operation of sprinklers shall be inspected and monitored on a twice-per-month basis to assure proper cover and operation. October through March monitor and inspect sprinklers once per month or upon the request of the Owner. This check shall include visual "inspection" of all accessible components of the irrigation system including but not limited to controllers, remote control valves, quick couplers and heads.
- D. Adjust sprinklers to avoid damage to windows, buildings and sign walls, also adjust heads to keep water off the street. Make repairs and alterations to the sprinkling system and water lines. All sprinkler repairs such as cleaning of heads or breaks caused by the Contractor shall be the Contractor's responsibility.

3.2 TREE MAINTENANCE

- A. Maintain mulch in tree wells at all times.
- B. Contractor shall maintain staking and guying of trees at all times and shall be responsible for any damage to trees or plant materials caused by chafing or breakage of foliage or limbs coming in contact with stakes or guys. Replace broken plant stakes and ties as needed. If ties are too tight, they must be replaced or adjusted.
- C. All suckers shall be continually removed from trees. Grass shall be trimmed at the base of trees in a manner that shall protect tree trunks from cutting of bark.
- D. Annual tree pruning and/or shaping as needed. Always prune out dead wood. Refer to schedule. CONTACT OWNER PRIOR TO COMMENCING ANY PRUNING OR SHAPING WORK.
- E. Spray all trees four times per years to control foliar feeding insects. The spray shall consist of alternately spraying 2 times (s) with an insecticide spray and 2 time (s) with a fungicide beginning in March, with the last spray in September.

3.3 SHRUB AND GROWDCOVER BED MAINTENANCE

- A. Weeding of all shrub, groundcover beds and seasonal color beds shall be performed twice monthly (total 24 times).
- B. All shrub and groundcover beds shall be pruned 8 times a year March - October in an attempt to develop the natural form of the plant.
- C. Pre-emergent weed control shall be applied 1 time in early spring and 1 time in late fall in planter beds only after careful thought of what is to occur in planters during the growing season.
- D. All shrub, groundcover beds and seasonal color areas shall be fertilized 3 times per year at a rate of 2 pounds of fertilizer per 1,000 square feet. April 1 - 22-0-6 / July 1 - 15-5-10 / October 1 - 22-0-6

3.4 TURF MAINTENANCE

- A. Mowing: All common Bermuda and/or St. Augustine grass shall be mowed approximately every seven days March - October. During periods of mild weather, the cut should not be lower than two (2") inches from the soil. Never scalp the lawn or cut more than one-half (1/3) of the existing top growth in one mowing. On irrigated areas, remove the clippings, never allowing visible clippings to remain on lawn surface more than four (4) hours. All sidewalks and curbs shall be edged as well as other objects (non-living) in the grass zone.

Allow grass to grow up to but not over sprinkler heads. Trim grass around heads with a circular sprinkler head trimmer. DO NOT USE "WEED-EATERS" TO TRIM AROUND SPRINKLER HEADS.

- B. Watering: Provide a regular, deep watering program. The established turf should not be kept wet but should dry out somewhat between waterings. A twice weekly watering is good under regular conditions, but if it is hot or windy, water more often. In very hot weather, a fast watering with fine spray will cool the turf zone and can supplement the regular, deeper watering program. In shaded areas caused by trees, water more frequently because of the competition for soil moisture. If lawn wilts (shows grey-brown) water more frequently.
- C. Lawn Fertilizer:
 - April 1 - 22-0-6 analysis at the rate of 10 pounds fertilizer per 1,000 square feet, nitrogen content shall consist of 50% sulphur coated urea. Analysis shall include 4% iron (10# per 1,000 equals 2.1# actual nitrogen per 1,000 square feet.
 - May 15 - 24-6-12 analysis at the rate of 10 pounds fertilizer per 1,000 square feet, nitrogen content shall consist of 50% sulphur coated urea. Analysis shall include 4% iron. (10# per 1,000 equals 2.1# actual nitrogen per 1,000 square feet.
 - July 1 - 15-5-10 analysis at the rate of 10 pounds fertilizer per 1,000 square feet, nitrogen content shall consist of 50% sulphur coated urea. Analysis shall include 4% iron. (10# per 1,000 equals 2.1# actual nitrogen per 1,000 square feet.
 - August 15 - 15-5-10 analysis at the rate of 10 pounds fertilizer per 1,000 square feet, nitrogen content shall consist of 50% sulphur coated urea. Analysis shall include 4% iron. (10# per 1,000 equals 2.1# actual nitrogen per 1,000 square feet.
 - October 1 - 22-0-06 analysis applied at the rate of 10# per 1,000 square feet. No sulphur coated urea, no iron.
- D. Fertilizer: Trace elements in fertilizer shall be based on the recommendations of the soil laboratory.

The fertilization program will be closely monitored by the Owner. The Contractor shall prepare submittals prior to each application showing the area to be covered. The quantity of fertilizer to be applied and the rates of application. The Owner will monitor the application to insure that materials and procedures are as specified.

- E. Weed Control and Undesirable Grass - General:
1. Contractor shall use extreme care in the use of chemicals for weed control. Before such applications are made, the turf should be well established and in a vigorous condition.
 2. All chemical applications shall be properly licensed with the proper governing authorities.
 3. The contractor shall carry the insurance required by the governing authority.
 4. Apply chemicals at the manufacturer's recommended rate to achieve complete control of weeds and undesirable grasses. All products utilized on this project must be labeled for turf use.
 5. Spot treatment of weeds and undesirable grasses shall be achieved without damaging the surrounding turf.
- F. Weed and Undesirable Grass Control Schedule:
- All Bermuda grass turf shall be sprayed 2 time(s) in early spring for pre-emergent control of crabgrass, dallisgrass, and other broadleaf grasses, and 2 time(s) in June-August for pre emergent control of winter weeds, for a total of 4 cycles. If permanent turf establishment is not complete, do not apply pre-emergent herbicide.
- Summer/Fall Spot treat turf areas to achieve a minimum 98% pure stand of turf.
- G. Insects: Control insects with regular applications of commercial insecticides at the manufacturer's recommended rate.
- H. Diseases: When they first appear, spray for diseases with an approved commercial fungicide strictly according to the manufacturer's recommendations.
- I. Maintain mulched saucers around all trees until establishment. Trim grass as required to prevent grass from encroaching into the saucer area. No "Weedeaters" shall be used around the trunk of any tree now, or at any time in the future.
- J. If initial installation (any or all) of the project site is in winter rye, the Contractor will at that time change the mowing and trimming rate to 45 times a year. Contractor shall also during the 1 year maintenance period and at the appropriate season, chemically kill out Winter Rye and Hydromulch Bermuda.
- K. One application of herbicide will be applied to aid in the eradication of temporary Rye Grass.

3.5 USE OF HERBICIDES, INSECTICIDES, STERILANTS, POISON, AND ANIMAL TRAPS

- A. The Contractor is hereby granted permission to use such herbicides, insecticides, poison, and animal traps as it may find necessary and advantageous in its grounds maintenance activities. Herbicides, insecticides, sterilants, and animal traps must be used responsibly and in conformance with Federal, State and Local laws and regulations. The Contractor assumes all liability for damage and/or injury resulting from accident or misuse of these products and/or equipment.
- B. Product leaving an undesirable residue or odor (i.e., weed oil shall not be used.
- C. The Owner shall be notified prior to application and advised of any danger associated with the use of these products (i.e., to avoid personal contact with sprayed areas, etc.
- D. Apply insecticides as needed to protect all plant materials from damage. The insect control program shall include slugs and snails and advance preventive spraying for twip borers. The Contractors shall be responsible for the choosing of chemicals and insecticides he uses and shall be accountable for any misuse of same.

- E. Apply the proper fungicide, herbicide and pesticides for the control of pests, weeds and plant diseases or treat cuts on turf, plants and trees.

3.6 GENERAL CLEAN UP

- A. The Contractor shall dispose of all waste materials or refuse from his operations off the property. See plans for contract area.
- B. All plant growth shall be prevented in any cracks in walks or within paved areas.
- C. Leaves, papers, grass clippings or other debris shall be removed at least weekly or at each visit from all areas.
- D. Sweep roads and walks or refuse, dirt and other materials which may be deposited as a result of the maintenance operation.

PART 4 - SCHEDULE

The Schedule as included herein shall govern the Work. Should the Contractor require an alteration of the Schedule, contact the Owner.

MAINTENANCE SCHEDULE

ITEM	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
Mow/Edge/Trim			2	4	4	5	5	5	5	4	2		36
Clean/Weed beds/Trash	2	2	2	2	2	2	2	2	2	2	2	2	24
Sprinkler	1	1	1	2	2	2	2	2	2	1	1	1	18
Fertilize (lawn)				1	1		1	1		1			5
Post-Emergent (lawn)			1	1		1		1					4
Post emergent of winter weeds													
Post emergent of crabgrass and other broadleaf grasses													
Fertilize (beds, Incl. ground cover)			1		1		1						3
Pre-emergent (beds)				1						1			2
Cultivate beds			1			1	1	1	1				5
Prune (shrubs, grnd. cover)			1	1	1	1	1	1	1	1			8
Prune (trees)			1										1
Insect/Disease control (lawn and beds)													As needed
Trees (insecticide)			1			1							2
Trees (fungicide)				1					1				2
ITEM	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL

END OF SECTION

SECTION 32 13 00

RIGID PAVING

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all work required to complete, as indicated by the Contract Documents, and furnish all supplementary items necessary for completion of all work specified in this Section.
- B. The work included in this Section, while not all inclusive but listed as a guide, shall include furnishing all labor, materials, equipment and services necessary to provide the installation of all portland cement concrete paving, curbs, gutters, sidewalks flatwork, sleeves for utilities, sleeving for future use, complete-in-place, as shown on the Construction Drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 22 00 – Grading
- B. Section 32 11 13 – Subgrade Modification (Lime)

1.3 QUALITY ASSURANCE

- A. The Contractor shall comply with TXDOT Standards and Specifications and with the standards and specifications specified herein. The most stringent shall apply.
- B. Hot and Cold Weather Concreting practices shall be utilized as appropriate per the latest ACI standards.

1.4 SUBMITTALS

- A. Immediately upon receipt of Notice to Proceed, the Contractor shall submit the following to the Engineer for his review and approval:
 - 1. Material Certificates: Provide two copies of materials certificates signed by the material producer and the Contractor, certifying that each material item complies with, or exceeds, specified requirements.
 - 2. Mix Design: Submit two copies of concrete mix design for each use of concrete.

1.5 TRAFFIC CONTROL

- A. New pavement shall be closed to all traffic, including vehicles of the Contractor, until the concrete is at least seven days old.
- B. The Paving Contractor shall maintain access for vehicular and pedestrian traffic as required for other site activities.
- C. Utilize flagmen, barricades, warning signs and warning lights as required by the authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Forms
 - 1. Steel, wood or other suitable material and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects.
 - 2. Use flexible spring steel forms or laminated boards to form radius bends as

- required.
3. Coat forms with a non-staining form release agent that will not discolor or deface the surface of the concrete.
- B. Welded Wire Mesh: Welded plain cold-drawn steel wire fabric, ASTM A 185.
 - C. Supports: Chair spacers or other required supports shall conform to the requirements of the ACI Detailing Manual 315.
 - D. Reinforcing Bars: Deformed steel bars, ASTM A 615, Grade 60, unless otherwise indicated.
 - E. Cement: Shall be Portland Cement conforming to current ASTM Specifications CI50, Type 1.
 - F. Coarse Aggregate:
 1. Shall consist of durable particles of gravel, crushed blast furnace slag and/or crushed stone of reasonably uniform quality throughout, free from injurious amounts of salt, alkali, vegetable matter or other objectionable material, either free or as an adherent coating on the aggregate.
 2. Shall be stockpiled in such a manner to prevent segregation and maintained as nearly as possible in a uniform condition of moisture.
 - G. Fine Aggregate: Shall consist of sand or a combination of sands, and shall be composed of clean, hard, durable, uncoated grains.
 - H. Air-entraining Agent: Shall conform to ASTM C260.
 - I. Water: Shall be drinkable.
 - J. Curing Compound: Shall conform to ASTM C309.
 - K. Expansion Joint Filler: Shall conform to requirements of ASTM D1751. An approved sealant shall be used in all construction and expansion joints and shall be compatible with joint fillers.
 - L. Epoxy Resin Grout: FS MMM-F-650.

2.2 CONCRETE MIX, DESIGN AND TESTING

- A. Comply with requirements as herein specified for concrete mix design, sampling and testing, and quality control. Design the mix to produce standard-weight concrete consisting of Portland cement, aggregate, air-entraining admixture and water to produce the following properties:
 1. Compressive Strength: minimum at 28 days, as indicated on the Drawings.
 2. Slump Range: 3" to 5".
 3. Air Content: 3% to 6%.
 4. Minimum Cement Content: 520 pounds per cubic Yard

PART 3 - EXECUTION

3.1 INSPECTION

- A. The Contractor shall examine the areas and conditions under which concrete curbs, walks and paving are to be installed and notify the Owner in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner. Do not proceed with the work until the necessary sleeves for irrigation, site lighting, electrical, gas, telephone, future use, and cable T.V. have been installed.

3.2 SUBGRADE PREPARATION

- A. The subgrade shall be uniform in composition and compaction of material and comply with the requirements in Section 31 22 00 and Section 32 11 13. All organic material shall be removed. The subgrade shall be in a moist condition at the time concrete is deposited thereon.

3.3 SURFACE PREPARATION

- A. Maintain subgrade in a smooth, compacted condition at the required section and grade until the pavement is ready to be placed. Keep subgrade thoroughly wetted down sufficiently in advance of placing pavement to insure a firm, moist condition for at least 2 inches below the prepared surface.
- B. Prepare only sufficient amount of subgrade in advance of the placing of pavement to enable the work to proceed smoothly and effectively. Avoid placing equipment or hauling equipment over completed subgrade until placement of pavement has been completed.

3.4 FORM CONSTRUCTION

- A. Set forms to the required grades and lines, rigidly braced and secured. Install sufficient quantity of forms to allow continuous progress of the work so that forms can remain in place at least 24 hours after concrete placement.

3.5 REINFORCEMENT

- A. Locate, place and support reinforcement as specified on the Drawings.

3.6 MIXING OF CONCRETE

- A. Ready-Mixed Concrete: Shall be used and shall conform to ASTM C94. The ready-mix producer shall be certified for compliance to the standards of N.R.M.C.A.
- B. Cold Weather Concreting: Shall conform to the standards set forth in ACI-306.
- C. Hot Weather Concreting: Shall conform to the standards set forth in ACI-305.

3.7 CONCRETE PLACEMENT

- A. General:
 - 1. Do not place concrete until subbase and forms have been checked for line and grade. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until adjusted to finished elevation and alignment.
 - 2. Place concrete using methods which prevent segregation of the mix. Consolidate concrete along the face of forms and adjacent to transverse joints with an interval vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.
- B. Deposit and spread concrete in a continuous operation between transverse joints as far as possible. If interrupted for more than 1/2 hour, place a construction joint.

3.8 CURBS AND GUTTERS

- A. Automatic machine may be used for curb and gutter placement at Contractor's option, if acceptable to the Owner. If machine placement is to be used, submit revised mix design and laboratory test results that meet or exceed the minimums herein specified. Machine

placement must produce curbs and gutters to the required cross-section, lines, grades, finish and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified.

3.9 JOINTS

- A. General: Construct expansion, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to surface of the concrete, unless otherwise indicated. Construct transverse joints at right angles to the centerline, unless otherwise indicated.
- B. Weakened-Plane (Contraction) Joints: Provide weakened-plane (contraction) joints with a maximum spacing of fifteen (15) feet unless noted otherwise on the Construction Documents. Construct weakened-plane joints for a depth equal to at least 1/4 concrete thickness, as follows:
 - 1. Sawed Dummy Joints: Form weakened-plane joints using powered saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into hardened concrete as soon as surface will not be torn, abraded, or otherwise damaged by cutting action, generally within 12 hours or as directed by the Owner's Representative.
- C. Construction Joints: Place construction joints at the end of all pours and locations where placement operations are stopped for a period of more than 1/2 hour, except where such pours terminate at expansion joints.
- D. Expansion Joints:
 - 1. Provide premolded joint, filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks and other fixed objects, unless otherwise indicated.
 - 2. Locate expansion joints at a maximum spacing of 65 feet unless indicated otherwise on the plans.
 - 3. Extend joint fillers full-width and depth of joint, and not less than 1/2" or more than 1" below finished surface where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished concrete surface.
 - 4. Furnish joint fillers in one-piece lengths for the full width being placed, wherever possible. Where more than one length is required, lace or clip joint filler sections together.
 - 5. Protect the top edge of the joint filler during concrete placement with a metal cap or other temporary material. Remove protection after concrete has been placed on both sides of joint.

3.10 CONCRETE FINISHING

- A. After striking-off and consolidating concrete, smooth the surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust the floating to compare the surface and produce a uniform texture.
- B. After floating, test surface for trueness with a 10-foot straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.
- C. Work edges of slabs, gutters, back top edge of curb and formed joints with an edging tool and round to 1/2" radius, unless otherwise indicated. Eliminate any tool marks on concrete surface.
- D. After completion of floating and when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:
- E. Burlap finish curb and gutter and pavement by dragging a seamless strip of damp burlap across the concrete in a perpendicular line to traffic or away from the building. Repeat operation to provide a gritty texture acceptable to Owner.

- F. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point-up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed by Engineer.
- G. Traffic shall not be allowed on the concrete for a minimum period of seven days.

3.11 CURING

- A. Protect and cure finished concrete paving. Use moist-curing methods or curing compounds as approved by the Engineer.

3.12 REPAIRS AND PROTECTIONS

- A. Repair or replace broken or defective concrete, as directed by Owner, at no additional cost to the Owner.
- B. Drill test cores when directed by Owner, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland cement concrete bonded to pavement with epoxy resin grout.
- C. Protect concrete from damage until acceptance of work. Backfill all curbs and remove debris from site. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Sweep concrete pavement and wash free of stains, discolorations, dirt and other foreign material just prior to final inspection.

END OF SECTION

SECTION 32 17 13

PARKING BUMPERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes wheel stops.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PARKING BUMPERS

- A. Concrete Wheel Stops: Precast, steel-reinforced, air-entrained concrete, 4000-psi (27.6-MPa) minimum compressive strength, 4-1/2 inches (115 mm) high by 9 inches (225 mm) wide by 72 inches (1800 mm) long. Provide chamfered corners, transverse drainage slots on underside, and a minimum of two factory-formed or -drilled vertical holes through wheel stop for anchoring to substrate.
 - 1. Surface Appearance: Free of pockets, sand streaks, honeycombs, and other obvious defects. Corners shall be uniform, straight, and sharp.
 - 2. Mounting Hardware: Galvanized-steel spike or dowel, 1/2-inch (13-mm) diameter, 10-inch (254-mm) minimum length.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install wheel stops according to manufacturer's written instructions unless otherwise indicated.
- B. Securely anchor wheel stops to pavement with hardware in each preformed vertical hole in wheel stop as recommended in writing by manufacturer. Recess head of hardware beneath top of wheel stop.

END OF SECTION

SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SUMMARY

- A. Related Documents: General and Supplementary Conditions of the Contract, Division 1 - General Requirements, and Drawings are applicable to this Section.
- B. Section Includes:
 - 1. Pavement markings including parking spaces, crosswalks, painted handicapped symbols at designated spaces and fire lane markings as required by authorities having jurisdiction.

1.02 QUALITY ASSURANCE

- A. Installer: Having a minimum of 2 years experience in the layout and striping of parking lots.
- B. Job Conditions: Do not apply marking paint when weather is foggy or rainy, or ambient or pavement temperatures are below 40 degrees F., nor when such conditions are anticipated during eight hours after application.

1.03 SUBMITTALS

- A. Submit manufacturer's product data and installation instructions

PART 2 PRODUCTS

2.01 MATERIALS

- A. Paint:
 - 1. Type: Non-bleeding, pigmented, alkyd-chlorinated rubber composition.
 - 2. Non-Volatiles: 70 percent by weight; 50 percent by volume.
 - 3. Application Thickness per Coat: 15 mils wet (7 mils dry).
 - 4. Application Rate per Coat: 300 to 320 linear feet of 4 inches wide line per gallon.
 - 5. Colors:
 - a. White: Parking stall striping, directional emblems, restricted parking zone striping, disabled accessibility paths.
 - b. Blue with White Copy: Disabled parking emblems.
 - c. Red with White Copy: Fire lanes.
 - 6. Acceptable Product: Chlorinated Rubber Traffic Paint by Centerline Supply, Inc.
- B. Substitutions: Submit manufacturer's product data and installation instructions.

2.02 APPLICATION EQUIPMENT

- A. Pressurized, self-contained paint machine capable of applying a straight line from 2 to 6 inch-wide, with consistent coverage.

PART 3 EXECUTION

3.01 INSPECTION AND PREPARATION

- A. Locate markings as indicated on Drawings. Provide qualified technician to supervise equipment and application of markings. Lay out markings using guidelines, templates and forms.
- B. Thoroughly clean pavement surfaces free of dirt, sand, gravel, oil and other foreign materials.

- C. Allow paving to cure before painting as required by manufacturer of traffic paint.

3.02 APPLICATION

- A. Apply in accordance with manufacturer's written instructions.
- B. Apply one coat to portland cement concrete paving and asphaltic concrete paving with protective seal coat. Apply two coats to asphaltic concrete paving without protective seal coat.
- C. Restrict traffic on pavement until striping if fully cured.

END OF SECTION

SECTION 32 18 13

SYNTHETIC GRASS SURFACING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes synthetic grass surfacing.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For synthetic grass surfacing.
 - 1. Include sections and details.
 - 2. Show locations of seams and method of seaming.
 - 3. Show location and layout of team logo/graphics.
- C. Samples: For each type of synthetic grass surfacing indicated.
 - 1. Turf Fabric: 12 inches (300 mm) square.
 - 2. Infill Material: 4 oz. (100 g) of each type.
 - 3. Seam Sample: 24 inches (600 mm) square with seam centered in sample.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each synthetic grass surfacing assembly.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For synthetic grass surfacing, including maintenance cleaning instructions, to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Turf Fabric: Minimum of 300 sq. ft. (28 sq. m) for each type indicated.
 - 2. Infill: Minimum of two bags of each type.
 - 3. Seaming Tape and Adhesive: One roll of seaming tape and one gallon of adhesive.
 - 4. One new set of maintenance tools, of type recommended by synthetic grass surfacing manufacturer for installation.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials in location and manner to allow installation of synthetic grass surfacing without excess disturbance of granular base.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace synthetic grass surfacing that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:

- a. Deterioration and excessive wear.
 - b. Deterioration from UV light.
 - c. Excessive loss of shock attenuation.
 - d. Seam separation, including game lines and markings.
2. Warranty Period: 8 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Turf Fabric: Turf fabric tested according to the following methods, with additional test method conditions for each method according to ASTM F 1551.
 1. Tuft Bind: Not less than 8 lbf (36 N) according to ASTM D 1335.
 2. Breaking Strength: Minimum 200 lbf (890 N) in warp direction and minimum 200 lbf (890 N) perpendicular to warp direction, according to ASTM D 5034.
- B. Synthetic Grass Surfacing: Assembly tested according to the following methods, with additional test method conditions for each method according to ASTM F 1551.

2.2 SYNTHETIC GRASS SURFACING

- A. Synthetic Grass Surfacing: Complete surfacing system, consisting of synthetic yarns bound to water-permeable backing and infill indicated, suitable for playing fields.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. AstroTurf/Symmetry Sports.
 - b. Desso Sports Systems North America.
 - c. FieldTurf, a Tarkett Sports Company.
 - d. Mondo U.S.A. Inc.
 - e. Shaw Sports Turf Division of Berkshire Hathaway.
- B. Turf Fabric: Woven turf fabric with multicolored fiber and UV resistance, complying with the following:
 1. Yarn Fiber: Monofilament polyethylene.
 2. Lead Content of Yarn Fiber: Maximum of 100 ppm according to ASTM F 2765.
- C. Backing: Manufacturer's standard woven or nonwoven polypropylene primary backing with urethane-coated secondary backing; provide perforations or drainage channels sufficient to meet permeability indicated.
- D. Infill: Manufacturer's standard infill.
 1. Infill Proportions: Manufacturer's standard proportions.
- E. Seaming Method: Adhesive.

2.3 MATERIALS

- A. Sand Infill: Uniformly sized silica sand free of silts, clays, and contaminants, and of subangular or rounder shape according to ASTM F 1632; mesh size as recommended by synthetic grass surfacing manufacturer.
- B. Seam Adhesive: One- or two-part urethane, recommended or approved by synthetic grass surfacing manufacturer, and suitable for ambient conditions at time of installation.
- C. Seam Tape: Synthetic grass manufacturer's recommended seam tape, minimum 12 inches (305 mm) wide, 18 inches (457 mm) wide for inlaid game lines.
- D. Seaming Cord: Seaming cord or thread, recommended by the synthetic grass surfacing manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine base and other conditions, with Installer present, for compliance with requirements for installation tolerances, permeability, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Avoid disturbance of base during installation of shock-attenuation pad and turf fabric.

- B. Shock-Attenuation Pad Installation: Roll out pad and allow to relax a minimum of six hours prior to final fit and trim. Stagger head seams between adjacent rows. Fit seams snugly without stretching or forcing.
 - C. Roll out turf fabric and allow to relax at least four hours prior to seaming.
 - D. Provide seams flat and snug, with no gaps or fraying. Remove yarns that are trapped within seams. Attach turf fabric to perimeter restraint system as recommended by the manufacturer.
 - E. Install inlaid game lines and markings by cutting through turf fabric and installing snugly fitting game line turf fabric. Provide seaming tape that extends minimum 6 inches (152 mm) beyond seam.
 - F. Repair loose seams and bubbles formed due to expansion of turf fabric prior to installation of infill.
 - G. Evenly broadcast and groom infill by machine in proportions and depth after settling as recommended by the manufacturer, and to meet indicated performance requirements. Rake fibers trapped by infill to surface.
 - H. Painted Game Lines: Apply lines and markings as recommended by the game line paint manufacturer.
- 3.3 FIELD QUALITY CONTROL
- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- 3.4 DEMONSTRATION
- A. Train Owner's maintenance personnel in proper maintenance procedures for synthetic grass surfacing.

END OF SECTION

SECTION 32 31 19

DECORATIVE METAL FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Decorative metallic-coated-steel tubular picket fences.
 - 2. Swing gates, including pedestrian gates and hardware.
 - 3. Horizontal-slide gates.
 - 4. Gate operators, including controls.
 - 5. Accessory devices.
 - 6. Wind Screens.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For fencing and gates.
 - 1. Include plans, elevations, sections, gate locations, post spacing, and mounting details, and grounding details.
 - 2. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
 - 3. Wiring Diagrams: Include diagrams for power, signal, and control wiring.
- C. Samples: For each fence material and for each color specified.
 - 1. Provide Samples 12 inches (300 mm) in length for linear materials.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Product Test Reports: For decorative metallic-coated-steel tubular picket fences, including finish, indicating compliance with referenced standard and other specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For gate operators to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Include 10-foot (3-m) length of fence complying with requirements.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Lightning-Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

2.2 DECORATIVE METALLIC-COATED-STEEL TUBULAR PICKET FENCES

- A. Decorative Metallic-Coated-Steel Tubular Picket Fences: Comply with ASTM F 2408 for light-industrial (commercial) application (class) unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ameristar Fence Products; an ASSA ABLOY company.
 - b. Fortress Iron.
 - 2. Basis-of-Design Product: Ameristar Fence Products, Inc.; Montage Commercial with Majestic Rail.
- B. Posts:
 - 1. End and Corner Posts: Square tubes 2-1/2 by 2-1/2 inches (64 by 64 mm) formed from 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch (2.66-mm) nominal-thickness steel sheet and hot-dip galvanized after fabrication.
 - 2. Posts at Swing Gate Openings: Square tubes 3 by 3 inches (76 by 76 mm) formed from 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch (2.66-mm) nominal-thickness steel sheet and hot-dip galvanized after fabrication.
 - 3. Posts at Horizontal-Slide Gate Openings up to 12 Feet (3.7 m): Square steel tubing 4 by 4 inches (102 by 102 mm) with 3/16-inch (4.76-mm) wall thickness, hot-dip galvanized.
 - 4. Guide Posts for Class 1 Horizontal-Slide Gates: Square tubes 3 by 3 inches (76 by 76 mm) formed from 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch (2.66-mm) nominal-thickness steel sheet and hot-dip galvanized after fabrication; installed adjacent to gate post to permit gate to slide in space between.
- C. Post Caps: Formed from steel sheet and hot-dip galvanized after forming.
- D. Rails: Square tubes.
 - 1. Size: 1-1/2 by 1-1/2 inches (38 by 38 mm).
 - 2. Metal and Thickness: 0.079-inch (2.01-mm) nominal-thickness, metallic-coated steel sheet or 0.075-inch (1.90-mm) nominal-thickness, uncoated steel sheet, hot-dip galvanized after fabrication.
- E. Pickets: Square tubes.
 - 1. Terminate tops of pickets at top rail for flush top appearance.
 - 2. Picket Spacing: 6 inches (152.4 mm) clear, maximum.
- F. Fasteners: Manufacturer's standard concealed fastening system.
- G. Metallic-Coated Steel Sheet: Galvanized-steel sheet or aluminum-zinc, alloy-coated steel sheet.
- H. Interior surface of tubes formed from uncoated steel sheet shall be hot-dip zinc coated same as exterior.
- I. Galvanizing: For components indicated to be galvanized and for which galvanized coating is not specified in ASTM F 2408, hot-dip galvanize to comply with ASTM A 123/A 123M. For hardware items, hot-dip galvanize to comply with ASTM A 153/A 153M.
- J. Finish: Organic coating complying with requirements in ASTM F 2408.

2.3 SWING GATES

- A. Gate Configuration: As indicated.
- B. Gate Frame Height: As indicated.
- C. Gate Opening Width: As indicated.
- D. Galvanized-Steel Frames and Bracing: Fabricate members from square tubes 2 by 2 inches (51 by 51 mm) formed from 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch (2.66-mm) nominal-thickness steel sheet and hot-dip galvanized after fabrication.
- E. Frame Corner Construction: Welded .
- F. Additional Rails: Provide as indicated, complying with requirements for fence rails.
- G. Infill: Comply with requirements for adjacent fence.
 - 1. Where indicated on Drawings, provide steel wire mesh infill.
 - a. Size: As indicated on Drawings.
- H. Picket Size, Configuration, and Spacing: Comply with requirements for adjacent fence.
 - 1. Treillage: Provide iron castings of pattern indicated between each pair of pickets. Finish as specified for adjacent fence.

- I. Hardware: Latches permitting operation from both sides of gate, hinges, and keepers for each gate leaf more than 5 feet (1.52 m) wide. Provide center gate stops and cane bolts for pairs of gates. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.
 - J. Self-Closing Spring Hinges: BHMA A156.17, Grade 1, suitable for exterior use.
 - 1. Function: 320 - Gate spring pivot hinge. Adjustable tension.
 - 2. Material: Malleable iron; galvanized.
 - K. Cane Bolts: Provide for inactive leaf of pairs of gates. Fabricated from 1/2-inch- (12.7-mm-) diameter, round steel bars, hot-dip galvanized after fabrication. Finish to match gates. Provide galvanized-steel pipe strikes to receive cane bolts in both open and closed positions.
 - L. Finish exposed welds to comply with NOMMA Guideline 1, Finish #2 - completely sanded joint, some undercutting and pinholes okay .
 - M. Galvanizing: For items other than hardware that are indicated to be galvanized, hot-dip galvanize to comply with ASTM A 123/A 123M. For hardware items, hot-dip galvanize to comply with ASTM A 153/A 153M.
 - N. Metallic-Coated-Steel Finish: Organic coating complying with requirements in ASTM F 2408.
- 2.4 HORIZONTAL-SLIDE GATES
- A. Gate Configuration: As indicated.
 - 1. Type: Cantilever slide, with external roller assemblies.
 - B. Gate Frame Height: As indicated.
 - C. Gate Opening Width: As indicated.
 - D. Automated vehicular gates shall comply with ASTM F 2200, Class II.
 - E. Galvanized-Steel Frames and Bracing: Fabricate members from square tubing.
 - 1. Frame Members: Square tubes 2 by 2 inches (51 by 51 mm) formed from 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch (2.66-mm) nominal-thickness steel sheet and hot-dip galvanized after fabrication.
 - 2. Bracing Members: Square tubes 2 by 2 inches (51 by 51 mm) formed from 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch (2.66-mm) nominal-thickness steel sheet and hot-dip galvanized after fabrication.
 - F. Frame Corner Construction:
 - 1. Welded frame with panels assembled with bolted or riveted corner fittings.
 - G. Additional Rails: Provide as indicated, complying with requirements for fence rails.
 - H. Infill: Comply with requirements for adjacent fence.
 - I. Picket Size, Configuration, and Spacing: Comply with requirements for adjacent fence.
 - 1. Treillage: Provide iron castings of pattern indicated between each pair of pickets. Finish as specified for adjacent fence.
 - J. Hardware: Latches permitting operation from both sides of gate, locking devices hangers roller assemblies and stops fabricated from galvanized steel.
 - K. Finish exposed welds to comply with NOMMA Guideline 1, Finish #2 - completely sanded joint, some undercutting and pinholes okay.
 - L. Galvanizing: For items other than hardware that are indicated to be galvanized, hot-dip galvanize to comply with ASTM A 123/A 123M. For hardware items, hot-dip galvanize to comply with ASTM A 153/A 153M.
 - M. Metallic-Coated-Steel Finish: High-performance coating.
- 2.5 GATE OPERATORS
- A. Gate Operators:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Chamberlain Group, Inc. (The).
 - b. DoorKing, Inc.
 - c. Eagle Access Control Systems, Inc.
 - d. Gates That Open, LLC.

- e. HySecurity.
- f. Maximum Controls, LLC.
- g. Viking Access Systems.
2. Basis-of-Design Unit: HySecurity; SlideDriver Model 30F with Smart Touch Controller.
3. Size: Sized to opening and weight of gate.
4. Operation by means of metal rail passing between pair of solid metal wheels with polyurethane treads. Operator motors shall be hydraulic, roller type. System shall not include belts, gears, pulleys, roller chains or sprockets to transfer power from operator to gate panel. Operator shall generate minimum horizontal pull of 300 pounds without drive wheels slipping and without distortion of supporting arms. Operator shall be capable of handling gates up to 3,000 pounds. Gate panel velocity shall be not less than 1.7 feet per second, and shall stop gradually to prevent shock loads to gate and operator assembly. The "soft stop" feature of gate operator shall be controlled by two adjustable hydraulic brake valves (one each direction). The "soft start" feature shall allow pump to start at zero pressure, progressively increasing pressure to 1,000 PSI over a period not less than two seconds.
 - a. The operator is to provide wear compensating, spring-loaded, friction-feed type drive mechanism. The drive mechanism is to consist of two drive wheels that can be manually disconnected by a toggle style disconnect. This disconnect is to instantly disengage the drive wheels for manual operation. The operator, upon returning to automatic operation by engaging the drive mechanism, shall function properly without regard to the gate's actual position.
 - b. The operator must be designed for high speed, high-cycle applications and low maintenance. The operator shall be capable of actuating gates up to 30 feet in overall length. The gate operator must be able to operate gates up to 150 percent of weight of actual gate at 2.2 feet per second.
5. Standard mechanical components shall include as a minimum:
 - a. Supporting Arms: Cast aluminum channel. Arms shall incorporate a fully bushed, 1-1/2 inches bronze bearing surface, acting on arm pivot pins.
 - b. Arm Pivot Pins: 3/4-inch diameter, stainless steel, with integral tabs for ease of removal.
 - c. Tension Spring: 2-1/2 inches heavy duty, 800 pound capacity.
 - d. Tension Adjustment: Tightening nut, not requiring the use of special tools.
 - e. Drive Release: Must instantly release tension on both drive wheels, and disengage them from contact with drive rail in a single motion, for manual operation.
 - f. Limit Switches: Fully adjustable, toggle types, with plug connection to control panel.
 - g. Electrical Enclosure: Oversized, metal, with hinged lid gasketed for protection from intrusion of foreign objects, and provide ample space for the addition of accessories.
6. Minimum standard electrical components:
 - a. Pump Motor: Shall be a 2 HP, 56C, TEFC, continuous duty motor, with a service factor of 1.15 or greater. Standard voltages available, single or three phase.
 - b. All components shall have overload protection.
 - c. Controls: Smart Touch Controller Board with 256K of program memory containing:
 - 1) Inherent entrapment sensor.
 - 2) Built-in "warn before operate" system.
 - 3) Built-in timer to close.
 - 4) Display of reporting of functions.
 - 5) 26 programmable output relay options.
 - 6) Anti-tailgate mode.
 - 7) Built-in power surge / lightning strike protection.
 - 8) Menu configuration, even logging and system diagnostics easily accessible with a PC and manufacturer's free software.
 - 9) RS232 port for connection to laptop or other computer peripheral and RS485 connection of Master/Slave systems or network interface.
 - d. Transformer: 75 VA, non-jumpered taps, for all common voltages.
 - e. Control Circuit: 24 VDC.
7. Required external sensors: Install through beam photo eyes, and gate edges on the leading and trailing edge of the gate, to be installed such that the gate is capable of reversing in either direction upon sensing an obstruction.
 - a. Provide (4) 3 inches by 3 inches steel posts matching fence system for mounting photo eyes.
 - b. Alert Device: Provide "warn before operate" audible beacon.

8. Gate Control Devices:
 - a. 3M Brand Bi-Directional Opticom Infrared System installed to be a complete and working system, including, but not limited to, Card Rack, Phase Selector, Detectors and Receivers.
 - b. Keypad and Exit Device: Keypad will be provided and installed by Security Contractor. Coordinate with door hardware specification, supplier and Owner for requirements.
 - 1) Provide 42-inch black powder coated gooseneck pedestal and concrete footing.
 - 2) Provide all required electrical and control wiring rough-in, ready for installation of keypad.
 - c. Vehicle Detector Loops:
 - 1) Basis-of-Design Product: HySecurity; HY-5A Plug-In Loop Detectors.
 - 2) Provide 6 feet by 8 feet obstructions loops on both sides of gate, and 6 feet by 8 feet free exit loop, per manufacturer's standards. Inside and outside obstruction loops are to be installed to prevent the gate from closing when vehicle traffic is present. Anti-tailgating logic is to be applied to entrance side. Free exit loop for exit side.
 - 3) Loop wire to be stranded Thhn or XLPE, crosslink polyethylene jacketed type acceptable for direct burial.
 - 4) Refer to Drawings for specific loop placement or refer to manufacturer's recommendations.
 - d. Other Options:
 - 1) HySecurity factory drive rail.
 - 2) 208/230 VAC three-phase.
 9. Provide concrete pad as required for operator, and concrete footings as required for all other components.
 10. Concrete Trough for Sliding Gate: Concrete Trough: 12 inches wide by 6 inches high by length of gate, or as shown on Drawings. Provide reinforced concrete with radiused edges flush with adjacent paving and graded to slope away from trough.
- B. Comply with NFPA 70.
- C. UL Standard: Manufacturer and label gate operators to comply with UL 325.
- D. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for automatic gate operators on gates that must provide emergency access.
- 2.6 WIND SCREENS
- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Ameristar Fence Products; an ASSA ABLOY company.
 2. Fortress Iron.
- B. Size: As indicated on Drawings.
- C. Graphic: As provided by School District.
- D. Location: As indicated on Drawings.
- 2.7 STEEL AND IRON
- A. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Bars (Pickets): Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.
- C. Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, structural quality, Grade 50 (Grade 340), with G90 (Z275) coating.
- E. Aluminum-Zinc, Alloy-Coated Steel Sheet: ASTM A 792/A 792M, structural quality, Grade 50 (Grade 340), with AZ60 (AZM180) coating.
- F. Castings: Either gray or malleable iron unless otherwise indicated.
1. Gray Iron: ASTM A 48/A 48M, Class 30.
 2. Malleable Iron: ASTM A 47/A 47M.

2.8 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Structural Engineer's documents with a minimum 28-day compressive strength of 3000 psi (20 MPa), 3-inch (75-mm) slump, and 1-inch (25-mm) maximum aggregate size.
- C. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M and specifically recommended by manufacturer for exterior applications.

2.9 GROUNDING MATERIALS

- A. Comply with requirements of Electrical Engineer's documents.
- B. Grounding Conductors: Size as indicated on Drawings. Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.
 - 1. Material above Finished Grade: Copper.
 - 2. Material on or below Finished Grade: Copper.
 - 3. Bonding Jumpers: Braided copper tape, 1-5/8 inch (41 mm) wide and 1/16 inch (1.6 mm) thick, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.
- C. Grounding Connectors and Grounding Rods: Comply with UL 467.
 - 1. Connectors for Below-Grade Use: Exothermic-welded type.
 - 2. Grounding Rods: Copper-clad steel.
 - a. Size: 5/8 by 96 inches (16 by 2440 mm).

2.10 METALLIC-COATED-STEEL FINISHES

- A. Galvanized Finish: Clean welds, mechanical connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.
- B. Surface Preparation: Clean surfaces of oil and other contaminants. Use cleaning methods that do not leave residue. After cleaning, apply a zinc-phosphate conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A 780/A 780M.
- C. High-Performance Coating: Apply epoxy primer, polyurethane intermediate coat, and polyurethane topcoat to prepared surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.
 - 1. Match approved Samples for color, texture, and coverage. Remove and refinish, or recoat work that does not comply with specified requirements.
 - 2. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.
- B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet (152.5 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.
 - 1. Construction layout and field engineering are specified in Section 01 73 00 "Execution."

3.3 DECORATIVE FENCE INSTALLATION

- A. Install fences according to manufacturer's written instructions.

- B. Post Excavation: Drill or hand-excavate holes for posts in firm, undisturbed soil. Excavate holes to a diameter of not less than 4 times post size and a depth of not less than 24 inches (600 mm) plus 3 inches (75 mm) for each foot (300 mm) or fraction of a foot (300 mm) that fence height exceeds 4 feet (1.2 m).
- C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
 - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
 - 2. Concrete Fill: Place concrete around posts and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 - a. Exposed Concrete: Extend 2 inches (51 mm) above grade. Finish and slope top surface to drain water away from post.
 - 3. Posts Set in Concrete: Extend post to within 6 inches (150 mm) of specified excavation depth, but not closer than 3 inches (75 mm) to bottom of concrete.
 - 4. Space posts uniformly at 6 feet (1.83 m) o.c.

3.4 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.5 GATE OPERATOR INSTALLATION

- A. General: Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.
- B. Excavation for Concrete Bases: Hand-excavate holes for bases in firm, undisturbed soil to dimensions and depths and at locations as required by gate operator component manufacturer's written instructions and as indicated.
- C. Concrete Bases: Cast-in-place or precast concrete, depth not less than 12 inches (300 mm), dimensioned and reinforced according to gate operator component manufacturer's written instructions and as indicated on Drawings.
- D. Vehicle Loop Detector System: Cut grooves in pavement and bury and seal wire loop according to manufacturer's written instructions. Connect to equipment operated by detector.
- E. Comply with NFPA 70 and manufacturer's written instructions for grounding of electric-powered motors, controls, and other devices.

3.6 WIND SCREEN INSTALLATION

- A. Install wind screen in accordance with manufacturer's written instructions and recommendations.

3.7 GROUNDING AND BONDING

- A. Comply with Electrical Engineer's documents.
- B. Fence Grounding: Install at maximum intervals of 1500 feet (450 m) except as follows:
 - 1. Fences within 100 Feet (30 m) of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet (225 m).
 - a. Gates and Other Fence Openings: Ground fence on each side of opening.
 - 1) Bond metal gates to gate posts.
 - 2) Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches (460 mm) below finished grade.
- C. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet (45 m) on each side of crossing.
- D. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.
- E. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches (150 mm) below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
- F. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.

- G. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - 1. Make connections with clean, bare metal at points of contact.
 - 2. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 3. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - 4. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- H. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 - 1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance not less than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.
 - 2. Excessive Grounding Resistance: If resistance to grounding exceeds specified value, notify Architect promptly. Include recommendations for reducing grounding resistance and a proposal to accomplish recommended work.
 - 3. Report: Prepare test reports of grounding resistance at each test location certified by a testing agency. Include observations of weather and other phenomena that may affect test results.

3.9 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Automatic Gate Operators: Energize circuits to electrical equipment and devices. Adjust operators, controls, safety devices, alarms, and limit switches.
 - 1. Hydraulic Operators: Purge operating system, adjust pressure and fluid levels, and check for leaks.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls, alarms, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Lubricate hardware, gate operators, and other moving parts.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain gates.

END OF SECTION

SECTION 32 33 00

SITE FURNISHINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Seating.
 - 2. Planters.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each type of exposed finish, not less than 6-inch- (152-mm-) long linear components and 4-inch- (102-mm-) square sheet components.
- C. Product Schedule: For site furnishings. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For site furnishings manufactured with preservative-treated wood.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For site furnishings to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 SEATING

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Wausau Tile.
- B. Basis-of-Design Product: Wausau Tile; DF5540 Collaboration Torvin Bench.
- C. Frame: Steel.
- D. Seat :
 - 1. Material:
 - a. Wood: Manufacturers standard species; formed into planks.
 - 2. Seat Height: As indicated.
 - 3. Seat Surface Shape: Flat.
 - 4. Overall Height: 17-1/2 inches.
 - 5. Overall Width: 38 inches .
 - 6. Overall Length: 109 inches.
 - 7. Weight: 500 lbs.
- E. Aluminum Finish: Color coated.
 - 1. Color: As selected by Architect from manufacturer's full range.
- F. Steel Finish: Galvanized and color coated.
 - 1. Color: As selected by Architect from manufacturer's full range.
- G. Wood Finish: Manufacturer's standard finish.
 - 1. Stain: As selected by Architect from manufacturer's full range.

2.2 PLANTERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Wausau Tile.
- B. Basis-of-Design Product: Wausau Tile; TF4001 Eclipse Concrete Planter.
- C. Overall Height: 38 inches.

- D. Overall Diameter: 38 inches.
- E. Weight: 990 lbs.
- F. Inner Container: Concrete container with drain holes.
- G. Installation Method: Anchored to substrate indicated on Drawings, unless otherwise directed by Architect.

2.3 MATERIALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated; free of surface blemishes and complying with the following:
 - 1. Rolled or Cold-Finished Bars, Rods, and Wire: ASTM B 211 (ASTM B 211M).
 - 2. Extruded Bars, Rods, Wire, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
 - 3. Structural Pipe and Tube: ASTM B 429/B 429M.
 - 4. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 - 5. Castings: ASTM B 26/B 26M.
- B. Steel and Iron: Free of surface blemishes and complying with the following:
 - 1. Plates, Shapes, and Bars: ASTM A 36/A 36M.
 - 2. Steel Pipe: Standard-weight steel pipe complying with ASTM A 53/A 53M, or electric-resistance-welded pipe complying with ASTM A 135/A 135M.
 - 3. Tubing: Cold-formed steel tubing complying with ASTM A 500/A 500M.
 - 4. Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A 513/A 513M, or steel tubing fabricated from steel complying with ASTM A 1011/A 1011M and complying with dimensional tolerances in ASTM A 500/A 500M; zinc coated internally and externally.
 - 5. Sheet: Commercial steel sheet complying with ASTM A 1011/A 1011M.
 - 6. Perforated Metal: From steel sheet not less than 0.120-inch (3.0-mm) nominal thickness; manufacturer's standard perforation pattern.
- C. Wood: Surfaced smooth on four sides with eased edges; kiln dried, free of knots, solid stock of species indicated.
 - 1. Wood Species: Manufacturer's standard.
- D. Anchors, Fasteners, Fittings, and Hardware: Manufacturer's standard; commercial quality, tamperproof, vandal and theft resistant.
 - 1. Angle Anchors: For inconspicuously bolting legs of site furnishings to on-grade substrate; extent as indicated.
 - 2. Antitheft Hold-Down Brackets: For securing site furnishings to substrate; two per unit.
- E. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M; recommended in writing by manufacturer, for exterior applications.
- F. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound; resistant to erosion from water exposure without needing protection by a sealer or waterproof coating; recommended in writing by manufacturer, for exterior applications.

2.4 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment: Pressure-treat wood according to AWPA U1, Use Category UC3b, and the following:
 - 1. Use preservative chemicals acceptable to authorities having jurisdiction and containing no arsenic or chromium. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 - 2. Kiln-dry lumber and plywood after treatment to a maximum moisture content, respectively, of 19 and 15 percent. Do not use materials that are warped or do not comply with requirements for untreated materials.

2.5 FABRICATION

- A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.

- B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended, so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.
- C. Preservative-Treated Wood Components: Complete fabrication of treated items before treatment if possible. If cut after treatment, apply field treatment complying with AWPA M4 to cut surfaces.
- D. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.
- E. Factory Assembly: Factory assemble components to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.6 GENERAL FINISH REQUIREMENTS

- A. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

- A. Powder-Coat Finish: Manufacturer's standard polyester powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.8 STEEL AND GALVANIZED-STEEL FINISHES

- A. Powder-Coat Finish: Manufacturer's standard polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.
- B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.
- C. Install site furnishings level, plumb, true, and positioned at locations indicated on Drawings.

END OF SECTION

SECTION 32 80 00

IRRIGATION

PART 1 - GENERAL

1.1 SCOPE

Installation of the irrigation system shall be by a Texas Licensed Landscape Irrigation contractor. It is intended that the cost of all work incidental to the completion of the system as shown or indicated on the plans or in these specifications, be included in the bid except as specifically noted herein.

1.2 CODES AND PERMITS

All work shall be done in accordance with all applicable ordinances of the City and State. The contractor shall take out all required permits, arrange for all necessary inspections, and shall pay all fees and expenses in connection with same as part of the work under this contract.

1.3 WORK BY OTHERS

- A. Electric power (115 VAC) to be furnished by the general contractor to supply power for the automatic controller unless noted otherwise on the plans. "Complete" electric service, (if called for on the plans) shall include a new electric meter, disconnect, breaker, and all required coordination with the electric utility company. Final hard-wire connection to the controller shall be the responsibility of the irrigation contractor and shall be performed by a licensed electrician.
- B. Sleeves shall be installed by the general contractor. The irrigation contractor shall be responsible for locating sleeves as they are shown on the plans or directed by the owner. Permanent sleeve markers shall be embedded or marked in the pavement.
- C. Water meters and all associated costs shall be as called for on the plans.

1.4 LAY OUT

The contractor shall lay out and stake the system according to the plans and specifications provided, making minor adjustments as required by the site to provide a complete system with uniform coverage. Any discrepancies, including required static water pressure, unanticipated obstructions, or site conflicts shall be brought to the attention of the owner's representative before authorization can be given to proceed with corrective measures.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Plastic PVC Pipe: All mainline and lateral pipe shall be class 200, SDR-21 solvent weld type. All pipe shall conform to National Sanitation Foundation Standard 14 for Thermoplastic pipe and shall bear the NSF seal. ASTM standard D2241 shall apply. Pipe shall be free from visible cracks, holes, foreign materials, blisters or dents.
- B. PVC Pipe Fittings: All solvent weld PVC fittings shall be type I, medium weight Schedule 40, as manufactured by LASCO Manufacturing Company, or equal. Swing joint assemblies for rotary heads and quick coupling valves shall be as manufactured by LASCO.
- C. Solvents: PVC solvent cement and primer shall be as recommended by the manufacturer. Glue shall be clear and primer shall be purple.
- D. Valve Boxes: All boxes to be made of polypropylene with a snap lid as manufactured by HIGHLINE formerly (ARMOR or PENTEK) and shall be a minimum of 12" x 17" for electric valves and isolation ball valves. All lids shall be green and lids shall be of the same manufacturer. Quick coupler lids to be purple

- E. Wire: Wiring from the electric controller to the control valves shall be type UF 600 volt solid copper single conductor with 4/64" insulation which is Underwriters Laboratory approved for direct underground burial when used in National Electric Code Class II Circuits, (30 Volts AC, or less). Wire connections shall be encased in a water-proof compound or gel, as manufactured by 3-M or equal. Heavier gauge wire may be necessary if length of run exceeds manufacturer's recommendation.
- F. Automatic Controller: Shall be as shown on the plans.
- G. Electric Valves: Shall be as shown on the plans. Shall be installed in min. 12" x 17" Highline valve box. All electric valves shall have same size ball valve installed in the same valve box upstream from the remote valve.
- H. Isolation Valves: Shall be of PVC construction. Use LASCO ball valves. To be located in 12" x 17" Highline valve box.
- I. Sprinkler Heads: Shall be as shown on the plans.
- J. Backflow Preventer: Shall be as shown on the plans and meet city and state code.

2.2 MATERIALS AND WORKMANSHIP

All materials shall be new and without flaws or defects and shall be the best of their class and kind. All materials and equipment shall be installed in a neat and workmanlike manner. The architect or the owner's representative reserves the right to direct the removal and replacement of any items, which in their opinion shall not present an orderly and reasonably neat appearance. Such removal and replacement shall be done, when directed, at the contractor's expense without additional cost to the owner. The contractor shall be responsible for full and complete coverage of all irrigated areas and shall make any necessary minor adjustments at no additional cost to the owner. The contractor shall visit the site prior to bidding to acquaint himself with all conditions requiring consideration to provide a complete system.

2.3 SUBSTITUTIONS

- A. Contractors desiring to substitute materials shall submit to the landscape architect the following:
 - 1. actual samples of each equipment item
 - 2. manufacturer's catalog sheet showing complete specifications
 - 3. detailed pressure loss computations based upon use of the proposed item

The decision of approval will be based on the comparative ability of the equipment to perform fully all purposes and functions of mechanics and general design. Approval of a substitute must be obtained before the bid is submitted. Approval shall not relieve the contractor of his responsibility to demonstrate that the final installed system will operate according to the intent of the original design.

PART 3 – EXECUTION

3.1 INSTALLATION:

Please note that all work done below the drip line of all existing trees to be preserved will have to be done by hand. This includes but is not limited to trenching, backfill, and settling of trenches.

- A. Plastic Pipe and Fittings: Plastic pipe and fittings shall be solvent welded using solvents and methods as recommended by the manufacturer of the pipe, except where screwed connections are required. Pipe and fittings shall be thoroughly cleaned of dirt, dust, and moisture before applying solvent with a non-synthetic bristle brush. Pipe may be assembled and welded on the surface. Snake pipe from side to side of trench to allow for expansion and contraction. Make all connections between plastic and metal items with threaded plastic male adapters. Teflon tape or

other non-oil based thread sealant shall be used to seal threads. Oil based sealants will not be allowed.

- B. Thrust Block: (For 3" size pipe and large) Quantity of concrete may vary due to amount of soil removed at fitting location. A minimum of one sack shall be used. Form thrust block so as not to prevent removal of fitting or wiring. Shall be place at fitting where a change of direction occurs, i.e., 45 and 90 degree fittings, tee, ball valves, and at reduction of pipe size. Place non-porous material between concrete and pipe to prevent concrete from sticking to pipe. Thrust blocks must be shaped so as to not encase pipe or electrical wiring for ease of maintenance. Thrust block shall be installed against pipe and non-disturbed soil. All debris shall be removed prior to installation.
- C. Mainline pipe shall be installed at a minimum depth of 18" and a maximum depth of 24". Lateral pipe shall be installed between 14" and 18". Multiple pipes in the same trench shall not rest directly against each other. Crosses shall not be allowed. Use multiple tees. A 4" minimum wide trench is required for pipe up to 2" size. A 6" trench is required for pipe up to 3" size. A 8" trench is required for pipe up to 4" in size.
- D. Trenching and Backfill: All excavation in this contract shall be unclassified and is to include earth, loose rock, solid rock, or any combination thereof, in a wet or dry state. All trenches shall be backfilled with the material removed except for rocks larger than 1". Backfill shall be flooded and tamped to prevent settling. Should solid rock be encountered, contractor shall remove such rock within 4" of contact with pipe and bed trenches with clean sand fill. Removal of excavated rock shall be included in the cost of this contract.
- E. Wire: All wiring shall be installed under lateral pipes and to the side of mainline piping. Expansion coils shall be provided every 100', and at all changes in direction. Wires shall be bundled and taped together, by controller, every 20'. All splices shall be located in a valve box. No field splices shall be allowed. Label each wire at the controller terminal strip.
- F. Valves: Valves shall be installed as per detail shown. In addition, each remote control valve shall have a ball valve upstream from remote valve in the same 12" x 17" Highline valve box. Valves shall be grouped in orderly arrangement. No valves shall be within 36" of another, or within 36" of a curb or sidewalk. Valve boxes shall be grouped in straight lines at the same grade. Valve boxes to be a minimum of 12" x 17" by Highline. Hand tamp and fill as necessary around all valve boxes. Valve boxes shall be flush with grade or slightly below or no final acceptance will be given.
- G. Heads: Install all spray heads and rotary heads as per detail. Allow a 3" to 4" space between all heads and any hardscape edge. Thoroughly flush all debris from lines before installing spray head nozzles or rotary internal assemblies. Filters are required as supplied by the manufacturer on all spray heads. Hand tamp and fill if necessary around all heads after nozzle installation. All heads shall be plumb, level, and flush with grade unless noted otherwise.
- H. Controllers: Automatic controllers shall be installed as per detail shown. The controller shall be installed level and secure. Wire conduits to controller shall be straight and secured with appropriate clamps as needed. Controller sensors shall be installed in optimum locations within access of the controller location. Assign zone numbers in a logical sequence around the site. Each valve wire end shall be labeled within the controller with zone number tape markers.

3.2 COORDINATION

The irrigation contractor shall coordinate and cooperate with other contractors to enable the work to proceed as rapidly and efficiently as possible.

3.3 "AS-BUILT DRAWINGS"

Prepare an "as-built" drawing on a reproducible print which shall show deviations from the bid documents made during construction affecting the mainline pipe, controller location, remote control valves, wiring, and all sprinkler heads. The drawing shall include dimensions from two separate landmarks to locate all electric and manual valves. The drawing shall be delivered to the owner before final acceptance will be given. Colored zone charts and typed zone lists shall be provided in each controller cabinet.

3.4 FINALIZATION:

Contractor to complete the following before requesting a final acceptance inspection.

- A. Clean Up: Contractor shall remove from the site all debris resulting from work of this section.
- B. Adjustment: Contractor shall test entire system for proper operation of all functions. Adjust all spray nozzles and rotary arcs for complete coverage with minimum overspray onto walls, walks, and streets. Repair any leaks. Straighten heads. Refill and compact any settled areas. System shall be required to pass inspection by city.
- C. Submittals: Contractor to deliver "as-built" drawings, quick coupler keys, and any required additional materials to the owner's representative along with a detailed list of such material items. A colored zone map and written chart shall be included within the controller cabinet with a description of the location of each section. A typed zone list for each controller shall be included within the controller cabinet with a description of the location and type of zone. The contractor shall provide recommended watering schedule to validate warranty.

3.5 ACCEPTANCE:

The date of final acceptance shall be the date when any "punch items" are completed to the satisfaction of the owner's representative. Until the date of final acceptance, it shall be the responsibility of the contractor to maintain and protect the system by all means within his control.

3.6 WARRANTY:

The contractor shall guarantee for a period one full year from substantial completion date, that the entire system shall be free from defects in materials and workmanship. Any such defects shall promptly be repaired or replaced at no cost to the owner. Any after-settling of trenches shall be refilled and compacted within the warranty period at no additional cost to the owner. Repairs required due to abuse, misuse, or neglect of the system are not included in this warranty.

END OF SECTION

SECTION 32 90 00

PLANTING

PART 1 - GENERAL

1.1 SCOPE

Provide all labor, materials, and equipment for complete installation of landscaping, as indicated on the drawings, and specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Irrigation System
- B. Lawns
- C. Earthwork
- D. General Requirements

1.3 QUALITY ASSURANCE

- A. Provide plant materials in compliance with applicable State and Federal laws relating to inspection for diseases and insect infestation at growing site.
- B. Plants are subject to inspection and approval by the Landscape Architect.
- C. Employ only qualified personnel familiar with required work.
- D. Off-site topsoil and topsoil on-site Testing (paid by Landscape Contractor):
 - 1. Provide source of off-site soil (If Required for Job) to the Owners representative for the purpose of soil investigation.
 - 2. Take random representative soil samples and test samples from each source for ph, alkalinity, total soluble salts, porosity, sodium content and organic matter.
- E. File certificate of Inspection of plant material by State and Federal authorities with Landscape Architect, if required by State.

1.4 REFERENCED STANDARDS

- A. American Standard for Nursery Stock, latest addition by American National Standards Institute, Inc. - Plant materials.
- B. Hortus Third, 1976 - Cornell University - Plant nomenclature.
- C. ASTM - American Standard Testing Material - Sharp sand.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver packaged materials in sealed containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery and while stored at site.
- B. Do not deliver more plant materials than can be planted in one day unless adequate storage and watering facilities are available on job site. Storage of materials and equipment at the job site will be at the risk of the landscape contractor. The owner will not be held responsible for theft or damage.
- C. If balled plants cannot be planted within 24 hours after delivery to site, protect root balls by heeling in with saw dust or other approved material.

- D. Protect during delivery to prevent damage to root ball or desiccation of leaves.
- E. Remove rejected plant material immediately from site.

1.6 JOB CONDITIONS

A. Planting Restrictions:

Perform actual planting only when weather and soil conditions are suitable in accordance with locally accepted practice. In no way shall any trees, plants, ground cover or seasonal color obstruct drainage or block a 2% minimum positive slope away from buildings.

B. Utilities:

1. Determine locations of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, if required, to minimize possibility of damage to underground utilities.
2. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
3. Coordinate work with irrigation contractor to prevent damage to underground sprinkler system.

1.7 WARRANTY

- A. Warranty for plants and trees shall be for one year after final acceptance. Replace dead materials and materials not in vigorous, thriving condition as soon as weather permits and on notification by Owners Rep. Replace plants, including trees, which in opinion of Landscape Architect have partially died thereby damaging shape, size, or symmetry.
- B. Replace plants and trees with same kind and size as originally planted, at no cost to the Owner. Provide one-year warranty on replacement plants. These should be replaced at start of next planting or digging season. In such cases, removed dead trees immediately. Protect irrigation system and other piping conduit or other work during replacement. Repair any damage immediately.
- C. Warranty excludes replacement of plants after final acceptance because of injury by severe storm, drought, hail, severe multi-day freeze, insects or diseases.
- D. At the end of the warranty period, staking and guying materials if required shall be removed from the site.

1.8 MAINTENANCE

- A. Water: Will be available on site. Provide necessary hoses and other watering equipment required to complete work. Some proposed grass areas will not have automatic irrigation and some temporary irrigation or hand watering will be required for establishing grass.
- B. Until final acceptance, maintain plantings and trees by watering, cultivating, mowing, weeding, spraying, cleaning and replacing as necessary to keep landscape in a vigorous, health condition and rake bed areas as required.
- C. A written notice requesting final inspection and acceptance should be submitted to Landscape Architect or owner's representative within seven (7) days prior to completion. At that time owner and Landscape Architect will prepare a final punch list to be reviewed with the landscape contractor.
- D. Following final acceptance, maintenance of plant material will become the Owner's responsibility. The Contractor shall provide Owner with a recommended maintenance program.

- E. All dead wood and suckers shall be removed from all existing trees on this property. Any branch lower than eight feet from vehicular or pedestrian pavement shall be pruned up to a minimum of eight feet.

PART 2 - PRODUCTS

2.1 PLANTS

- A. Quantities: The drawings and specifications are complementary: anything called for on one and not the other is as binding as if shown and called for on both. The plant schedule is an aid to bidders only. Confirm all quantities on plan.
- B. Plants shall be equal to well formed No. 1 grade of better; symmetrical, heavily branched with an even branch distribution, densely foliated and/or budded, and a strong, straight, distinct leader where this is characteristic of species. Plants shall possess a normal balance between height and spread. The Landscape Architect will be the final arbiter of acceptability of plant form, either before or after planting and shall be removed at the expense of the Landscape Contractor and replaced with acceptable plants as specified.
- C. Plants shall be healthy, free of disease, insect pests and their eggs, and larvae.
- D. Plants shall have a well-developed fibrous root system.
- E. Plants shall be free of physical damage such as scrapes, broken or split branches, scars, bark abrasions, sun scalds, fresh limb cuts, disfiguring knots, or other defects.
- F. Pruning of all trees and shrubs, as directed by Landscape Architect, shall be executed by Landscape Contractor at no additional cost to the Owner.
- G. Plants shall meet the sizes indicated on the Plant List. Where a size or caliper range is stated, at least 50% of the material shall be closer in size to the top of the range stated.
- H. Plants indicated "B&B" shall be balled and burlapped. Plants shall be nursery grown unless otherwise specified in plant list. Balls shall be firm, neat, slightly tapered and well burlapped. Non-biodegradable ball wrapping material will not be accepted. Any tree loose in the ball or with broken ball at time of planting will be rejected. Balls shall be ten (10") inches in diameter for each one (1") inch of trunk diameter, measured six (6") inches above ball.
- I. Container grown plants shall be well rooted and established in the container in which they are growing. They shall have grown in the container for a sufficient length of time for the root system to hold the planting medium when taken from the container, but not long enough to become root bound.

2.2 SOIL PREPARATION MATERIALS

- A. Peat Moss: Commercial sphagnum moss or hyphum peat.
- B. Pre-mixed soils can be used as long as samples are submitted with manufacturer's data and laboratory test reports.
- C. Sandy Loam:
 - 1. Friable, fertile, dark, loamy soil, free of clay lumps, subsoil, stones, and other extraneous material and reasonably free of weeds and foreign grasses. Soil containing Dallisgrass or Nutgrass shall be rejected.
 - 2. Physical properties as follows:
 - Clay - between 7-27 percent
 - Silt - between 28-50 percent
 - Sand - less than 52 percent

- D. Sharp Sand: Clean, washed sand, (fine aggregate) ASTM C-33.

2.3 COMMERCIAL FERTILIZER

- A. Fertilizer shall be delivered in manufacturer's standard container printed with manufacturer's name, material weight, and guaranteed analysis. Fertilizers with N-P-K analysis other than that specified may be used provided that the application rate per square foot of nitrogen, phosphorus, and potassium is equal to that specified.
- B. Commercial Fertilizer for Planting Beds: Complete fertilizer 5-10-5 element ratio with minimum 8% sulfur and 4% iron plus micro-nutrients.
- C. Controlled-Release fertilizer planting tablets for tree planting pits, shall be equal to Agriform 20-10-15 planting tablets as manufactured by Sierra Chemical Co., Milpitas, California 95035 or approved equal.

2.4 MULCH

Mulch for trees shall be hardwood mulch chips, ranging in size from 1-inch to 2-inches in size, medium texture. Mulch for planting beds shall be rock per detail on planting details sheet.

PART 3 - EXECUTION

3.1 CONDITION OF SURFACES

- A. New bed areas will be left within one tenth of a foot of finish grade by other trades. Contractor will be responsible for raking and smoothing of grade. Remove from site and legally dispose of stones $\frac{3}{4}$ -inch and larger, clods 1-inch or larger, sticks, and other debris exposed during this operation. Top of mulch in bed areas shall be flush with adjacent pavement or grade.
- B. Examine subgrade upon which work is to be performed. Notify the Landscape Architect or owners representative of unsatisfactory conditions.

3.2 TREE PLANTING

- A. Plant ornamental trees in pits 12-inches larger than the root ball. Plant shade trees in pits 24-inches greater in diameter than root ball and equal to depth of root ball.
- B. After excavation of tree pits, review water percolation. If tree pit does not drain adequately prepare hole for use with a tree sump. Paint PVC standpipe and cover dark green. After tree is installed, pump water out on a daily basis.
- C. In the event rock or underground construction work or obstructions are encountered in any plant pit excavation work to be done under this section, alternate locations may be selected by the Landscape Architect. Where locations cannot be changed the obstructions shall be removed to a depth of not less than six (6") inches below bottom of ball when plant is properly set at the required grade. The work of this section shall include the removal from the site of such rock or underground obstructions encountered at the cost of the Landscape Contractor.
- D. Prepare soil for planting by thoroughly mixing two parts sandy loam and one part peatmoss or other approved organic matter. If planting soil does not fall within the ph range of 5.5 to 7.0 add limestone or aluminum sulphate to bring soil into the specified ph range.
- E. Backfill tree pits with a mixture of $\frac{1}{2}$ prepared soil and $\frac{1}{2}$ existing site soil. Lightly tamp every 6-inches to fill all voids and pockets. When pit is $\frac{2}{3}$ full, water thoroughly and leave water to soak in. Place fertilizer planting tablets per manufacturer's recommendations. Complete backfilling and form a saucer around the tree.
- F. Completely fill each tree saucer with mulch to a depth of three inches.

- G. Contractor shall keep trees plumb until established. Reference detail sheet.
- H. Pruning: Prune trees to preserve the natural character of the plant in a manner appropriate to its particular requirements in the landscape design as directed by the Landscape Architect. In general, remove at least one-third of wood by thinning and pruning. DO NOT cut back terminal branches. Prune native grown plants heavier than nursery grown plants. Remove sucker growth and broken or badly bruised branches.

3.3 SHRUB PLANTING

- A. Any existing grass area to receive shrubs or ground cover must have grass properly killed and removed to a depth of four inches to ensure that no existing grass will come back in the bed area. Soil mix shall be used to replace the four inches removed in this area.
- B. All shrub areas shall have weed barrier mat below the mulch (rock).
- C. Till 12 inches min. of thoroughly mixed prepared soil in all planting bed areas as follows:
1 part sandy loam
1 part peat moss
1 part sharp sand
Add 4 pounds commercial fertilizer per 100 SF of bed area and mix thoroughly.
- D. Some soil may need to be removed after soil mix has been added and tilling has been completed. The beds (top of rock) should generally be flush with adjacent grade or adjacent curb.
- E. Plant where shown on plans, setting plants with tops of balls even with tops of beds, and compact soil carefully around each plant ball.
- F. Excavate planting hole 3" larger than the width and height of the root ball. Backfill with 1/3 (soil mix and/or peatmoss), 1/3 native soil and 1/3 sandloam.
- G. Water each plant thoroughly with hoses to eliminate air pockets.
- H. Carefully prune plants to remove dead or broken branches, various tags, and hand-rake bed areas to smooth even surfaces, and mulch bed areas. Reference landscape plan as some areas will receive rock as mulch and some areas will receive hardwood mulch.

3.4 CLEANUP

During work, keep premises neat and orderly including organization of storage area. Remove trash, including debris resulting from removing weeds or rocks from planting areas, preparing beds, or planting plants from site daily as work progresses. Keep walk and driveway area clean by sweeping or hosing.

END OF SECTION

SECTION 32 92 00

LAWNS AND GRASSES

PART 1 - GENERAL

1.1 SCOPE

Furnish all labor, tools, transportation, materials, equipment, supervision, etc., required to adequately establish a dense lawn of permanent grasses, free from lumps and depressions as indicated by plans and specifications.

Redo any part of the area failing to show uniform cover until a dense lawn is established. The cost of miscellaneous labor and materials for topsoil, weeding, tilling, pest control, fertilizing, etc., are not separate pay items and shall be included in the bid price for grassing.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Irrigation System
- B. Landscaping

1.3 MAINTENANCE OF GRASS

The Contractor shall maintain the grass until final acceptance. Such maintenance shall include spraying, weeding, cultivation, fertilizing, watering, disease and insect control, top dressing low spots, plus any procedures consistent with horticultural practice necessary to insure normal, vigorous, and healthy grass.

1.4 JOB CONDITIONS

- A. Water: Will be available on site. Provide necessary hoses and other watering equipment required to complete work. Not all areas shown to have grass will be receiving automatic irrigation
- B. Lawn areas will be left within 1/10 of a foot of finish grade by other trades. Fine grading, raking and smoothing will be the responsibility of the contractor.

1.5 SCHEDULE

- A. Sodding: Sod Bermuda/Tiff 419 year-round under favorable conditions.
- B. Seeding/hydromulching - Bermuda grass: Complete only between May 1 to August 31 under favorable conditions. (warm season)

1.6 ACCEPTANCE

The work will be accepted when a completed, undamaged stand of grass is achieved, as approved by the Owner's Representative. A stand of grass is defined as full, thick, vigorously growing grass in all turf areas. All areas disturbed by construction not shown on the plans to receive sod shall be sodded to provide full coverage.

PART 2 - PRODUCTS

2.1 TOPSOIL – (Verify 6" in all general landscape areas, should be completed with onsite topsoil)

- A. No topsoil shall be removed from the site. General contractor shall excavate and stockpile topsoil on site if the soil is of good quality. The soil shall be tested at a lab and the results, including suggested treatments for soil, sent to the landscape architect. A minimum of three soil samples shall be taken on site if requested. These shall be spread out evenly throughout the site. These samples shall be tested by a certified institution and the institution shall provide recommendations (for the turf specified for this project) for any adjustment in the soils condition. The landscape

contractor shall be responsible for any soil amendments as recommended. The contractor shall forward two copies of all the soil reports, recommendations, and a list of soil amendments to the owner and architect.

- B. General contractor shall be responsible for distributing the stockpiled soil back to all areas of the site if the topsoil is of good quality. The general contractor shall be responsible for providing the specified amount of topsoil in all landscape areas. If there is not enough topsoil stockpiled on-site the general contractor shall be responsible for purchasing and transporting quality topsoil to the site including the distribution throughout the site.
- C. In the event that there is more stockpiled top- soil than was required to provide the specified topsoil the topsoil shall be retained for the school district. No topsoil shall be hauled off of the site unless directed by the owner.
- D. Topsoil should be friable, fertile, dark, loamy soil, free of clay lumps, sub-soil stones, and other extraneous material and reasonable free of weeds and foreign grasses. Topsoil containing dallisgrass, nutgrass or weeds shall be rejected.
- E. If requested, the soil shall be tested at a lab at contractor's expense and the results, including suggested soil treatments, sent to the architect and landscape architect. Samples may be requested from both stockpiled soil and imported soil.
- F. Physical properties of imported topsoil should be as follows:
Clay - between 7-27 percent
Silt - between 28-50 percent
Sand - less than 52 percent
- G. Landscape contractor shall be responsible for verifying positive flow of water away from building in all areas. Landscape contractor shall be responsible for verifying that finished grass levels are below all weep holes.

2.2 GRASS

- A. Bermuda Sod/Tiff 419: Solid rolled sod, live, rich, dark green in color, free of foreign grasses, weeds, nutgrass, cut with a full ¾" min. layer of soil covering roots. Deliver to site in standard rolls (24" min width). Do not stack for more than 24 hours between time of cutting and time of delivery. All sod netting shall be removed during installation..
- B. Bermuda Grass: Extra fancy, hulled and treated, lawn type seed, delivered to site in original, unopened containers meeting requirements of Texas State Seed Law. Minimum purity germination 90 percent.

2.3 FERTILIZER

Fertilizer shall be organic base, uniform in composition, dry and free flowing. Deliver fertilizer to site in original, unopened containers, each bearing manufacturer's guaranteed statement of analysis.

- A. First application: 12-12-12 element percentage with minimum 8% sulfur and 4% iron, plus micro-nutrients.
- B. Second application: 3:1:2 element ratio. Nitrogen source to be a minimum 50% slow release organic nitrogen (SCU or UF) plus minimum 8% sulfur and 4% iron plus micro-nutrients.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Scarify lawn areas where excessive compaction is greater than 85% Standard Proctor to a depth of 4-inches by discing or rototilling. Repeat cultivation as required to thoroughly loosen soil.

- B. Leave areas free of weeds and ready for final grading.
- C. Provide barricades around scarified areas to prevent compaction by construction vehicles.
- D. Contractor shall amend soil as stated above. Contractor responsible for meeting finish grade including all soil amendments and sod.

3.2 FINAL GRADING

- A. Remove from site and legally dispose of stones 3/4-inch and larger, clods 1-inch or larger, sticks and other debris exposed during this operation. Continue to remove stones and debris as they appear until a stand of grass is accepted.
- B. Provide finish grading leaving surface uniform without depressions and undulations. Grade should be approximately 1-inch below paving on low side of concrete and flush on the high side of concrete to facilitate water flowing across walks and drives and to avoid standing water on concrete surfaces.

3.3 HERBICIDE

Apply herbicide to remove any remaining weeds. This work is to be performed by a licensed applicator following the manufacturer's recommendations.

3.4 FERTILIZER

- A. Place first application with hydromulch at rate of 12 pounds per 1,000 square feet.
- B. Uniformly distribute second application using a rotary type fertilizer spreader 3-4 weeks after first application at 12 pounds per 1,000 square feet.

3.5 SOLID SOD

- A. Solid Rolled Sod: Plant grass edge to edge with staggered joints. Topdress with sharp sand raked in carefully to fill joints. Roll to eliminate undulations and provide complete soil contact. Continue topdressing and rolling until all seams and undulations have been eliminated and levels are within tolerances of 1 inch in ten feet of run. All sod areas will be rolled and top dressed multiple times until all areas are level. All sod netting shall be removed during installation.
- B. Sod shall be top dressed prior to rolling as indicated above. After 2 weeks, landscape contractor shall review all sod areas again and top dress any remaining open or uneven joints. Grass will be required to have a very smooth finish in all playing surfaces. No grass area with undulations or uneven joints will be accepted until leveled and finished out to the owner's satisfaction.
- C. Fertilizing: Fertilize immediately after grass is planted at rate of 4 lbs. Per 1,000 square foot. Repeat fertilizing at the same rate 3-4 weeks later.

3.6 HYDROMULCH/SEEDING:

- A. At the time of hydromulch/seeding, soil shall be moist but not muddy, and wind velocity shall not exceed ten (10) miles per hour. Add water if required to moisten soil.
- B. Hydromulch seed uniformly at the rate of 2 pounds of Bermuda grass seed per 1,000 square feet.
- C. Add tackifier to hydromulch mix for slopes 5:1 or greater at the rate of 1 lb. Per bag of mulch. Use a 4' x 8' batter board against bed areas.

3.7 ESTABLISHMENT AND MAINTENANCE OF LAWN AREAS

A. Watering

1. Water lawn areas immediately after grassing operation.
2. Continue watering as required to keep soil uniformly moist to a minimum depth of 4-inches.
3. Be alert to over-watering newly planted grass, particularly in heavy clay soils.
4. Some areas will require hand watering or temporary irrigation.

B. Replanting/Erosion Control

1. Correct any erosion that may occur during the establishment of grass.
2. Reseed (sod) any areas not showing sufficient growth within 3 weeks after initial grassing. Continue seeding (sodding) until a stand of grass is achieved.
3. A stand of grass will be defined as a uniform cover of activity growing permanent turf. No bare areas larger than one square foot will be accepted. All areas shall be smooth and ready to mow. All areas must have healthy actively growing turf and be relatively weed free prior to acceptance. Rye grass coverage does not constitute a standoff grass.

C. Mowing/Weed Control

1. Mow lawn areas weekly until a stand of grass is achieved. Begin mowing when the lawn reaches a height of 3-inches; set mower to cut at 2-inches. Reduce over 2 cuts to final cut of 1.5 inches. Site shall be mowed per the maintenance schedule until the site landscaping is accepted.
2. Weed lawn areas until acceptance, removing all foreign vegetation, either by hoeing or pulling. If approved, herbicide spot treatments may be used.

3.8 CLEANUP

During work, keep premises neat and orderly, including organization of storage areas. Remove trash, including debris resulting from removing weeds and rocks from site daily as work progresses. Keep paved areas clean by sweeping or hosing.

END OF SECTION

SECTION 33 00 00

UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Perform all work required to complete the project as indicated by the Contract Documents and furnish all supplementary items necessary for the completion of all work specified in this Section.
- B. The work included in this Section, while not all inclusive but listed as a guide, shall include furnishing all labor, tools, materials and incidentals required to complete the work; the complete installation of conduit for site lighting and sleeving for future use; and cleaning up.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 22 00 - Grading

1.3 STANDARDS

- A. Standards will meet the requirements and recommendations of applicable portions of the standards listed:
 - 1. American Society of Testing and Materials, ASTM.
 - 2. TXDOT Standard Specifications.

1.4 JOB CONDITIONS

- A. Site Information:
 - 1. The data on indicated subsurface conditions is not intended as representations or warranties of the accuracy or continuity between soil borings. It is expressly understood that the Owner will not be responsible for interpretation or conclusions drawn there from by the Contractor. The data is made available for the convenience of the Contractor. Additional test borings and other exploratory operations may be made by the Contractor at no cost to the Owner.
- B. Existing Utilities:
 - 1. It shall be the Contractor's responsibility to verify the location (horizontal and vertical depth) of all utilities prior to beginning construction. If utilities are to remain in place, provide protection from damage during construction operations.
 - 2. The Contractor shall notify the Owner's Representative and utility companies when working in areas where utility lines might be encountered. The Contractor will be held responsible for all damage to utility lines as a result of work under this contract.
 - 3. The Contractor shall not interrupt existing utilities serving facilities occupied and used by the Owner. In the event that service from an active utility line should need to be discontinued for any period of time, the utility will be shut down by the respective utilities. Prior to discontinuing service on any active utility line, the Contractor shall submit a request, in writing, to the Owner's Representative stating the need to shut down a specific utility. This request shall be submitted to the Owner's Representative a minimum of seven (7) days prior to service being discontinued.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Underground Pipe Conduit and sleeving shall be Schedule 40 PVC Pipe unless otherwise noted on the Drawings. The Contractor shall locate and flag all conduits so that it will be readily identifiable by the Owner.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall comply with all requirements of TXDOT Standards and with those specified herein. The most stringent will apply.
- B. It shall be the responsibility of the Contractor to insure that all trenches resulting from the placement of underground utilities are backfilled in accordance with the specifications set forth for this project. In the event that any subcontractor or public utility company fails to properly backfill their trenches, the Contractor at no additional cost shall perform this work.

3.2 EXCAVATION

- A. The Contractor shall excavate all materials encountered regardless of the difficulties encountered. The ditch shall be no greater in width or depth than is necessary to permit construction in accordance with the plans and these specifications. The maximum width of trench at top of pipe without sheeting, shoring, and bracing shall not be more than the external diameter of pipe plus 16 inches.
- B. All trench excavations shall meet the requirements of the TXDOT and O.S.H.A.
- C. Soft, spongy or otherwise unstable material which will not provide a firm foundation for the pipe shall be removed and replaced to the extent required by the Owner's Representative. The material thus removed shall be replaced with suitable selected material from the excavation or other sources approved by the Owner's Representative. and shall be compacted as provided in these Specifications. When unstable conditions are not corrected by the above means, the Contractor will be required to use rock, gravel, concrete or timber foundations. The type of foundation shall be determined by the Owner's Representative. There will be no extra compensation for this work.

3.3 BEDDING

- A. The bedding for pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe. Recesses for bells of the pipe shall be excavated for every joint and shall be of sufficient size and depth to relieve the bell of the load, permitting the barrel of the pipe to lie firmly throughout the entire length. The pipe positively will not be supported on blocks in order to raise the bell.
- B. Earth bedding shall be used unless another type is designated on the Drawings or specified per the City standards and specifications for construction. The pipe shall be placed on the natural undisturbed earth foundation, which has been carefully shaped to fit the lower part of the conduit for not less than 1/4 of its circumference. When rock, shale or boulders are encountered in the trench, they shall be removed to a depth of six (6) inches below the grade line and the trench shall be refilled with good, sound earth, gravel or granular material up to the original grade and tamped into place. Bell holes will be required as above.

- C. Other types of bedding and embedment shall be provided when designated on the Drawings.

3.4 EMBEDMENT AND BACKFILLING

- A. After the pipe has been installed and embedded as designated on the Drawings, selected material from the excavation, at a moisture content with which the required density can be obtained, shall be placed in layers not exceeding nine (9) inches loose depth and shall be compacted by an approved method which will obtain the density of the adjacent undisturbed soil. Backfill for pipes under pavements shall be compacted as specified in section 31 22 00, "Grading". Water jetting will not be permitted.
- B. Clay plugs shall be installed in pipe trenches, along three feet of the pipe trench, where crossing building lines and pavement edges to prevent water from migrating along the trench backfill and entering beneath building or pavement areas.
- C. When earth bedding is used and material suitable for the initial backfill up to a point 12 inches above the top of the pipe is not available from the excavation, the Contractor shall obtain a granular material from other sources. Granular material is construed to mean a free flowing material like sand, or mixed sand and pea gravel, free from lumps, large stones, clay and organic materials. When wet, granular material shall not form mud or muck.

3.5 CLEANING UP

- A. Upon completion of the work covered by this Section, the Contractor shall clean up all work areas by removing all debris, surplus material and equipment from the site. The ground surface will be restored to within 0.10 foot of its original position.

END OF SECTION

SECTION 33 40 00

STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Perform all work required to complete, as indicated by the Contract Documents, and furnish all supplementary items necessary for completion of all work specified in this Section.
- B. The work included in this Section, while not all inclusive but listed as a guide, shall include furnishing all labor, tools, materials and incidentals required to complete the work; preparation of a trench safety plan and obtaining City approval of the trench safety plan; laying out all lines and structures; the complete installation of storm drains, grate inlets, catch basins, area drains, curb inlets, headwalls, etc. and cleaning up. For work within public rights-of-way and proposed easements, the Contractor shall comply with all requirements of the local governing standards, TXDOT standards, and with the standards and specifications stated herein. The most stringent shall apply.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 22 00 - Grading

1.3 STANDARDS

- A. Construction will meet the requirements and recommendations of applicable portions of the Standards listed:
 - 1. American Society for Testing and Materials, ASTM.
 - 2. TXDOT 1993 Standard Specifications for Construction of Highways, Streets and Bridges
 - 3. Standard Specifications for Public Works Construction, North Central Texas Council of Governments, NCTCOG.

1.4 JOB CONDITIONS

- A. Site Information
 - 1. The data indicated in the geotechnical investigation is made available for the convenience of the Contractor. The Owner will not be responsible for interpretations of the geotechnical investigation made by the Contractor. Additional test borings and other exploratory operations may be made by the Contractor at no cost to the Owner.
- B. Existing Utilities
 - 1. It shall be the Contractor's responsibility to verify the location (horizontal and vertical depth) of all utilities prior to beginning earthwork operations. If utilities are to remain in place, provide protection from damage during construction operations.
 - 2. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult Owner immediately for directions as to proceed. Cooperate with Owner, public and private utility companies in keeping services and facilities in operation. Repair damaged utilities to satisfaction of utility Owner.
 - 3. Do not interrupt existing utilities serving facilities occupied and used by Owner, except when permitted in writing by Owner and then only after temporary utility services have been provided.

- C. Use of Explosives
 - 1. The use of explosives is not permitted.
- D. Protection of Persons and Property
 - 1. Barricade open excavations occurring as part of this work and post with warning lights. Operate warning lights as recommended by authorities having jurisdiction.
 - 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damages caused by settlement, lateral movement, undermining, washout and other hazards created by excavation operations.

PART 2 - MATERIALS

2.1 STORM DRAINAGE PIPE

- A. All storm drainage pipe 18 inches in diameter or larger, or located under drives or fire lanes, shall be Class III, reinforced concrete pipe (RCP) with tongue and groove joints and shall conform to the latest ASTM Designation C 76, unless otherwise noted on the plans.
- B. Portland Cement shall be a standard brand and shall conform to the latest ASTM Designation C 150 Type 1.
- C. Mortar and grout shall be composed of two parts fine aggregate and one part cement and mixed with water to produce a homogeneous mixture of such consistency that it can be easily handled and spread by trowel. Mortar and grout which has been retempered or has attained its initial set shall not be used.
- D. Aggregates for concrete shall be considered as either fine or coarse and shall meet the requirements of NCTCOG Item 2.1.
- E. Concrete shall be composed of Portland cement, coarse aggregate, fine aggregate, water, mineral filler and/or admixtures if permitted by the Owner. Concrete shall have a minimum compressive strength at 28 days of not less than 3000 psi and shall have a maximum water-cement ratio of 7.0 gallons per sack, minimum cement content of 5.0 sacks per cubic yard, and a slump from two (2) to three (3) inches. Measuring materials, batching and mixing shall conform to ASTM Designation C 94.
- F. Reinforcing steel shall conform to ASTM Designation A 615, Grade 60.
- G. Cast iron rings, cover and grates shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength and value for the service intended. Angles shall be filleted and arises shall be sharp and true. Surfaces shall be machined where indicated or where otherwise necessary to secure true, flat surfaces. Cover and grates shall fit properly into frames, and seat uniformly and solidly.
 - 1. Castings shall conform to the following ASTM Designations:
 - a. Gray-iron Castings A 48 Class 30
 - b. Malleable Castings A 47 25018
 - c. Ductile Iron Castings A 395 60-45-15

3.1 EXCAVATION

- A. The Contractor shall excavate all materials encountered regardless of the difficulties encountered. The ditch shall be no greater in width or depth than is necessary to permit construction in accordance with the Plans and these Specifications. The maximum width of trench at top of pipe without sheeting, shoring and bracing shall be as follows: Up to 33" External Diameter of Pipe + 16", 36" and larger External Diameter of Pipe + 24".
- B. The Contractor shall provide sheeting, shoring and bracing, whenever the excavation or trench is more than five feet in depth and eight feet or more in length. When sheeting and bracing are necessary the trench or excavation shall be dug to such width that proper allowance is made for the space occupied by the sheeting. All sheeting, shoring and bracing shall have sufficient strength and rigidity to withstand the pressure exerted and protect all persons or property from injury or damage. Neither sheeting nor shoring shall be left in place, but shall be removed in such a manner as not to endanger or damage new or existing structures. All holes or voids left by the removal of sheeting shall be backfilled.
- C. Soft, spongy or otherwise unstable material which will not provide a firm foundation for the pipe shall be removed and replaced with a suitable selected material from the excavation or other sources approved by the Construction Manager and shall be compacted as provided in the Specifications. When unstable conditions are not corrected by the above means, the Contractor will be required to use rock, gravel, concrete or timber foundations. There will be no extra compensation for this work.

3.2 BEDDING

- A. The bedding for the pipe, which shall provide a firm foundation of uniform density throughout the entire length of the pipe, shall be as designated on the drawings.

3.3 PLACING STORM SEWER

- A. No pipe shall be laid until it has been inspected and approved. All pipes shall be laid and jointed in the dry. The pipe shall be laid up-grade beginning at the lower end of the line. Pipe shall be laid accurately to line and grade with the tongue end downstream entering the groove to full depth and in such manner as not to drag earth into the annular space for joint grouting. When the entering pipe has been checked for line and grade, the body of the pipe shall be backfilled with enough earth, rock or concrete on both sides to hold the pipe firmly in position.

3.4 PIPE JOINTS

- A. The ends of the pipe shall be cleaned thoroughly and wetted before making the joint. The groove of the pipe as laid and the tongue of the pipe section being laid shall be plastered thoroughly with an even layer of mortar. The pipes shall then be pulled together taking care that the inner surfaces are flush and even. The entire inner circumference of the joints of pipe 24 inches and larger in diameter shall be sealed and packed with mortar and finished smooth. A bead shall be formed on the pipe exterior extending at least one inch on either side of the joint and of approximately semicircular cross section and covering the top half of the pipe circumference.
- B. For pipe less than 24 inches inside diameter, a tight stopper of burlap or other equivalent materials shall be dragged through the pipe past the new joint. Curing compound shall be

used to protect the mortar. No jointing shall be done when the atmospheric temperature is below 40°F. Mortar shall be protected from freezing temperatures for 48 hours after being applied to joints.

- C. Alternate methods of joints may be used at the option of the Contractor. The alternate methods are (1) cold applied, plastic asphalt sewer joint compound, (2) rubber gasket and (3) cold applied performed plastic gaskets. If the alternate method is used it shall meet all requirements for materials and installation of TXDOT Item 464.

3.5 PIPE CONNECTIONS

- A. **Wye Connections:** The connection of one pipe to another may be accomplished with a precast wye or by means of pipe-to-pipe connection. A pipe-to-pipe connection shall be made by cutting a hole in the larger pipe slightly larger than the outside diameter of the pipe to be connected. The smaller pipe to be connected shall not project into the larger pipe. A concrete collar not less than six (6) inches thick and six (6) inches wide shall be placed around the smaller pipe on the exterior surface of the larger pipe.
- B. **End-To-End Connections:** Wherever a smaller pipe is jointed end-to-end to a larger pipe, the inside tops of the two pipes shall be matched, unless otherwise shown on the Plans. The void between pipes shall be filled with cemented brickwork or where this is not possible the void shall be filled with concrete mortar. In either case, a concrete collar not less than six (6) inches thick and six (6) inches wide shall be placed around the pipes over the joint.

3.6 INLETS, DRAINS, CLEANOUTS AND MANHOLES

- A. Inlets, drains, cleanouts and manholes shall be constructed as per the plans.
- B. Grates shall have continuous and even bearing on frame and shall be set to avoid rocking.
- C. Coordinate with paving construction to assure proper elevation of inlets as shown on plans.
- D. Install and seal joints at connection pipes.

3.7 BACKFILL

- A. After the pipe has been installed and the mortar joints completely set, selected material from the excavation at a moisture content with which the required density can be obtained shall be placed equally along both sides of the pipe in layers not exceeding six (6) inches loose depth. Care shall be taken to insure thorough compaction of the fill under the haunches of the pipe. Each layer shall be thoroughly compacted by hand or pneumatic tamper until the fill has reached an elevation of 12 inches above the top of the pipe.
- B. Clay plugs shall be installed in pipe trenches, along three feet of the pipe trench, where crossing building lines and pavement edges to prevent water from migrating along the trench backfill and entering beneath building or pavement areas.
- C. The remainder of the backfill shall be placed in layers not exceeding eight (8) inches loose depth and shall be compacted by an approved method which will obtain the density of the adjacent undisturbed soil. Backfill for pipes under pavements shall be compacted as specified in section 31 22 00, "Grading". Water jetting will not be permitted.

3.8 CLEAN UP

- A. Upon completion of the work covered by this Section, the Contractor shall clear interior of piping and structures of dirt and other superfluous material by flushing or other means as approved by the Engineer. The Contractor shall also clean up all work areas by removing all debris, surplus materials, and equipment from the site. The ground surface shall be restored to within 0.10 foot of original condition. Excess trench excavation, which cannot be utilized onsite, shall be legally disposed of offsite at the Contractor's expense.

END OF SECTION