



University of Texas Southwestern
Medical Center

**Simmons Biomedical Research Building Level 04
Neuroscience Renovation**

**Construction Documents
Project Manual**

Construction Documents

March 4, 2025

HDR Project No. 10411392





University of Texas Southwestern Medical Center

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Neuroscience Renovation**

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Construction Documents

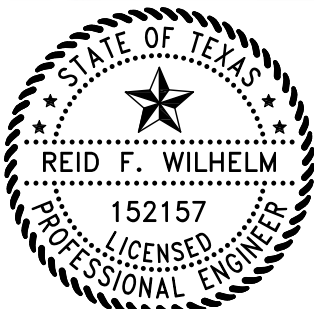
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HDR Project No. 10411392

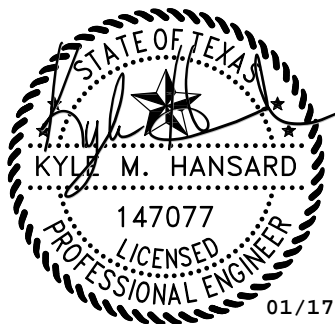


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01/17/2025



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01/17/25



01/17/2025



01/17/2025



TABLE OF CONTENTS

DIVISION 01 — GENERAL REQUIREMENTS

- 01 10 00 - SUMMARY
- ~~01 23 00 — ALTERNATES REMOVED ADDENDUM 01~~
- 01 25 00 - SUBSTITUTION PROCEDURES
- 01 25 00.01 - SUBSTITUTION REQUEST FORM
- 01 33 00 - SUBMITTAL PROCEDURES
- 01 35 16 - ALTERATION PROJECT PROCEDURES
- 01 41 00 - REGULATORY REQUIREMENTS
- 01 42 00 - REFERENCES
- 01 45 00 - PROJECT QUALITY CONTROL
- 01 45 29 - STRUCTURAL TESTING LABORATORY SERVICES
- 01 50 00 - TEMPORARY FACILITIES AND CONTROLS
- 01 57 19 - AIRBORNE CONTAMINANTS CONTROL
- 01 60 00 - PRODUCT REQUIREMENTS
- 01 71 23 - FIELD ENGINEERING
- 01 73 00 - EXECUTION
- 01 73 29 - CUTTING AND PATCHING
- 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
- 01 77 00 - CLOSEOUT PROCEDURES AND SUBMITTALS
- 01 79 00 - DEMONSTRATION AND TRAINING

DIVISION 02 — EXISTING CONDITIONS

- 02 41 00 - DEMOLITION

DIVISION 03 — CONCRETE

- 03 10 00 - CONCRETE FORMING AND ACCESSORIES
- 03 20 00 - CONCRETE REINFORCING
- 03 30 00 - CAST-IN-PLACE CONCRETE

DIVISION 05 — METALS

- 05 50 00 - METAL FABRICATIONS

DIVISION 06 — WOOD, PLASTICS, AND COMPOSITES

- 06 10 00 - ROUGH CARPENTRY

DIVISION 07 — THERMAL AND MOISTURE PROTECTION

- 07 62 00 - SHEET METAL FLASHING AND TRIM
- 07 84 00 - FIRESTOPPING
- 07 84 13 - PENETRATION FIRESTOPPING
- 07 84 43 - JOINT FIRESTOPPING
- 07 92 00 - JOINT SEALANTS

DIVISION 08 — OPENINGS

- 08 06 71 - DOOR HARDWARE SCHEDULE
- 08 11 14 - INTERIOR HOLLOW METAL DOORS AND FRAMES
- 08 14 16 - FLUSH WOOD DOORS
- 08 31 13 - ACCESS DOORS AND FRAMES
- 08 71 00 - DOOR HARDWARE

DIVISION 09 — FINISHES

- 09 22 16 - NON-STRUCTURAL METAL FRAMING
- 09 29 00 - GYPSUM BOARD
- 09 51 00 - ACOUSTICAL CEILINGS
- 09 65 13 - RESILIENT BASE
- 09 65 16 - RESILIENT SHEET FLOORING
- 09 67 23 - RESINOUS FLOORING
- 09 91 23 - INTERIOR PAINTING
- 09 96 00 - HIGH-PERFORMANCE COATINGS

DIVISION 10 — SPECIALTIES

- 10 26 00 - WALL AND DOOR PROTECTION
- 10 28 00 - TOILET AND BATH ACCESSORIES
- 10 43 00 - EMERGENCY AID SPECIALTIES
- 10 44 13 - FIRE EXTINGUISHER CABINETS
- 10 44 16 - FIRE EXTINGUISHERS

DIVISION 11 — EQUIPMENT

- 11 53 13 - LABORATORY FUME HOODS
- 11 53 19 - LABORATORY SPECIALTY EQUIPMENT
- 11 53 43 - LABORATORY SERVICE FITTINGS
- 11 53 53 - BIOLOGICAL SAFETY CABINETS

DIVISION 12 — FURNISHINGS

- 12 24 13 - ROLLER WINDOW SHADES
- 12 35 53 - LABORATORY CASEWORK
- 12 46 00 - FURNISHING ACCESSORIES

DIVISION 13 — SPECIAL CONSTRUCTION

- 13 21 01 - CONTROLLED ENVIRONMENTAL ROOM

DIVISION 21 — FIRE SUPPRESSION

- 21 08 00 - COMMISSIONING OF FIRE PROTECTION SYSTEMS
- 21 13 13 - AUTOMATIC FIRE SPRINKLER SYSTEMS

DIVISION 22 — PLUMBING

- 22 00 10 - BASIC PLUMBING REQUIREMENTS
- 22 00 11 - MEP AUTOCAD PROCEDURES AND STANDARDS
- 22 00 13 - PLUMBING DESIGN REQUIREMENTS
- 22 05 16 - PIPING EXPANSION COMPENSATION
- 22 05 19 - METERS AND GAUGES
- 22 05 29 - HANGERS FOR PLUMBING PIPING
- 22 05 53 - PLUMBING IDENTIFICATION
- 22 07 19 - PLUMBING INSULATION
- 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS
- 22 11 16 - PLUMBING PIPING
- 22 11 19 - PLUMBING SPECIALTIES
- 22 13 16 - STORM AND SANITARY WASTE AND VENT PIPING
- 22 13 19 - SANITARY WASTE PIPING SPECIALTIES
- 22 20 00 - PIPING, VALVES, AND FITTINGS
- 22 40 00 - PLUMBING FIXTURES
- 22 61 10 - LABORATORY COMPRESSED AIR SYSTEM
- 22 62 19 - MEDICAL GAS AND VACUUM SYSTEMS
- 22 64 00 - MEDICAL GASES STARTUP AND CERTIFICATION PROCEDURE
- 22 66 00 - LAB WASTE SYSTEM
- 22 67 06 - DEIONIZED WATER SYSTEM

DIVISION 23 — HEATING VENTILATING AND AIR CONDITIONING

- 23 00 00 - MECHANICAL DESIGN REQUIREMENTS
- 23 05 13 - MOTORS
- 23 05 15 - MECHANICAL PIPING, VALVES, AND FITTINGS
- 23 05 16 - PIPING EXPANSION COMPENSATION
- 23 05 19 - METERS AND GAUGES
- 23 05 29 - SUPPORTS AND ANCHORS
- 23 05 53 - MECHANICAL IDENTIFICATION
- 23 05 93 - TESTING, ADJUSTING, AND BALANCING
- 23 05 94 - SYSTEM TESTING, ADJUSTING AND BALANCING
- 23 07 13 - DUCTWORK INSULATION
- 23 07 19 - PIPING INSULATION
- 23 08 00 - COMMISSIONING OF HVAC SYSTEMS
- 23 09 00 - INSTRUMENTATION AND CONTROL FOR HVAC

23 09 55 - CONTROL SEQUENCE
23 20 10 - PIPING, VALVES, AND FITTINGS
23 21 13 - HVAC PIPING
23 21 15 - HYDRONIC SPECIALTIES
23 22 23 - STEAM AND STEAM CONDENSATE SPECIALTIES
23 31 00 - DUCTWORK
23 33 00 - DUCTWORK ACCESSORIES
23 36 00 - AIR TERMINAL DEVICES
23 36 10 - AIR VALVES
23 37 00 - AIR INLETS AND OUTLETS
23 82 19 - FAN COIL UNITS

DIVISION 26 — ELECTRICAL

26 00 00 - BASIC ELECTRICAL REQUIREMENTS
26 00 10 - ELECTRICAL DESIGN REQUIREMENTS
26 05 00 - BASIC ELECTRICAL MATERIALS AND METHODS
26 05 01 - ELECTRICAL DEMOLITION
26 05 19 - BUILDING WIRE CABLE AND CONNECTORS (600V AND BELOW)
26 05 24 - TEMPERATURE CONTROLS
26 05 26 - GROUNDING
26 05 29 - SUPPORTING DEVICES
26 05 33 - CONDUITS AND BOXES
26 05 53 - ELECTRICAL IDENTIFICATION
26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS
26 09 23 - LIGHTING CONTROL DEVICES
26 24 17 - BRANCH CIRCUIT PANELBOARDS
26 27 26 - WIRING DEVICES AND FLOOR BOXES
26 28 13 - FUSES, 600 VOLT
26 28 16 - DISCONNECT SWITCHES - HEAVY DUTY
26 29 20 - MOTORS, CONTROLLERS, AND ELECTRIC POWERED EQUIPMENT
26 29 21 - MOTOR AND CIRCUIT DISCONNECTS
26 51 00 - INTERIOR LIGHTING

DIVISION 27 — COMMUNICATIONS

27 05 00 - COMMON WORK RESULTS FOR COMMUNICATIONS
27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS
27 05 28.29 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS
27 05 28.33 - CONDUITS AND BOXES FOR COMMUNICATION SYSTEMS
27 05 53 - IDENTIFICATION FOR COMMUNICATIONS SYSTEMS
27 07 00 - COMMUNICATIONS TESTING
27 11 19 - COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS
27 11 23 - COMMUNICATIONS CABLE MANAGEMENT
27 13 13.13 - COMMUNICATIONS COPPER CABLE SPLICING AND TERMINATIONS
27 13 13.13 - COMMUNICATIONS COPPER CABLE SPLICING AND TERMINATIONS
27 15 13 - COMMUNICATIONS COPPER HORIZONTAL CABLING
27 15 43 - COMMUNICATIONS FACEPLATES AND CONNECTORS
27 16 19 - COMMUNICATIONS PATCH CORDS AND STATION CORDS
27 53 13 - CLOCK SYSTEMS
27 53 13.13 - WIRELESS CLOCK SYSTEM
27 53 18 - WLAN
27 84 13 - COMMUNICATIONS PENETRATION FIRESTOPPING

DIVISION 28 — ELECTRONIC SAFETY AND SECURITY

28 05 00 - GENERAL SECURITY REQUIREMENTS
28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY
28 05 37 - DISTRIBUTED ANTENNA SYSTEM (DAS)
28 08 00 - COMMISSIONING OF FIRE ALARM SYSTEMS
28 31 00 - ADDRESSABLE FIRE ALARM



DIVISION 01

GENERAL REQUIREMENTS



SECTION 01 10 00

SUMMARY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Project information.
- B. Work covered by Contract Documents.
- C. Phased construction.
- D. Contractor duties.
- E. Work by Owner.
- F. Owner-furnished products.
- G. Access to site.
- H. Coordination with occupants.
- I. Work restrictions.
- J. Specification and drawing conventions.

1.3 PROJECT INFORMATION

- A. Project Identification:
 - 1. Project Location: 6201 Harry Hines Blvd.
 - 2. Dallas, TX 75235
 - a. Building Name: Simmons Biomedical Research Building
 - b. Floor: Level 04
 - 3. UTSW Work Order Number: 40558
- B. Owner: University of Texas Southwestern Medical Center, Dallas, Texas.
 - 1. Owner's Representative: Refer to Project Directory.
- C. Architect: Refer to Project Directory.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of the Project is defined by the Contract Documents and consists of the following:
 - 1. Modify existing storage room into an equipment gally, Replace existing cold room with a new room of similar size, Refresh space with updated equipment, Replace existing cold room with a new Cold Room of similar size.
- B. Type of Contract:
 - 1. Project will be constructed under a single prime contract.

1.5 PHASED CONSTRUCTION

- A. The Work shall be conducted in 3 phases, with each phase substantially complete as indicated:
 - 1. Phase Insert phase 1: Briefly describe work of this phase.
 - a. Work of this phase shall commence within Insert number of daysafter the Notice to Proceed and be substantially complete and ready for occupancy within after the Notice to Proceed by Insert date
 - b. Work of this phase shall commence by Insert date and be substantially complete and ready for occupancy within Insert number of daysafter the Notice to Proceed by Insert date
 - 2. Phase Insert phase 2 :The remaining Work shall be substantially complete and ready for occupancy at time of Substantial Completion for the Work.
 - 3. Phase Insert phase 3 :The remaining Work shall be substantially complete and ready for occupancy at time of Substantial Completion for the Work.
- B. Before commencing Work of each phase, submit an updated copy of the Contractor's construction schedule showing the sequence, commencement and completion dates, and move-out and -in dates of Owner's personnel for all phases of the Work.

1.6 CONTRACTOR DUTIES

- A. VOC Compliance: Ensure that all assemblies, components, and systems comply with all VOC (Volatile Organic Components) requirements and regulations of the Environmental Protection Agency (EPA), Occupational Safety Health Administration (OSHA), State, County, City, and Local Air Control District.
- B. Except as specifically noted, provide and pay for:
 - 1. Labor, materials, and equipment.
 - 2. Tools, construction equipment and machinery.
 - 3. Water, heat, and utilities required for construction.
 - 4. Other facilities and services necessary for proper execution and completion of work.
- C. Secure and pay for, as necessary for proper execution and completion of Work, and as applicable at time of receipt of bids:
 - 1. Building permit.
 - 2. Licenses.
- D. Give required notices.
- E. Comply with all applicable local Building Codes, ordinances, rules, regulations, orders and other legal requirements of public authorities which bear on performance of Work.
- F. Promptly submit written notice to Architect of observed variance of Contract Documents from requirements of authorities having jurisdiction. Assume responsibility for Work known to be contrary to code or regulatory requirements performed without such notice.

1.7 WORK BY OWNER

- A. General: 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.

1.8 OWNER-FURNISHED PRODUCTS

- A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products and making building services connections.
- B. Owner-Furnished, Contractor-Installed Products:
 - 1. Room signage.
 - 2. Toilet Accessories (Paper Towel Dispensers, Soap Dispensers).
 - 3. Laboratory Fume Hoods and Bio Safety Cabinets.
 - 4. Glass Washers and Sterilizers as indicated.

1.9 ACCESS TO SITE

- A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- B. Use of Site: Limit use of Project site to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
- C. 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.

1.10 COORDINATION WITH OCCUPANTS

- A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's 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 authorities having jurisdiction.
 - 2. Provide not less than 3 days' notice to Owner of activities that will affect Owner's operations.

1.11 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and other requirements of authorities having jurisdiction.

- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, except as otherwise indicated.
 - 1. Hours for Core Drilling and other noisy activity: Coordinate with Owner. Perform when building is least occupied.
- 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 providing temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than 2 weeks in advance of proposed electrical utility interruptions or energized electrical work (EEW) permit requests.
 - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, 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. Tobacco- Free Environment: UTSW Policy SEC-205 prohibits smoking and/or using tobacco products on all property that is owned, operated, occupied, or controlled by the institutions. There are no designated smoking areas.
- F. Employee Identification: Provide identification tags for Contractor personnel working on the Project site. Require personnel to utilize identification tags at all times.
- G. Use of Existing Building: Maintain existing building in a weathertight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

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. Contract Documents may omit modifying words such as "all" or "any," and articles such as "the" or "an." The absence of a modifier or article from one statement that appears in another is not intended to affect the interpretation of either statement.
 - 3. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
 - 4. The specifications do not:
 - a. Establish trade jurisdictions or divisions of responsibility.
 - b. Define subcontract scopes of work.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Work specified in any one Section is related to, and dependent upon, Work specified in other Sections, whether or not specific reference is made to the Work of other Sections. Cross-references in the Specifications are general references intended as a matter of convenience for aiding in the location general information, and are not all-inclusive.
- D. Names, telephone numbers, and website addresses and other contact information listed in the Contract Documents are for convenience only, are subject to change, and are believed to be accurate and up-to-date as of the printing of the Contract Documents.
- E. Use of the word "including," when following any general statement, shall not be construed to limit such statement to specific items or matters listed, whether or not non-limiting language (such as "without limitation," "but not limited to," or other words of similar import) is used with reference thereto; but rather, shall be deemed to refer to all other items or matters that could reasonably fall within the broadest possible scope of such general statement.
- F. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications. One or more of the following are used on the 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 published as part of the U.S. National CAD Standard and scheduled on Drawings.
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 01 10 00

SECTION 01 25 00
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Administrative and procedural requirements for submitting and processing requests for product substitutions after the bid.

1.3 RELATED REQUIREMENTS:

- A. Section 01 21 00 - Allowances for products selected under an allowance.
- B. Section 01 23 00 - Alternates for products selected under an alternate.
- C. Section 01 60 00 - Product Requirements for requirements for submitting comparable product submittals for products by listed manufacturers.

1.4 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 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 in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.5 ACTION SUBMITTALS

- A. Substitution Requests: Submit electronic PDF's of each request for consideration to Owner and Architect. Identify 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 at the end of this Section.
 - a. Requests for substitution will not be reviewed if submitted on an incorrect form.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product, fabrication, or installation cannot be provided, if applicable.
 - b. Coordination 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 substitution 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 and 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 and model code organization acceptable to the authorities having jurisdiction.

- j. Detailed comparison of Contractor's construction schedule using proposed substitution 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.
- B. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- 1. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - 2. Acceptance, if granted, will be based on reliance upon data submitted and the opinion, knowledge, information, and belief of the Architect at the time decision is rendered. Approval therefore is interim in nature and subject to reevaluation and reconsideration as additional data, materials, workmanship, and coordination with other work are observed and reviewed.
 - 3. In proposing items for consideration, Contractor assumes all risk, costs, and responsibility for item's final acceptance, compliance with Contract Documents, integration into the Work, and performance.
 - 4. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.6 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.

1.7 PROCEDURES

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

1.8 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. Requested substitution provides sustainable design characteristics that specified product provided.
 - c. Substitution request is fully documented and properly submitted.
 - d. Requested substitution will not adversely affect Contractor's construction schedule.
 - e. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - f. Requested substitution is compatible with other portions of the Work.
 - g. Requested substitution has been coordinated with other portions of the Work.
 - h. Requested substitution provides specified warranty.
 - i. 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: Not allowed, unless otherwise indicated.

1.9 ATTACHMENTS

- A. Post-Award Substitution Request Form.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 25 00

SECTION 01 25 00.01

SUBSTITUTION REQUEST FORM

(FOR USE AFTER PROCUREMENT PHASE)

1.1 TO: UNIVERISTY OF TEXAS SOUTHWESTERN MEDICAL CENTER

1.2 FROM:

A. Substitution Request No: _____

B. Date: _____

C. Contractor hereby requests acceptance of the following product or system as a substitution in accordance with provisions of Division 01 Section "Substitution Procedures:"

1.3 PROJECT SPECIFICATION

A. Specification Name/Number: _____

B. Article, Paragraph, Page Number: _____

C. Item/System to be Substituted: _____

1.4 REASON FOR SUBSTITUTION REQUEST

A. PROPOSED PRODUCT

1. Will reduce the Contract Time by _____ Days

2. Will reduce the Contract Sum by \$ _____

B. SPECIFIED PRODUCT

1. _____ Is no longer available.

2. _____ Is unable to meet project schedule.

3. _____ Is unsuitable for the designated application.

4. _____ Cannot interface with adjacent materials.

5. _____ Is not compatible with adjacent materials.

6. _____ Cannot provide the specified warranty.

7. _____ Is an Owner-initiated substitution

8. _____ Other: _____

9. Cannot be obtained due to one or more of the following:

a. _____ Strike

b. _____ Lockout

c. _____ Bankruptcy of manufacturer or supplier

d. _____ Similar occurrence

10. Explanation of each item marked above (attach documentation):

1.5 EFFECT OF SUBSTITUTION

A. Proposed substitution affects other work or trades: _____ No _____ Yes (if yes, explain)

B. Proposed substitution requires dimensional revisions or redesign of architectural, structural, mechanical, electrical, plumbing, life safety, or other work:

1. _____ No _____ Yes (if yes, attach data explaining revisions)

1.6 PRODUCT COMPARISON

A. Provide side-by-side comparison between proposed substitution and specified product to facilitate review of Substitution Request:

B. Specified Product:

1. Manufacturer: _____

2. Name / Brand: _____

3. Catalog No: _____

4. Supplier: _____

5. Features: _____
 - C. Proposed Product:
 1. Manufacturer: _____
 2. Name / Brand: _____
 3. Catalog No: _____
 4. Supplier: _____
 5. Features: _____
 6. Variations: _____
 - a. (Attach additional sheets if necessary)
 - D. Local Distributor or Supplier: _____
 - E. Manufacturer's Representative: _____
 - F. Maintenance Service Available: ___ Yes ___ No
 - G. Spare Parts Source and Location: _____
 - H. Warranty Available is equivalent to the specified warranty: ___ Yes ___ No ___ Years
 - I. Describe any variation from specified warranty: _____
 - J. Product Manufacturing History: ___ 2-5 yrs ___ 6-10 yrs ___ More than 10 yrs old
- 1.7 SUPPORTING DATA ATTACHED (REQUIRED WHERE APPLICABLE)
- A. ___ Point-by-point comparison of performance criteria, materials, and components of specified product with proposed substitution.
 - B. ___ Specifications
 - C. ___ Product Data
 - D. ___ Samples
 - E. ___ Reports
- 1.8 REFERENCED INSTALLATIONS
- A. Identify at least three similar local projects on which proposed substitution was used:
 - B. PROJECT #1:
 1. Project: _____
 2. Date Installed: _____
 3. Address: _____
 4. Owner: _____
 - a. Telephone: _____
 5. Architect: _____
 - a. Telephone: _____
 6. Contractor: _____
 - a. Telephone: _____
 - C. PROJECT #2:
 1. Project: _____
 2. Date Installed: _____
 3. Address: _____
 4. Owner: _____
 - a. Telephone: _____
 5. Architect: _____
 - a. Telephone: _____
 6. Contractor: _____
 - a. Telephone: _____
 - D. PROJECT #3:
 1. Project: _____
 2. Date Installed: _____
 3. Address: _____
 4. Owner: _____
 - a. Telephone: _____
 5. Architect: _____
 - a. Telephone: _____
 6. Contractor: _____

a. Telephone: _____

1.9 ACKNOWLEDGEMENTS: THE UNDERSIGNED CERTIFY THAT:

- A. Performance: Proposed substitution has been fully investigated and determined to be equal or superior in all respects to the specified product, including appearance, quality, performance, code compliance, and sustainability compliance.
- B. Warranty: Same warranty will be furnished for proposed substitution as for specified product.
- C. Operations and Maintenance: Same maintenance service and source of replacement parts, as applicable, are available locally for the proposed substitution.
- D. No Adverse Effect: Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- E. No Adverse Time or Cost: Cost data and time as stated above are complete. Contractor bears all costs for labor and materials associated with fully integrating proposed substitution into the Project. Claims for additional costs or time related to accepted substitution which may subsequently become apparent are waived.
 - 1. Payment will be made to the Owner for changes to the project design, including Architect's and Engineer's redesign fees and engineering, detailing, special inspection, and construction costs incurred by the Owner caused by acceptance of the substitution.
 - 2. Coordination necessary to fully integrate the proposed substitution, and any associated modifications to related or adjacent Work, have been or will be performed.
- F. Dimensions and Clearances: Proposed substitution does not affect dimensions or functional clearances.
- G. Conditions of Acceptance: The Architect's recommendation for approval, if granted, relies on data submitted and the opinion and knowledge of the Architect at the time decision is rendered. The approval is conditional in nature and subject to reevaluation and reconsideration if additional data or materials are submitted, or coordination with other work is observed to invalidate claims that substitution is equal to item originally specified.

1.10 CONTRACTOR: _____

A. Date: _____ By: _____

1.11 SUBCONTRACTOR: _____

A. Date: _____ By: _____

- 1. Note: Substitution requests are not part of the standard submittal process and shall not be submitted as part of Shop Drawings, Product Data, or Samples submittals. Substitution requests must be filled out completely. Unresponsive or incomplete requests will be rejected and returned without review.

1.12 ARCHITECT'S REVIEW AND ACTION

- A. ___ Substitution acceptance is recommended.
- B. ___ Substitution acceptance is recommended, with the following comments:
- C. ___ Architect's additional services proposal attached.
- D. ___ Resubmit Substitution Request:
 - 1. ___ Provide the following: _____
 - 2. ___ Provide proposal indicating amount of savings / credit to Owner.
- E. ___ Substitution acceptance is not recommended:
 - 1. ___ Substitution Request received too late.
 - 2. ___ Substitution Request received directly from subcontractor or supplier.
 - 3. ___ Substitution Request not submitted in accordance with requirements.
 - 4. ___ Substitution Request Form is not properly executed.
 - 5. ___ Substitution Request does not indicate what item is being proposed.
 - 6. ___ Insufficient information submitted to facilitate proper evaluation.
 - 7. ___ Proposed product does not appear to comply with specified requirements.
 - 8. ___ Design Team has no experience with product / manufacturer, and is therefore unable to comment on the track record of quality, performance, or reliability.
 - 9. ___ Proposed product will require substantial revisions to Contract Documents.
- F. Architect acknowledges its reliance upon information provided by the Contractor, and makes no claim as to the accuracy, completeness, or validity of such information. If an accepted substitution is later found to

not comply with requirements of the Contract Documents, the Contractor shall be solely responsible for performance of the work in accordance with requirements of the Contract Documents.

1. By: _____ Date: _____

1.13 OWNER'S REVIEW AND ACTION

- A. ____ Substitution is accepted; Architect to prepare Change Order.
- B. ____ Substitution is not accepted.
- C. ____ By accepting this substitution, Owner agrees to compensate Architect for additional services, if any, necessary to implement the substitution.
 - 1. Additional Services: \$ _____
- D. By: _____ Date: _____

(OWNER'S REPRESENTATIVE)

END OF FORM

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.3 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.
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. Portable Document Format (PDF): An open standard file format, equipped with Optical Character Recognition, licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 TIMELINESS:

- A. The burden of timeliness in the complete cycle of submittal data, shop Drawings, and sample processing is on the Contractor.
- B. The Contractor shall allow a minimum of six (6) weeks time frame for review of each submission by the office of the design discipline involved after receipt of such submissions by that design discipline.
- C. The Contractor is responsible for allowing sufficient time in the construction schedule to cover the aforementioned cycles of data processing, including time for all resubmittal cycles on unacceptable materials, equipment, etc. covered by the data submitted.
- D. Construction delays and/or lack of timeliness in the above regard are the responsibility of the Contractor and will not be considered in any request for scheduled construction time extensions and/or additional costs to the Owner.

1.5 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule 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 modifications to submittals noted by the 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: Submit concurrently with start-up 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: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule 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 dates for installation.
 - i. Activity or event number.

1.6 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic copies of CAD Drawings of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals.
 1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
 - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - b. Digital Drawing Software Program: The Contract Drawings are available in AutoCAD 2013.
 - c. Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement or alternate form provided by Architect acceptable to Owner.
 - d. The following plot files will be furnished for each appropriate discipline:
 - 1) Floor plans.
 - 2) Reflected ceiling plans.
- 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 different types of submittals for related parts of the Work 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. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
 2. Initial Review: Allow 7 days for small projects initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 3. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 4. Resubmittal Review: Allow 7 days for small projects review of each resubmittal.
 5. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 10 days for small projects initial review of each submittal.
 - a. Insert list of Specification Sections requiring sequential review .
 6. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 7 days for small projects review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

- D. Identification and Information: Place a permanent label or title block on each paper copy submittal item for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
 3. Include the following information for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Name of subcontractor.
 - f. Name of supplier.
 - g. Name of manufacturer.
 - h. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Location(s) where product is to be installed, as appropriate.
 - l. Other necessary identification.
- E. Identification and Information: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
 4. Include the following information on an inserted cover sheet:
 - a. Project name.
 - b. Date submitted.
 - c. Name and address of Architect.
 - d. Name of Contractor.
 - e. Name of firm or entity that prepared submittal.
 - f. Name of subcontractor.
 - g. Name of supplier.
 - h. Name of manufacturer.
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Location(s) where product is to be installed, as appropriate.
 - l. Related physical samples submitted directly.
 - m. Other necessary identification.
 5. Include the following information as keywords in the electronic file metadata:
 - a. Project name.
 - b. Number and title of appropriate Specification Section.
 - c. Manufacturer name.
 - d. Product name.
 - e. Insert additional required information.
- F. Options: Identify options requiring selection by the Architect.
- G. Deviations: Identify deviations from the Contract Documents on submittals.
- H. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
- I. Transmittal: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Contractor.
 1. Transmittal Form: Use AIA Document G810.
 2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- J. 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.
- K. 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.
- L. Use for Construction: Use only final submittals that are marked with approval notation from Architect's action stamp.

PART 2 PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 1. Post electronic submittals as PDF electronic files directly to Project Web site specifically established for Project.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 2. Action Submittals: After Architect's return of approved submittal, create 3 paper copies of each submittal and transmit to Owner for their review and archive purposes.
 3. Informational Submittals: Submit PDF electronic files.
 4. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."
 5. Certificates and Certifications Submittals: Provide 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.
 - a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.
 - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
 6. Test and Inspection Reports Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."
- B. 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 not suitable 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 showing 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 or concurrent with Samples.
- 6. Submit Product Data in the following format:
 - a. PDF electronic file.
- 7. After Architect's return of approved electronic submittal, create 6 paper copies of each submittal and transmit to Owner for their review and archive purposes.
- C. 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.
 - 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. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 42 inches (750 by 1067 mm).
 - 3. Submit Shop Drawings in the following format:
 - a. PDF electronic file.
 - 4. After Architect's return of approved electronic submittal, create 3 paper copies of each submittal and transmit to Owner for their review and archive purposes.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
 - 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 - 3. Provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
 - 4. 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.
 - 5. 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.
 - 6. 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 sets of Samples. Architect and Owner to receive one sample set each.
 - 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.
- E. 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.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
 5. Submit product schedule in the following format:
 - a. PDF electronic file.
 - b. Three paper copies of product schedule or list, unless otherwise indicated. Architect will return two copies.
- F. 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. Use CSI Form 1.5A. Include the following information in tabular form:
 1. Name, address, and telephone number 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.
 4. Submit subcontract list in the following format:
 - a. PDF electronic file.
- G. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- H. 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.
- I. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on American Welding Society (AWS) forms. Include names of firms and personnel certified.
- J. 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.
- K. 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.
- L. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- M. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- N. 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.
- O. Product Test Reports: Submit written reports indicating 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.

- P. 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:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- Q. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."
- R. 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.
- S. 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 primers and substrate preparation needed for adhesion.
- T. Field Test Reports: Submit 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.
- U. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 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 Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally-signed PDF electronic file and three paper copies 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.

PART 3 EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action 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.
 - 1. Equipment Review: The Contractor shall carefully examine all data forwarded for approval and shall sign a certificate to the effect that the data has been carefully checked and found to be correct with respect to dimensions and available space and that the equipment complies with all requirements of the Specifications.
- B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Division 01 Section "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, 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.

3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- C. 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.
- D. Submittals are reviewed for conformance with the design concept expressed in the Contract Documents. Review is not for the purpose of confirming or approving:
 - 1. Deviation from the Contract Documents, including but not limited to deviation with reference to material, quantity, location, quality, dimension, or orientation (except as expressly annotated in writing by the Architect herein)
 - 2. Means, methods, sequences, or techniques of construction (unless expressly called for in the Contract Documents and herein expressly highlighted for review and approval by the Architect)
 - 3. Safety of the contractor(s) work, work plan, procedures, workers or of the site
 - 4. Any clarification of a patent or latent ambiguity or defect in the Contract Documents
 - 5. The procurement or request for any labor, materials or other expense of the contractor(s) which is in addition to that previously approved by the Owner.
- E. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- F. Incomplete submittals are not acceptable, will be considered non-responsive, and will be returned without review.
- G. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 01 33 00

SECTION 01 35 16

ALTERATION PROJECT PROCEDURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Products and installation for patching and extending Work within construction areas of existing facilities.
- B. Providing transition and adjustments.
- C. Repair of damaged surfaces and finishes.

1.3 RELATED REQUIREMENTS

- A. Section 01 50 00 - Temporary Facilities and Controls for construction of temporary fire-rated partitions to separate existing occupied areas from construction areas.

1.4 OCCUPANCY, ACCESS, AND PROTECTION

- A. Entire existing facility will be occupied during progress of construction for conduct of normal operations.
- B. Cooperate with Owner in scheduling operations to minimize conflict and to permit continuous usage. Perform work not to interfere with operations of occupied areas.
- C. Existing facilities will remain in full operation during execution of this Work. Exercise every precaution to ensure safety and protection for existing facilities, occupants, merchandise, pedestrians, and vehicles.
 - 1. Maintain safe access and egress at all times for occupants, pedestrians, and vehicles.
 - 2. Provide protection to prevent damage to facilities, merchandise, and vehicles from dust, water, weather, and other similar harmful elements.
 - 3. Maintain exiting from facilities to provide safe passage complying with applicable codes.

1.5 SCHEDULING OF WORK

- A. Make arrangements with Owner and schedule Work to avoid interference with normal operations of occupied areas. Submit schedule and summary of applicable Work within occupied areas and obtain Owner approval not less than three days prior to commencement of such Work.
 - 1. Requests for use of certain existing loading docks, passage ways, and other similar spaces within areas outside limits of construction operations will be limited to day-by-day basis and must be approved in advance by Owner.
- B. Coordinate access and scheduling of Work within tenant areas with Owner.

1.6 TORCH-CUTTING AND WELDING PROCEDURES

- A. Notify Owner in advance of torch-cutting and welding operations performed within occupied areas; obtain approval prior to proceeding with such operations.
 - 1. Neither open-flame torch-cutting, welding nor arc-welding are allowed without having secured appropriate permit from Fire Marshal or authority having jurisdiction.
 - 2. Keep portable fire extinguisher of appropriate class within reach during welding or torch-cutting operations.
 - 3. Screen arc-welding from vision of passersby.
- B. Maintain a "Fire Watch" for minimum of 60 minutes after completion of each torch-cutting and welding operation.

1.7 UTILITY SERVICE OUTAGES

- A. Keep utility and service outages to minimum and perform only after written approval of Owner is received.
 - 1. Requests for outages will not be considered unless they include an identification of areas which will be affected by proposed outage.
 - 2. Schedule outages for times other than normal business hours.
 - 3. Make requests for outages minimum of five calendar days in advance of proposed outage (non-electrical utilities).

4. Make requests for electrical utility outages or energize electrical work (EEW) permit requests a minimum of 10 calendar days in advance of proposed outage.
- B. Contractor: Responsible for investigating utility and service lines to determine effect of outage upon building operations outside of limit of operations. Obtain approval in advance from Owner to execute investigations.

1.8 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 designated by Owner.
 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.

1.9 KEYS

- A. When necessary to perform Work, Owner will issue keys to existing mechanical/electrical equipment spaces.
- B. Return keys at end of each work day; request keys on succeeding days, if necessary.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Type and Quality of Existing Products: Use products or types of construction that exist in structure, as needed to patch, extend, or match existing Work.
 1. Generally, Contract Documents do not define products or standards of workmanship present in existing construction.
 2. Determine by inspecting and testing products where necessary, referring to existing work as quality standard.
- B. New Materials: Comply with Specifications for each product involved.
 1. Match existing products and work for patching existing work.
- C. Materials for Temporary Fire-Rated Partitions: Comply with provisions of Division 01 Section "Temporary Facilities and Controls."
- D. Salvaged Materials: Salvage sufficient quantities of cut or removed material to replace damaged Work of existing construction, when material is not readily obtainable on current market.
 1. Store salvaged items in dry, secure place on site.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that areas are ready for alteration and remodeling.
- B. Discrepancies: Verify dimensions and elevations indicated in layout of existing work.
 1. Prior to commencing work, carefully compare and check Contract Documents for discrepancies in locations or elevations of work to be executed.
 2. Refer discrepancies among Drawings and existing conditions to Architect for adjustment before work affected is performed.

3. Existing conditions concealed behind accessible ceilings which are contrary to anticipated or proposed conditions, shall not be used as a basis for change order requests. Existing conditions behind in-accessible ceilings may be used as a basis for change order requests, provided it can be documented that there was no way conditions could be verified.

3.2 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.

3.3 PREPARATION

- A. Construct temporary fire-rated partitions to separate existing occupied areas from construction and alteration areas. Comply with provisions of Division 01 Section "Temporary Facilities and Controls."
- B. Cut, move, or remove items as necessary for access to alteration and renovation Work.
 1. Remove unsuitable material not marked for salvage, such as rotted wood, corroded metals, deteriorated masonry and concrete, and other deteriorated materials. Replace materials as specified for finished Work.
 2. Remove debris and abandoned items from area and from concealed spaces.
- C. Cutting and Removal: Perform cutting and removal work to remove minimum necessary, and in manner to avoid damage to adjacent work. Cut finish surfaces such as masonry, tile, plaster, or metals by methods to terminate surfaces in straight line at natural point of division.
 1. Do not modify, damage or alter any existing firestopping device without the proper repair and re-certification.
- D. Prepare surface and remove surface finishes as necessary to provide for proper installation of new materials and finishes.
- E. Close openings in exterior surfaces to protect existing Work from weather and extremes of temperature and humidity. Insulate ductwork and piping to prevent condensation in exposed areas.
- F. Provide temporary barriers and closures to control operations to prevent spread of dust to occupied portions of building.
- G. 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.

3.4 INSTALLATION

- A. Coordinate Work of alterations and renovations to expedite completion and to accommodate Owner occupancy.
- B. Remove, cut, and patch Work in manner to minimize damage and to provide means of restoring products and finishes to specified condition.
 1. Refinish visible existing surfaces to remain in renovated rooms and spaces, to specified condition for each material, with neat transition to adjacent finishes.
- C. Install products as specified in individual Specification sections.
- D. Where new Work abuts or aligns with existing, perform smooth and even transition to match existing adjacent surface in texture and appearance.

1. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and request instructions from Architect as to method of making transition.

3.5 ADJUSTMENTS

- A. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to provide smooth plane without breaks, steps, or soffits.
- B. Trim existing doors as necessary to clear new floor finish. Refinish trim as required.
- C. Fit Work tightly at penetrations of surfaces.
- D. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections. Repair substrate prior to application of finishes.

3.6 FINISHES

- A. Finish new surfaces as specified in individual Specification sections.
- B. Finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersections.

3.7 CLEANING

- A. Thoroughly clean areas and spaces affected by Work. Completely remove paint, mortar, oils, putty and items of similar nature.
- B. Clean Owner-occupied areas daily. Clean spillage, overspray, and heavy collection of dust in Owner-occupied areas immediately.

END OF SECTION 01 35 16

SECTION 01 41 00

REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.1 REGULATORY REQUIREMENTS

- A. General: Reference to codes, standards or regulatory requirements made on Drawings or in Specifications is considered an integral part of Contract Documents as minimum requirements. Nothing in Contract Documents should be understood to conflict with laws, by-laws, or regulations of municipal, State, Federal, and other authorities having jurisdiction.
- B. Should Contractor knowingly perform any work that does not conform with requirements of applicable codes, ordinances, regulations, or standards, Contractor shall assume full responsibility for such work and shall correct non-conforming work at no additional cost to Owner.
- C. Code Requirements:
 - 1. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements
 - 2. NFPA 1 Fire Code - 2021 - Effective beginning September 1, 2023.
 - 3. NFPA 101 Life Safety Code - 2021 - Effective beginning September 1, 2023.
 - 4. NFPA 99 - Health Care Facilities Code.
 - 5. NFPA Codes as applicable, with emphasis on the following:
 - a. NFPA 12A, NFPA 20, NFPA 22, NFPA 92, NFPA 204
 - b. Additional NFPA For EH&S: NFPA 13, NFPA 70, NFPA 72, NFPA 99, NFPA 45, NFPA 30, NFPA 10
 - 6. ICC (IBC)-2021 - International Building Code.
 - 7. ICC (IMC)-2021 - International Mechanical Code.
 - 8. ICC (IPC)-2021 - International Plumbing Code.
 - 9. ICC (IFGC)-2021 - International Fuel Gas Code.
 - 10. National Electrical Code 2023 Edition.
 - 11. Energy Conservation Design Standard for New State Buildings (including major renovation projects), current edition, State Comptroller's Office, Government, Code sec. 447.004 and 34 TAC § 19.32
 - 12. ASHRAE Std 90.1 I-P-2019.
 - 13. ICC (IECC)-2021 - International Energy Conservation Code (IECC).
 - 14. State Energy Conservation Office (SECO) Energy and Water Conservation Design Standards for State Agencies, New Construction and Major Renovation must comply with 34 Tex. Admin. Code 19.32 2020 (effective January 1, 2021)
 - 15. ACI 318 - American Concrete Institute (ACI – 318 current edition)
 - 16. American Institute of Steel Construction (AISC current edition)
 - 17. Texas Department of Insurance Windstorm Inspection Program
 - 18. FEMA 100 year flood plain
 - 19. Texas Accessibility Standards (TAS).
 - 20. Elevators and Escalators, Health & Safety Code chapter 754 and 16TAC § 74 (see 16TAC § 74.100 for effective dates of ASME standards) (see 754.014(k) for date of installation definition)
 - 21. Boilers, Health & Safety Code chapter 755 and 16TAC § 65.
 - 22. Guidelines for Design and Construction of Healthcare Facilities, The Facility Guidelines Institute.
 - 23. Association for the Advancement of Medical Instrumentation.
 - 24. Center for Medicare and Medicaid Services.
 - 25. Texas Administrative Code For Health Services, Title 25.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION 01 41 00

SECTION 01 42 00

REFERENCES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 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.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "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."
- E. "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.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "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.

1.3 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.
- 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.

1.4 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" or in Columbia Books' "National Trade & Professional Associations of the United States." Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.
 - 1. A/E: Architect/Engineer
 - 2. AHJ: Authority Having Jurisdiction
 - 3. ANSI: American National Standards Institute
 - 4. ASTM: ASTM International (American Society for Testing and Materials International)

5. BOR: Board of Regents
6. CCD: Construction Change Directive
7. CCL: Construction Cost Limitation
8. CMAR: Construction Manager at Risk
9. CSP: Competitive Sealed Proposal
10. DD: Design Development
11. EPA Environmental Protection Agency
12. FCC Federal Communications Commission
13. FDA Food and Drug Administration
14. FPE: Fire Protection Engineer
15. GA Gypsum Association
16. GCs: General Conditions
17. GMP: Guaranteed Maximum Price
18. GSA: General Services Administration
19. GSF: Gross Square Feet
20. HSP: HUB Subcontractor Plan
21. HUB: Historically Underutilized Business
22. HUD Department of Housing and Urban Development
23. LA: Landscape Architect
24. LEED: Leadership in Energy and Environmental Design
25. LDs: Liquidated Damages
26. NASF: Net Assignable Square Feet
27. NFPA (National Fire Protection Association)
28. NTP: Notice to Proceed
29. OAC: Owner/Architect/Contractor
30. OCM: Owner's Construction Manager
31. ODR: Owner's Designated Representative
32. PAR: Progress Assessment Report
33. PE: Professional Engineer
34. PM: Project Manager
35. RID: Registered Interior Designer
36. R&R: Repair and Rehabilitation
37. SD: Schematic Design
38. SDs: Schematic Design Drawings
39. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association
40. UGC/SGC: Uniform General Conditions/Supplemental General Conditions
41. UL: Underwriters Laboratories Inc.
42. USGBC: U.S. Green Building Council

1.5 APPLICABLE PUBLICATIONS

- A. Unless a specific release or publication date is provided in reference to a published specification, code, standard, or other requirement in these Specifications, it shall be understood that the latest published version shall apply.

1.6 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Subcontractor shall maintain copies of the codes and reference standards with the Contract Documents at the jobsite at all times.
- B. All conflicts between codes, reference standards, drawings, and the other Contract Documents shall be brought to the attention of UTSW for clarification prior to ordering or providing any materials or furnishing labor.
- C. References to "OSHA Regulations for Construction" shall mean Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations (OSHA), including all changes and amendments thereto.
- D. References to "OSHA Standards" shall mean Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 42 00

SECTION 01 45 00
PROJECT QUALITY CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Uniform General and Supplementary General Conditions for University of Texas System Building Construction Contracts (UGC) and other Division 1 – Division 33 Specification Sections, apply to this Section.
- B. In the event of conflict between specific requirements of the various documents, the more restrictive, more extensive (i.e., more expensive) requirement shall govern.

1.2 DEFINITIONS

A. QUALITY CONTROL

- 1. Quality Control shall be the sole responsibility of the Contractor, unless specifically noted otherwise. The Contractor shall be responsible for all testing, coordination, start-up, operational checkout, and commissioning of all items of work included in the project, unless specifically noted otherwise. All costs for these services shall be included in the Contractor's cost of work and general conditions.
- 2. The Contractor shall assign one employee, not the project superintendent, to be responsible for Quality Control. This individual can have other responsibilities, but shall not be the project superintendent or the project manager.

B. QUALITY ASSURANCE

- 1. Quality Assurance is performed by the Owner or their delegated representatives. These procedures may include observations, inspections, testing, verification, monitoring, and any other procedures deemed necessary to ensure compliance with the contract documents.
- 2. The Contractor shall cooperate with and provide assistance to the Owner for all aspects of this endeavor. This shall include providing ladders, lifts, scaffolds, lighting, protection, safety equipment, and any other devices and/or equipment (including operators if required) deemed necessary by the Owner to access the work for observation/inspection.

1.3 SUMMARY

- A. This section provides administrative and procedural requirements for Contractor quality control on the project.
- B. Specific quality-control requirements for individual construction activities are specified in the Sections that govern those activities. Requirements in those Sections may also cover production of manufactured products.
- C. Specified tests, inspections, and related actions do not limit Contractor's quality control obligations to comply fully with the Contract Document requirements in all regards.
- D. Provisions of this Section do not limit the requirements for the Contractor to provide quality control services required by the contract documents or the Authority Having Jurisdiction.
- E. The following quality issues are addressed in detail in this Section:
 - 1. Quality Control
 - 2. Quality Assurance
 - 3. Testing Agency
 - 4. Testing
 - 5. Inspections
 - 6. Pre-installation Meetings
 - 7. Mock-ups

1.4 TESTING AGENCY

- A. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E 548, and that specializes in types of tests and inspections to be performed.
- B. Owner will employ services of independent testing agencies to perform certain specified testing, as it deems necessary.

- C. The Contractor shall employ and pay for services of an independent testing agency to perform all specified testing requiring an independent agency, unless noted otherwise.
- D. Employment of agency in no way relieves the Contractor of the obligation to perform Work in accordance with requirements of Contract Documents.
- E. The Contractor Employed Agency:
 - 1. Testing agency shall comply with requirements of ASTM E 329, ASTM E 548, ASTM E 543, ASTM C 1021, ASTM C 1077, and ASTM C 1093.
 - 2. Laboratory shall maintain a full time Engineer on staff to review services. Engineer shall be licensed in the state of Texas.
 - 3. Testing Equipment: Calibrate devices at reasonable intervals (minimum yearly) with accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.
- F. The Contractor shall not employ the same testing entity engaged by the Owner for the project, unless agreed to in writing by the Owner.

1.5 TESTING

- A. Where specific testing is specified in a technical section of the Specifications or indicated in the Contract Documents, the Contractor shall bear all costs of such tests unless they are specifically stated to be paid by the Owner.
- B. Testing specifically identified to be conducted by Owner will be performed by an independent entity and will be arranged and paid for by the Owner unless otherwise indicated in the Contract Documents. Should the test return unacceptable results, the Contractor shall bear all costs of retesting and re-inspection as well as the cost of all material consumed by testing, and replacement of unsatisfactory material and/or workmanship.
- C. The Owner's Construction Inspector (CI) will schedule the Owner's testing services unless otherwise directed in writing by the Owner. The Contractor is required to coordinate with the CI to facilitate timeliness of such testing services.
- D. The Owner may engage additional consultants for testing, air balancing, or other special services. The activities of any such Owner consultants are in addition to Contractor testing of materials or systems necessary to prove that performance is in compliance with requirements. The Contractor must cooperate with persons and firms engaged in these activities in accordance with the Contract.
 - 1. The Contractor is required to self-perform various tests to verify performance and/or operation of various systems. These test reports shall be consecutively numbered and defined by scope and extent of test. Copies of the test report forms can be obtained from the RCM. The following OCP test report forms shall be used for this purpose and shall not be altered in any manner:
 - a. Pipe Test Report.
 - b. Duct Test Report.
 - c. Equipment Start-up Request Form
 - d. Contractor's Request for Utility Shutdown.
 - e. Domestic Water Sterilization and Flushing Report.

1.6 INSPECTIONS

- A. It is the intent of the Contract Documents that all work be subjected to inspection and verification of correct operation prior to 100 percent payment of the line item(s) pertaining to that aspect of the Work.
- B. The Contractor shall incorporate adequate time for performance of all inspections and correction of noted deficiencies into the Work Progress Schedule for the project.
- C. During the course of construction, the Owner, Architect and/or other Owner representatives may visit the site for observation of the work in place. The Contractor shall provide all necessary equipment for safe access to the work to be inspected or observed. This requirement shall extend to all Owner personnel and their representatives. Some of these inspections will be informal and some will require formal notification by the Contractor. The following are typical project inspections:
 - 1. Informal Daily Reviews of project conditions by the Construction Inspector and/or members of the Owner's and/or Design Consultant's team(s). When considered appropriate, results of these reviews will be documented via Observation Report or Memorandum. In addition to cooperating with, and providing safe access for the Owner's agents, the Contractor shall provide a system of tracking all field reports, describing items noted and resolution of each item. This printed report shall be reviewed as necessary, at least on a monthly basis.

2. Concealed Space Inspections are to be formally scheduled in advance through the Construction Inspector by submitting written notification at least five (5) workdays in advance. Subject areas include partitions, structural walls, chases, crawl spaces, ceiling spaces, and any other work which will be difficult or impossible to examine once concealed in the final construction.
3. Progress Inspections for piping, ductwork, and other systems are to be scheduled with the Construction Inspector as appropriate portions, or sections, of the work are completed. This is in addition to "system-wide" performance verification and tests. These tests are to be scheduled and documented using the standard OCP Pipe Test and Duct Test report forms. The forms shall be filled out and signed as meeting contract requirements prior to submission for verification by the OCP CI. The Contractor shall conduct the tests and the OCP CI will witness and approve the results.
 - a. The Contractor shall coordinate their intended "apportioning" of systems tests with the Construction Inspector immediately following formal submission of their Work Project Schedule so that all parties are aware of the intended work and inspection sequence.
4. Overhead and Above Ceiling Inspections are similar in nature and requirements to the Concealed Space Inspections. Where ceilings are to be fixed in place, such as gypsum board or plaster, it would constitute a Concealed Space. Where ceilings are of "lay-in" type, or where no finish ceiling is scheduled, it would be considered an "overhead" inspection. Such inspections are to be included in the Contractor's Detailed Construction Schedule. Contractor shall provide written inspection request notice to the CI and Architect at least five (5) workdays in advance.
 - a. No finish ceiling material shall be installed until all overhead punchlist items have been resolved to the satisfaction of the Owner.
 - b. Work in place necessary for an overhead inspection shall include:
 - 1) Ceiling grid or framework installed
 - 2) All above ceiling electrical work, including light fixtures, installed and operational
 - 3) All HVAC and plumbing work above ceiling complete with diffusers installed and connected
 - 4) Fire sprinkler heads installed
 - 5) All required tests for above ceiling work completed and approved
 - 6) Contractor generated punchlist of all areas being requested for inspection
5. Inspections of Building Systems and Equipment are required to confirm acceptable operation and are to be formally scheduled through the Construction Inspector with the Architect. Refer to Section 01 91 00 - General Commissioning Requirements for additional requirements pertaining to system start-up, operation, demonstration and acceptance.
- D. On systems/equipment requiring a manufacturer's representative to verify installation/operation, the Contractor is required to perform a thorough check-out of operations with the manufacturer's representatives prior to requesting formal inspection by the Owner be scheduled. Notify the CI, in advance, as to when the manufacturer's representative is scheduled to arrive.
- E. Inspection of individual equipment and/or system(s) must be accomplished prior to requesting Substantial Completion Inspection for any area affected by that equipment and/or system.
- F. For "building-wide" and/or life safety systems, such as fire alarm, fire sprinkler systems, smoke evacuation systems, toxic gas monitoring, captured exhaust systems, etc., completion and acceptance of Functional Testing is required prior to requesting Substantial Completion Inspection for any area of the Project.
 1. The manufacturer's representatives and the installing contractor will be expected to demonstrate both operation and compliance to the Owner's agents and consultants. If coordinated and scheduled appropriately by the Contractor, these equipment and/or systems inspections may also serve to provide the required Owner Training, if approved in advance by the Owner.
 2. The Contractor is responsible for requesting that the Construction Inspector and Architect arrange for the inspection of materials, equipment and work prior to assembly or enclosure that would make the materials, equipment or work inaccessible for inspection, and at such other times as may be required.
- G. For any requested inspection, the Contractor shall make prior inspection to ensure that items are ready for inspection and acceptance by the Owner and/or Architect.
 1. The Contractor will be responsible for any and all costs incurred by Owner and/or Owner representatives, including consultants, resulting from a review or inspection that was scheduled prematurely.

- H. The Contractor shall coordinate the work and schedule the inspections in advance so as not to delay the work. All major inspections should be indicated on the Work Progress Schedule for advance planning and the Contractor should allow a minimum of five (5) working days to confirm schedule of requested inspections with Owner and its consultants.
- I. The contractor shall list and track all punchlist items on the Office of Capital Projects (OCP) Inspection Matrix (refer to Attachment A). The matrix shall be kept up-to-date reflecting status of work in place and inspections on the project. Copies of this populated and updated matrix shall be supplied to the A/E and the OCP CI for use during the course of the project.

1.7 PRE-INSTALLATION MEETINGS

- A. The Contractor shall coordinate and conduct meetings to review the installation of major systems/equipment on the project.
- B. The Contractor shall ensure attendance of the installing subcontractor, manufacturer and/or supplier (if appropriate), supporting subcontractors involved in the installation and any other parties involved in the phase of work to be reviewed. The Owner and Architect shall be notified in writing at least five (5) days in advance of the meeting.
- C. Each party shall be prepared to discuss in detail the staging, installation procedure, quality control, testing/inspection, safety and any other pertinent items relating to the work being reviewed. Submittal approval shall be a prerequisite of the meeting.
- D. The Contractor shall chair and take minutes of this meeting and distribute to all attending parties.
- E. Whether required in the technical section or not, a pre-installation meeting shall be conducted for the following work, if included in the project:
 - 1. Concrete.
 - 2. Masonry.
 - 3. Large Steel Fabrications/Erection.
 - 4. Waterproofing.
 - 5. Roofing.
 - 6. Exterior Glazing (including storefront and curtain wall).
 - 7. Door Hardware.
 - 8. Security.
 - 9. Audio/Visual Equipment.
 - 10. Air Handling Units.
 - 11. Medical Gas Systems.

1.8 MOCK-UPS

- A. Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required, using materials indicated for the completed Work.
- B. Build mockups in location and of size indicated or, if not indicated, as directed by Architect. The mock-up may be work in place that is intended to remain, unless otherwise directed by the Owner.
- C. Notify Architect and Owner five (5) working days in advance of dates and times when mockups will be constructed.
- D. Demonstrate the proposed range of aesthetic effects and workmanship. Include anticipated repairs in mockup, such as stone veneer.
- E. Obtain Architect's and Owner's approval of mockups before starting work, fabrication, or construction.
- F. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
- G. Demolish and remove mockups when directed, unless otherwise indicated.
- H. For any of the following work items included in the project, a mockup shall be prepared whether required by the technical section or not:
 - 1. Exterior wall system to include: substructure, masonry/stone veneer, plaster, architectural concrete and windows.
 - 2. Roof system.
 - 3. Interior lab room
 - 4. Interior patient care room
 - 5. Interior wall finishes.
 - 6. Ceramic tile.

7. Finished flooring.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

ATTACHMENT A – OCP PROJECT INSPECTION MATRIX



OCP PROJECT INSPECTION MATRIX

Office of Facilities Planning & Construction

Project Number:

Project Name:

OCP Construction Inspector:

Construction Inspector:

PROJECT AREA & SYSTEM INSPECTION LIST								
Item #	Inspection Type	Location	Date Initiated	Date of Next Up Inspection	Date of Next Sign Off	OCP Find Sign Off	Comments	
1	As-Built Review	Complete Part of Construction #3002	06/20/15	07/13/15	07/20/15	Asm Lead		
2	As-Built Review	Block 5 pipe	06/24/15	07/27/15	07/27/15	Asm Lead		
3	Pre-Test of A/E	Block 5 pipe	06/24/15	07/14/15	07/20/15	Asm Lead		
4	As-Built Review	Block 5 pipe	06/24/15	07/27/15	07/27/15	Asm Lead		
5	As-Built Review	Block 5 roof	07/07/15	07/27/15	08/04/15	Asm Lead		
6	Pre-Test Service System	Factory	07/08/15	07/24/15	08/04/15	Asm Lead		
7	AS-Built Review	Block 5 room	07/22/15	07/27/15	08/21/15	Asm Lead		
8	As-Built	Test room	07/22/15	08/07/15	08/21/15	Asm Lead		
9	As-Built Review	As-Built	07/22/15	08/07/15	08/21/15	Asm Lead		
10	Handover	As-Built	07/24/15	08/19/15	08/21/15	Asm Lead		
11	As-Built Review	As-Built	08/04/15	08/19/15	08/21/15	Asm Lead		
12	As-Built Review	As-Built	08/04/15	08/19/15	08/21/15	Asm Lead		
CONCRETE INSPECTION ITEM LIST								
Item #	Level	Room	Item Description	Date Inspected	Inspector's Job	Contractor Sign Off	OCP Find Sign Off	Comments
1	1	1.1001.1	Verify layout of the gridlines	07/01/15	Complete	John Doe	Asm Lead	
2	1	1.1001.2	Verify layout of the gridlines against steel deck	07/01/15	Complete	John Doe	Asm Lead	
3	1	1.1001.4	Check notes for rebar layout to be placed when rebar is placed	07/01/15	Design	John Doe	Asm Lead	
4	1	1.1001.4	Complete installation of rebar in all areas of slab	07/01/15	Design	John Doe	Asm Lead	
5	1	1.1001.4	Complete installation of rebar in all areas of concrete	07/01/15	Design	John Doe	Asm Lead	
6	1	1.1001.4	Verify layout of the gridlines	07/01/15	Complete	John Doe	Asm Lead	
7	1	1.1001.4	Verify layout of the gridlines	07/01/15	Complete	John Doe	Asm Lead	
8	1	1.1001.4	Verify layout of the gridlines	07/01/15	Complete	John Doe	Asm Lead	
9	1	1.1001.4	Verify layout of the gridlines	07/01/15	Complete	John Doe	Asm Lead	
10	1	1.1001.4	Verify layout of the gridlines	07/01/15	Complete	John Doe	Asm Lead	
11	1	1.1001	Verify notes for rebar to be placed when rebar is placed	07/01/15	DESIGN	John Doe	Asm Lead	
12	1	1.1001	Verify all rebar layout	07/01/15	Field Prod	John Doe	Asm Lead	
13	1	1.1001	Complete installation of rebar in all areas of slab	07/01/15	Design	John Doe	Asm Lead	
14	1	1.1001	Complete installation of rebar in all areas of slab	07/01/15	Design	John Doe	Asm Lead	
15	1	1.1001	Complete installation of rebar in all areas of slab	07/01/15	Design	John Doe	Asm Lead	
16	1	1.1001	Verify layout of the gridlines	07/01/15	Complete	John Doe	Asm Lead	
17	1	1.1001	Verify all rebar to be placed when rebar is placed	07/01/15	Design	John Doe	Asm Lead	
18	1	1.1001.2	Verify notes for rebar to be placed when rebar is placed	07/01/15	Field Prod	John Doe	Asm Lead	
19	1	1.1001.2	Verify notes for rebar to be placed when rebar is placed	07/01/15	DESIGN	John Doe	Asm Lead	
20	1	1.1001.2	Verify notes for rebar to be placed when rebar is placed	07/01/15	Complete	John Doe	Asm Lead	
21	1	1.1001.2	Verify notes for rebar to be placed when rebar is placed	07/01/15	Complete	John Doe	Asm Lead	
22	1	1.1001.1	Verify all rebar to be placed when rebar is placed	07/01/15	Field Prod	John Doe	Asm Lead	
23	1	1.1001	Complete above slab and rebar layout	07/01/15	DESIGN	John Doe	Asm Lead	
24	1	1.1001	Complete installation of rebar in all areas of slab	07/01/15	Design	John Doe	Asm Lead	
25	1	1.1001	Complete installation of rebar in all areas of slab	07/01/15	Design	John Doe	Asm Lead	
26	1	1.1001	Verify layout of the gridlines	07/01/15	Complete	John Doe	Asm Lead	
27	1	1.1001	Verify layout of the gridlines	07/01/15	Design	John Doe	Asm Lead	
28	1	1.1001	Verify notes for rebar to be placed when rebar is placed	07/01/15	Complete	John Doe	Asm Lead	
29	1	1.1001	Verify notes for rebar to be placed when rebar is placed	07/01/15	Field Prod	John Doe	Asm Lead	
30	1	1.1001	Verify notes for rebar to be placed when rebar is placed	07/01/15	Design	John Doe	Asm Lead	

END OF SECTION 01 45 00

SECTION 01 45 29

STRUCTURAL TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SCOPE OF WORK

- A. The Owner's Testing Laboratory: An independent testing laboratory will sample and test materials as they are being installed for compliance with acceptance criteria as specified and report and interpret the results. The laboratory shall monitor and report on the installation of constructed work and shall perform tests on the completed construction as required to indicate Contractor's compliance with the various material specifications governing this work. The owner shall be responsible for paying the testing laboratory for these services.
- B. The Contractor shall not engage the same testing laboratory for construction services as the Owner has for quality assurance testing, unless agreed to by the Owner.

1.3 SPECIAL INSPECTIONS

- A. The Owner's Testing Laboratory or a separate agency shall serve as a Special Inspector to provide Special Inspection services for the items listed below. The scope of such services for each item shall be as defined in the International Building Code - 2009 or as defined in the local building code of the jurisdiction wherein the project is located. These inspections are mandatory for conformance to the legal requirements of the building code and shall be in addition to the inspections and tests otherwise defined in this specification.
 - 1. Reinforcing Steel Placement
 - 2. Concrete Work
 - 3. Welding of Reinforcing Steel
 - 4. Inspection of Structural Steel, Bolting, and Welding Material
 - 5. Welding of Structural Steel
 - 6. High-Strength Bolting
 - 7. Spray-Applied Fire-Resistive Materials
 - 8. Prepared Earth Fill
 - 9. Pier Foundations
 - 10. Masonry Work
- B. Qualifications of Special Inspector: The special inspector shall be a qualified person who shall demonstrate competence, to the satisfaction of the Building Official, for inspection of the particular type of construction or operation being inspected. The Special Inspector shall meet the legal qualifications of the building code having jurisdiction.
 - 1. Duties and Responsibilities of the Special Inspector:
 - 2. The special inspector shall observe the work assigned to ascertain, to the best of his/her knowledge that it is in conformance with the approved design drawings and specifications.
 - 3. The special inspector shall furnish inspection reports to the Building Official, the Architect/Engineer, and the Owner. All discrepancies shall be brought to the immediate attention of the Architect/Engineer, Contractor, and Owner. A report that the corrected work has been inspected shall be sent to the Building Official, the Architect/Engineer, and the Owner.
 - 4. The special inspector shall submit a final signed report stating whether the work requiring special inspection was, to the best of the inspector's knowledge, in conformance to the approved plans and specifications and the applicable workmanship provisions of the building code.

1.4 QUALIFICATIONS OF TESTING LABORATORY

- A. The Testing Laboratory shall meet the basic requirements of ASTM E329 and shall submit to the Owner, Architect, and Engineer evidence of current accreditation from the American Association for Laboratory Accreditation, the AASHTO Accreditation Program or the "NIST" National Voluntary Laboratory Accreditation Program.

- B. The Testing Laboratory shall be an Approved Agency by the Building Official of the city wherein the project is located to perform Special Inspections and other tests and inspections as outlined in the applicable building code.
 - C. Tests and inspections shall be conducted in accordance with specified requirements, and if not specified, in accordance with the applicable standards of the American Society for Testing and Materials or other recognized and accepted authorities in the field.
 - D. Qualifications of Welding Inspectors
 - 1. Inspectors performing visual weld inspection shall meet the requirements of AWS D1.1 Section 6.1.4. Welding inspection shall be supervised and the inspection reports signed by an inspector with current certification as an AWS Certified Welding Inspector (CWI)
 - 2. Inspectors performing nondestructive examinations of welds other than visual inspection (MT, PT, UT, RT) shall meet the requirements of AWS D1.1, Section 6.14.6.
- 1.5 AUTHORITIES AND DUTIES OF THE LABORATORY
- A. Attending Preconstruction Conferences: The Owner's Testing Laboratory shall receive from the Owner and review the project plans and specifications with the Architect and Engineer as soon as possible prior to the start of construction. The Laboratory shall attend preconstruction conferences with the Architect, Engineer, Project Manager, General Contractor, and Material Suppliers as required to coordinate materials inspection and testing requirements with the planned construction schedule and shall participate in such conferences throughout the course of the project.
 - B. Cost Proposal: The Testing Laboratory's proposal to the Owner shall contain unit price stipulations for specified tests and inspections and on an hourly basis for personnel. A total estimated price shall also be submitted.
 - C. Cooperation with Design Team: The Laboratory shall cooperate with the Architect, Engineer, and Contractor and provide qualified personnel promptly on notice.
 - D. The Laboratory shall perform the required inspections, sampling, and testing of materials as specified under each section and observe methods of construction for compliance with the requirements of the Contract Documents and the applicable building code.
 - E. Notification of Deficiencies in the Work: The Laboratory shall notify the Architect, Engineer, and Contractor within 24 hours of discovery by telephone or e-mail, and then in writing of observed irregularities and deficiencies of the work and other conditions not in compliance with the requirements of the Contract Documents.
 - F. Reports:
 - 1. Information on Reports: The Laboratory shall submit copies of reports of inspections and tests promptly and directly to the parties named below. The reports shall contain at least the following information:
 - 2. Project Name
 - 3. Date report issued
 - 4. Testing Laboratory name and address
 - 5. Name and signature of inspector
 - 6. Date of inspection and sampling
 - 7. Date of test
 - 8. Identification of product and Specification section
 - 9. Location in the project
 - 10. Identification of inspection or test
 - 11. Record of weather conditions and temperature (if applicable)
 - 12. Results of test regarding compliance with Contract Documents
 - G. Copies: The Laboratory shall send signed copies of test and inspection reports to the following parties:
 - 1. 2 copies to the Owner or his representative
 - 2. 2 copies to the General Contractor
 - 3. 1 copy to the Architect
 - 4. 1 copy to the Engineer of responsibility
 - H. Certification: Upon completion of the job, the Laboratory shall furnish to the Owner, Architect, and Engineer of Record, a statement signed by a licensed professional engineer that, to the best of their knowledge, required tests and inspections were made in accordance with the requirements of the Contract Documents.

- I. Accounting: The Testing Laboratory shall be responsible for separating and billing costs attributed to the Owner and costs attributed to the Contractor.
- J. Monitoring Product and Material Certifications: The Testing Laboratory shall be responsible for monitoring the submittals of product and material certifications from manufacturers and suppliers as specified in the Specifications and shall report to the Owner, Architect, and Engineer when those submittals are not made in a timely manner.
- K. Limitations of Authority: The Testing Laboratory is not authorized to revoke, alter, relax, enlarge upon, or release any requirements of the Specifications or to approve or accept any portion of the work or to perform any duties of the General Contractor and his Subcontractors.

1.6 CONTRACTOR'S RESPONSIBILITY

- A. Cooperation with Design Team: The Contractor shall cooperate with laboratory personnel, provide access to the work, and to manufacturer's operations.
- B. Furnishing Samples and Certificates: The Contractor shall provide to the laboratory certificates and representative samples of materials proposed for use in the work in quantities sufficient for accurate testing as specified.
- C. Furnishing Casual Labor, Equipment and Facilities: The Contractor shall furnish casual labor, equipment, and facilities as required for sampling and testing by the laboratory and otherwise facilitate the required inspections and tests.
- D. Advance Notice: The Contractor shall be responsible for notifying the Testing Laboratory sufficiently in advance of operations to allow for assignment of personnel and scheduling of tests. Failure to sufficiently notify may result in additional costs incurred by the Testing Laboratory that may be back-charged to the Contractor by the Owner.
- E. Payment for Substitution Testing: The Contractor shall arrange for and pay for any additional samples and tests above those required by the Contract Documents as requested by the Contractor for his convenience in performing the work.
- F. Payment for Retesting: The Contractor shall be liable to the Owner for the cost for any additional inspections, sampling, testing, and retesting done by the Owner's Testing Laboratory as required when initial tests indicate work does not comply with the requirements of the Contract Documents.
 - 1. Payment by Contractor: The Contractor shall furnish and pay for the following items if required:
 - 2. Soil survey of the location of borrow soil materials, samples of existing soil materials, and delivery to the Contractor's Testing Laboratory.
 - 3. Samples of concrete aggregates and delivery to the Contractor's Testing Laboratory.
 - 4. Concrete mix designs as prepared by his concrete supplier.
 - 5. Site-situated storage boxes for concrete cylinders
 - 6. Concrete coring, tests of below strength concrete, and load tests, if ordered by the Owner, Architect, or Engineer.
 - 7. Certification of reinforcing steel mill order.
 - 8. Certification of structural steel mill order.
 - 9. Certification of portland cement, lime, fly ash.
 - 10. Certification of welders and preparation of Welding Procedure Specifications.
 - 11. Tests, samples, and mock-ups of substitute material where the substitution is requested by the Contractor and the tests are necessary in the opinion of the Owner, Architect or Engineer to establish equality with specified items.
 - 12. The making and testing of concrete cylinders for the purpose of evaluating strength at time of form stripping or for post-tensioning or the time spent evaluating the in situ strength of concrete using the Maturity Method.
 - 13. Any other tests when such costs are required by the Contract Documents to be paid by the Contractor.
- G. Notification of Source Change: The Contractor shall be responsible for notifying the Owner, Architect, Engineer, and Owner's Testing Laboratory when the source of any material is changed after the original tests or inspections have been made.
- H. Tests for Suspected Deficient Work: If in the opinion of the Owner, Architect, or Engineer any of the work of the Contractor is not satisfactory, the Contractor shall furnish and pay for all tests that the Owner, Architect, or Engineer deem advisable to determine its proper construction. The Owner shall pay all costs if the tests prove the questioned work to be satisfactory.

1.7 PAYMENT OF TESTING LABORATORY

- A. The Owner will pay for the initial Laboratory services for testing of materials for compliance with the requirements of the Contract Documents. The Contractor will be liable to the Owner for the cost for testing and retesting of materials that do not comply with the requirements of the Contract Documents and shall furnish and pay for the testing and inspection of other items as specified in these Specifications.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SCOPE OF WORK

- A. The work to be performed by the Testing Laboratory shall be as specified in this Section of the Specification and as determined in meetings with the Owner, Architect, and Engineer.

3.2 EARTHWORK

- A. Compacted Fill Inspection and Testing:
1. Inspection of Subgrade Below Compacted Fill: The Owner's Testing Laboratory shall observe and verify that the subgrade below compacted fill has been properly prepared before compact fill construction begins.
 2. Verification of Fill Material: Perform classification and testing to verify that the fill material to be used complies with the project specifications.
 3. During placement and compaction of fill, determine that the material being used and the maximum lift thickness comply with the specifications.
 4. Field Density Testing: Perform field density testing as described below
 - a. Building Slab Subgrade:
 - 1) Make at least one field density test of the natural subgrade for every 2500 square feet of paved area or building slab but in no case less than three tests.
 - 2) In each compacted fill layer or lift, make one field density test for every 2500 square feet of building slab or paved area but in no case less than three tests.
 - b. Foundation Wall Backfill: Make at least one field density test for each 200 lineal feet of wall with a minimum of 4 tests for the basement walls around the perimeter of each building and a minimum of one test for every other type of foundation wall on the site. Tests shall be performed in random lifts along each wall.
 5. Field Density Tests: Field Density Tests shall be run according to ASTM D2937, or ASTM D2922 as applicable.
 6. Acceptance Criteria: The results of field density tests by the Laboratory will be considered satisfactory if the average of any three consecutive tests has a value not less than the required density with no single test falling more than 2 percent below the required density and the moisture content conforms to the requirements of the specification.
 7. Report Copies: Moisture-density curves and results of field density tests shall be submitted to the parties specified earlier in this section.
 8. Additional Testing: If reports by the Laboratory indicate field densities lower than specified, additional tests will be run by the Laboratory with at least the frequencies scheduled above on recompacted fill and/or natural subgrade. The Testing Laboratory shall notify the Contractor on a timely basis for any required retesting so as not to delay the work. The costs of such tests shall be liable to the Owner for repayment by the Contractor.
- B. Foundation Inspection by the Testing Laboratory:
1. Material Testing: The Owner's Testing Laboratory shall provide testing and inspection of materials used in foundation elements as described below.
 2. Drilled Piers:
 - a. Concrete Cylinders: Make and test concrete cylinders as specified for Cast-in- Place Concrete.
 - b. Reinforcing Steel: Inspect reinforcing steel for proper number and size of bars and confirm dowel or anchor bolt placement into top of pier.
- C. Foundation Inspection by the Geotechnical Engineer: The Geotechnical Engineer of Record shall provide inspection service for the following items before and during foundation installation as appropriate for the foundation type. The Geotechnical Engineer shall submit written field inspection reports promptly after

inspection to the parties listed above and report his findings after each inspection by telephone or e-mail to the Engineer.

1. Drilled Piers:
 - a. Bearing Elevation: Observe that piers are founded in proper bearing strata as defined in the Geotechnical Report and that bottom of hole is clean and properly formed. Recommend appropriate action if specified bearing elevation does not provide proper strength.
 - b. Shaft Stability: Observe the shaft sides as drilling proceeds and recommend appropriate action if sloughing becomes excessive.
 - c. Concrete Quantities: Record quantity of concrete placed in each pier and compare against theoretical quantity required. Report discrepancies to Engineer.
 - d. Placement Method: Observe that piers are placed by approved methods as defined in the Geotechnical Report and in the specifications. Confirm that casings are being used as recommended in the Geotechnical Report. Confirm that concrete is not being contaminated by soil encroachment into pier.
 - e. Report: For each drilled shaft installed, prepare and submit a report indicating the following information: pier number and location, pier shaft diameter, bottom elevation, top elevation, pier length, theoretical volume of concrete in pier, estimate of actual volume of concrete placed, reinforcing steel size and depth actually placed, drilling start and finish time, concreting start and finish time, variation from specified tolerances including surveyed location and plumbness, construction method (dry method, casing method, or slurry displacement method), groundwater conditions (rate of water infiltration and depth of water in hole prior to concreting for dry piers; water elevation in hole for wet piers), elevation of top and bottom of any casing left in place, description of temporary or permanent casing (including purpose, diameter, wall thickness and length), description and elevation of any obstructions encountered and whether removal was obtained, description of pier bottom including amount and extent of loose material, method of concrete placement, any difficulties encountered in drilling or concreting operations, and any deviations from specifications. The report shall include the name of the project, the name of the drilling contractor and the name of the field superintendent. The report shall be signed by a licensed engineer in the state where the project is located.

3.3 REINFORCING STEEL

- A. Mechanical Tension Splices: The Owner's Testing Laboratory shall provide 100 percent visual inspection of mechanical tension splices on the project. Inspection shall verify compliance with specifications and conformance with the manufacturer's recommendations for installation after consulting with the manufacturer, who is to be present for the first installation of the splice on the project. The Laboratory shall additionally conduct monotonic tension tests in accordance with ASTM A1034 of mechanical tension splices of the type as specified on the structural drawings. It is not necessary that the specimens to be tested are production splices, however, the specimens to be tested shall have been made by the Contractor's personnel under field conditions. The rate of testing shall be as follows:
 1. Two specimens for the first 50 splices (or fraction thereof for small jobs) at the beginning of the job. Splices not meeting tension requirements shall be retested at Contractor's expense until all splices meet the tension requirements.
 2. One specimen for every 100 (or fraction thereof) additional splices occurring on the job. Any splices not meeting tension requirements shall be retested at Contractor's expense until all splices have passed the test.
 3. A minimum of one test specimen shall also be selected from transition splices (splices of one bar size to another bar size), if any.
- B. Reinforcing Steel Field Inspection: The Owner's Testing Laboratory or designated Special Inspector shall inspect 100 percent of reinforcement before each concrete pour to verify the information noted below. Inspection reports shall be prepared and distributed in accordance with the local building code and as specified in this specification.
 1. Primary and secondary, longitudinal reinforcement has correct size and number in proper layers.
 2. Longitudinal reinforcement has correct length and lap.
 3. Ties and stirrups are of correct size, spacing, and number and have the proper termination- hook geometry.

4. Unscheduled face reinforcement in beams are provided and are of correct size, number and spacing and have the proper end terminations.
5. Proper hooks are provided at bar ends as detailed.
6. Reinforcement is properly supported and braced to formwork to prevent movement during concreting operation.
7. Reinforcement has proper cover.
8. Sufficient spacing between reinforcement for concrete placement.
9. Dowel reinforcement is of proper size, at proper spacing, and has proper lap length and embedment length.
10. Welded wire reinforcement is composed of flat sheets, has proper wire gage and spacing, is properly supported, and is properly lapped with a length of one square plus two inches.
11. Proper Construction/Control/Expansion joint spacing and reinforcement.
12. Reinforcement around embedded items is erected according to details.
13. Welded reinforcement has been done according to AWS requirements. Review the Welding Procedure Specification (WPS) submitted by the contractor for any reinforcing steel other than ASTM A 706 that is proposed to be welded for consistency with acceptable welding practices and the AWS.

3.4 CONCRETE MATERIALS AND POURED IN PLACE CONCRETE

- A. Concrete Mix Designs: The Owner's Testing Laboratory shall review the submitted mix designs for conformance to the specifications and for suitability for use in the project. The Testing Laboratory shall attend the Mix Design Conference and the Pre-Concrete Conference as noted in the Cast-in-Place Concrete Specification.
- B. Concrete Batch Plant Inspection: An initial batch plant inspection shall be made by the Owner's Testing Laboratory prior to the start of concrete work. The scope of batch plant inspection shall include the following:
 1. Inspection of Batch Plant Facilities: The Laboratory shall inspect batch plant facilities proposed for use in the work and report in writing inspection results to the Architect, Engineer, and Owner for approval. The inspection shall confirm the batch plant conforms to the standards set forth in ASTM C94 and can show proof of certification by the National Concrete Ready Mix Association. Inspection shall include:
 - a. Batch Plant operations and equipment
 - b. Truck mixers
 - c. Scales
 - d. Stockpile placement
 - e. Material storage
 - f. Admixture dispensers
 2. Multiple Batch Plants: The Contractor shall reimburse the Owner for the costs accrued to the Owner's Testing Laboratory for visits to more than 1 batch plant.
- C. Job Site Inspection: The scope of the work to be performed by the inspector on the jobsite shall be as follows:
 1. Prior to Concrete Placing
 - a. Grade Beams and Slab on Carton Forms
 - 1) Verify that moisture retarder is provided, is lapped properly, and is not torn or punctured
 - 2) Verify width, depth and elevation of grade beams.
 - 3) Verify that forms are plumb and straight, braced against movement, and lubricated for removal.
 - 4) Verify that carton forms below grade beam and slab are dry.
 - 5) Verify that carton forms are neatly formed around piers and face of grade beams.
 - 6) Inspect reinforcement per REINFORCING STEEL section.
 - b. Slab-on-Grade
 - 1) Verify that moisture retarder is provided, is lapped properly, and is not torn or punctured.
 - 2) Verify formwork at turndowns and slab edges is plumb and straight, braced against movement and lubricated for removal.
 - 3) Inspect reinforcement per REINFORCING STEEL section.
 - 4) Verify there is no standing water or debris in pour area.

- c. Columns
 - 1) Verify that forms are plumb and straight, braced against movement, lubricated for removal, and conform to approved shop drawings.
 - 2) Verify proper dimensions and orientation.
 - 3) Verify that top of column elevation is set in form and that it is 1/2 inch below the future slab soffit.
 - 4) Inspect reinforcement per REINFORCING STEEL section.
 - 5) Verify that debris is removed.
 - d. Elevated Deck (General)
 - 1) Verify that formwork conforms to signed and sealed shop drawings.
 - 2) Verify that shoring layout conforms to signed and sealed shop drawings.
 - 3) Verify that reshores at all levels conforms to signed and sealed shop drawings.
 - 4) Verify that forms are plumb and straight, braced against movement, and lubricated for removal.
 - 5) Verify that the forms used for exposed finish surfaces are of the type specified and provide a joint system as shown on the Architect's drawings.
 - 6) Verify the proper dimensions of girders, beams and joists.
 - 7) Verify that the slab thickness and top-of-slab elevation is correct.
 - 8) Verify that openings and sleeves are correct size and location.
 - 9) Verify that horizontal and vertical sleeves through girders, beams, or joists have been approved by the Engineer and that approved reinforcement is provided.
 - 10) Verify the top of columns are 1/2 inch below the deck soffit.
 - 11) Inspect reinforcement per REINFORCING STEEL section.
 - 12) Verify that debris is removed.
2. On-Site Concrete Material Testing and Inspection
- a. Verify that the Contractor is following appropriate concreting practices consistent with any extreme environmental conditions at the point of placement in the structure as defined below.
 - b. Inspect concrete upon arrival to verify that the proper concrete mix number, type of concrete, concrete strength, and that it is meeting job specifications, is being placed at the proper location. Report concrete not meeting the specified requirements and immediately notify the Contractor, Batch Plant Inspector, Architect, Engineer, and Owner.
 - c. Inspect plastic concrete upon arrival at the jobsite to verify proper batching. Observe mix consistency and adding of water as required to achieve target slumps in mix designs. Record the amount of water added and note if it exceeds that allowed in the mix design. The responsibility for adding water to trucks at the job site shall rest only with the Contractor's designated representative. The Contractor is responsible that all concrete placed in the field is in conformance to the Contract Documents.
 - d. Obtain concrete test cylinders as specified below.
 - e. Perform tests to determine slump, concrete temperature, unit weight, and air entrainment as specified below. The slump tests shall be made on concrete taken from the same location from which the concrete for the test cylinders is obtained.
 - f. Record information for concrete test reports as specified below.
 - g. Pick up and transport to Laboratory, cylinders cast the previous day.
3. During concrete placing, provide continuous monitoring to:
- a. Verify that the concrete is not over 90 minutes old at the time of placement.
 - b. Verify that Hot-Weather or Cold-Weather techniques are being applied as required.
 - c. Verify that concrete deposited is uniform and that vertical drop does not exceed six feet and is not permitted to drop freely over reinforcement causing segregation.
 - d. Verify that there are no cold joints.
 - e. Verify that the concrete is properly vibrated.
 - f. Verify that the finishing of the concrete surface is done according to specifications.
 - g. Verify that sawcut control joints on slab-on-grades are cut within 12 hours of placement.
 - h. Verify that the formwork has remained stable during the concreting operation.
 - i. Inspect bolts to be installed in concrete for proper grade, size and length and verify they have been properly installed to the specified embedment.

4. In-situ Concrete Strength Verification: The Owner's Testing Laboratory shall verify that the concrete has reached the required minimum strength before form removal by evaluating the specified tests.
 - a. If concrete strength for form stripping is to be determined using field-cured cylinders, one additional cylinder per set will be required for formed slab for the purpose of evaluating the concrete strength at the time of form stripping. This cylinder shall be stored on the floor where form removal is to occur under the same exposure conditions as the floor concrete. The cylinder shall be cured under field conditions in accordance with ASTM C31. Field cured test cylinders shall be molded at the same time and from the same samples as Laboratory cured test specimens. The cylinder shall be broken at the time of form removal as directed by the Contractor. The Contractor shall reimburse the Owner for the cost of making and testing these cylinders.
 - b. If concrete strength for form stripping is to be determined using the Maturity Method, the Owner's Testing Laboratory shall verify that the requirements of ASTM C 1074 are being followed and that the proper criteria for determining concrete strength by this method has been established and is being followed.
5. After Concrete Floor Placing and Finishing
 - a. Verify that the curing process is according to specifications and that any curing compound used is applied in accordance with manufacturer's recommendations.
 - b. Floor Flatness and Levelness Measuring
 - 1) The Testing Service providing Services for the Owner shall measure the floor for flatness and levelness according to ASTM E 1155.
 - 2) Measurement of the finished concrete surface profile for any test section shall be made when requested by the Owner's Representative at his option. Notwithstanding, measurements shall be made within 24 hours after completion of finishing operations. For structural elevated floors measurement shall also be made prior to removal of forms and shores. The Contractor shall be notified immediately after the measurements of any section are complete and a written report of the floor measurement results shall be submitted within 72 hours after finishing operations are complete.
 - 3) The concrete surface profile shall be measured using equipment manufactured for the purpose such as a Dipstick Floor Profiler as manufactured by the Edward W. Face Company in Norfolk, Virginia, F- Meters manufactured by Allen Face & Company in Norfolk, Virginia, optical, or laser means or other method specified in ASTM E 1155.
 - (a) Each floor test section and the overall floor area shall conform to the two-tiered measurement standard as specified herein.
 - (b) Minimum Local Value (MLV). The minimum local FF/FL values represent the absolute minimum surface profile that will be acceptable in any one floor test section.
 - (c) Specified Overall Value (SOV). The specified overall FF/FL values represent the minimum values acceptable for all combined floor test sections representing the overall floor.
 - 4) For purposes of this specification a floor test section is defined as the smaller of the following areas:
 - (a) The area bounded by column and/or wall lines.
 - (b) The area bounded by construction and/or control joint lines.
 - (c) Any combination of column lines and/or control joint lines.
 - (d) Test sample measurement lines within each test section shall be multidirectional along two orthogonal lines as defined by ASTM E 1155.
 - (e) The precise layout of each test section shall be determined by the Owner's Testing Laboratory and shall be submitted for Architect/Engineer review and approval.
 - c. Testing of Concrete Floor Slabs for Acceptability to Receive an Adhesive-Applied, Low-Permeable Floor Covering
 - 1) The following tests shall be performed by the Owner's Testing Laboratory as a part of quality assurance testing to insure that the proper moisture condition and alkalinity of the substrate has been achieved prior to installing adhesive-applied, low-permeability floor coverings such as vinyl composition tile (VCT), linoleum, sheet vinyl, vinyl-backed carpet,

- rubber, athletic flooring, synthetic turf, wood, acrylic terrazzo, thin-set tile, epoxy overlays and adhesives, et.al.
- 2) Moisture Vapor Emission Rate: Perform testing according to ASTM F 1869 to determine if the moisture emission rate from the floor is below the flooring manufacturer's maximum recommended value but not greater than 5lbs/1000sq.ft./24h.
 - 3) Relative Humidity Determination Test: As an alternate to the Moisture Vapor Emission Rate Test, and if agreed to by the Contractor, Architect and Owner, perform testing according to ASTM F 2170 to determine if the relative humidity of the concrete slab is below the flooring manufacturer's maximum recommended value but not greater than 75 percent.
 - 4) Alkalinity Testing: Perform testing in accordance with ASTM F 710-03, paragraph 5.3, to determine if the pH level of the concrete slab surface is below the flooring manufacturer's maximum recommended value but not greater than 10. Perform one test per 1000 sq. ft. with a minimum of three tests within the total area being tested.
6. The job site inspector shall report any irregularities that occur in the concrete at the job site or test results to the Contractor, Architect, Owner, and Engineer.
- D. Concrete Test Cylinders: The Owner's Testing Laboratory shall mold and test concrete test cylinders as described below.
1. Cylinder Molding and Testing: Cylinders for strength tests shall be molded and Laboratory cured in accordance with ASTM C31 and tested in accordance with ASTM C39.
 2. Field Samples: Field samples for strength tests shall be taken in accordance with ASTM C172.
 3. Frequency of Testing: Each set of test cylinders shall consist of a minimum of four standard test cylinders. A set of test cylinders shall be made according to the following minimum frequency guidelines:
 - a. One set for each class of concrete taken not less than once a day.
 - b. Piers: One set for each 50 cubic yards or fraction thereof.
 - c. Pier Caps: One set for each 50 cubic yards or fraction thereof.
 - d. Basement Walls: One set for each 150 cubic yards.
 - e. Floors: One set for each 150 cubic yards or fraction thereof but not less than one set for each 5,000 square foot of floor area.
 - f. Columns: One set for each 50 cubic yards or fraction thereof with a minimum of 2 sets per floor.
 - g. All Other Concrete: A minimum of one set for each 150 cubic yards or fraction thereof.
 - h. No more than one set of cylinders at a time shall be made from any single truck.
 - i. If the total volume of concrete is such that the frequency of testing as specified above would provide less than five strength tests for a given class of concrete, tests shall be made from at least five randomly selected batches or from each batch if fewer than five batches are used.
 - j. The above frequencies assume that one batch plant will be used for each pour. If more than one batch plant is used, the frequencies cited above shall apply for each plant used.
 4. The cylinders shall be numbered, dated, and the point of concrete placement in the building recorded.
 5. For concrete specified on the drawings to reach the required strength at 28 days, break one of the four cylinders of the set at seven days, two at 28 days, and one at 56 days. For mixes with high percentages of fly ash content to meet specific LEED requirements, provide one break at seven days, one at 28 and two at 56 days. Contractor to consult and coordinate with Concrete Supplier and Architect/ Engineer.
 6. Cylinder Storage Box: The Contractor shall be responsible for providing a protected concrete cylinder wooden storage box at a point on the job site mutually agreeable with the Testing Laboratory for the purpose of storing concrete cylinders until they are transported to the Laboratory. The box shall be constructed and equipped to maintain the environment specified for initial curing in ASTM C31.
 7. Transporting Cylinders: The Owner's Testing Laboratory shall be responsible for transporting the cylinders to the Laboratory in a protected environment such that no damage or ill effect will occur to the concrete cylinders including loss of moisture, freezing temperatures or jarring.

8. Information on Concrete Test Reports: The Owner's Testing Laboratory shall make and distribute concrete test reports after each job cylinder is broken. Such reports shall contain the following information:
 - a. Truck number and ticket number
 - b. Concrete Batch Plant
 - c. Mix design number
 - d. Accurate location of pour in the structure
 - e. Strength requirement
 - f. Date cylinders made and broken
 - g. Technician making cylinders
 - h. Concrete temperature at placing
 - i. Air temperature at point of placement in the structure
 - j. Amount of water added to the truck at the batch plant and at the site and whether or not it exceeds the amount allowed by the mix design
 - k. Slump
 - l. Unit weight
 - m. Air content
9. Cylinder compressive strengths with type of failure if concrete does not meet Specification requirements. Seven day breaks are to be flagged if they are less than 60 percent of the required 28 day strength of 30 percent of the required 56 day strength. 28 day and 56 day breaks are to be flagged if either cylinder fails to meet Specification requirements.
10. Standards for Tests of Concrete:
 - a. Slump Tests: Slump Tests (ASTM C143) shall be made at the beginning of concrete placement for each batch plant and for each set of test cylinders made. The slump test shall be made from concrete taken from the end of the concrete truck chute. The concrete shall be considered acceptable if the slump is within plus or minus 1 inch of the slump noted on the mix design submittal form for that class of concrete.
 - b. Air Entrainment: Air entrainment tests (ASTM C231 or C173, C173 only for lightweight concrete) shall be made at the same time slump tests are made as cited above.
 - c. Concrete Temperature: Concrete temperature at placement shall be measured (ASTM C1064) at the same time slump tests are made as cited above.
 - d. Unit Weight Test: ASTM C138
11. Evaluation and Acceptance of Concrete:
 - a. Strength Test: A strength test shall be defined as the average strength of two cylinder breaks from each set of cylinders tested at the time indicated above.
 - b. Quality Control Charts and Logs: The Owner's Testing Laboratory shall keep the following quality control logs and charts for each class of concrete containing more than 2,000 cubic yards. The records shall be kept for each batch plant and submitted on a weekly basis with cylinder test reports:
 - 1) Number of strength tests made to date.
 - 2) Strength test results containing the average of all strength tests to date, the high test result, the low test result, the standard deviation, and the coefficient of variation.
 - 3) Number of tests under specified strength.
 - 4) A histogram plotting the number of strength test cylinders versus compressive strength.
 - 5) Quality control chart plotting compressive strength test results for each test.
 - 6) Quality control chart plotting moving average for strength where each point plotted is the average strength of three previous test results.
 - 7) Quality control chart plotting moving average for range where each point plotted is the average of 10 previous ranges.
 - c. Acceptance Criteria: The strength level of an individual class of concrete shall be considered satisfactory if both of the following requirements are met:
 - 1) The average of all sets of three consecutive strength tests equal or exceed the required f'_c .
 - 2) No individual strength test falls below the required f'_c by more than the greater of 10 percent of f'_c or 500 PSI.

- d. If either of the above requirements is not met, the Testing Laboratory shall immediately notify the Engineer by telephone. Steps shall immediately be taken to increase the average of subsequent strength tests.
- E. Investigation of Low Strength Concrete Test Results:
 - 1. Cost of Investigations for Low Strength Concrete: The Contractor shall reimburse the Owner for the costs of investigations of low strength concrete, as defined above.
- F. Scope of Investigations: See Specification Section 03 30 00, Cast-In-Place Concrete, for the investigations that may be required by the Engineer. The Owner's Testing Laboratory will conduct these investigations.
- G. Causes for Rejection of Concrete: The Contractor shall reject concrete delivered to the site for any of the following reasons:
 - 1. Wrong class of concrete (incorrect mix design number).
 - 2. Environmental Conditions: Environmental condition limits shall be as follows unless appropriate provisions in concreting practices have been made for cold or hot weather:
 - a. Cold Weather: Air temperature must be 40 degrees F and rising or the average daily temperature cannot have been lower than 40 degrees F for 3 consecutive days unless the temperature rose above 50 degrees F for at least one-half of any of those 24 hour periods.
 - b. Hot Weather: Environmental conditions must be such that cause an evaporation rate from the concrete surface of 0.2 lb./sq. ft./hr. or less as determined by Figure 2.1.5 in ACI 305R-91.
 - c. Concrete may be placed at other environmental condition ranges only with approval of the job inspector for the Owner's Testing Laboratory or other duly appointed representative.
 - 3. Concrete with temperatures exceeding 95°F shall not be placed in the structure.
 - 4. Air contents outside the limits specified in the mix designs.
 - 5. Slumps outside the limits specified.
 - 6. Excessive Age: Concrete shall be discharged within 90 minutes of plant departure or before it begins to set if sooner than 90 minutes unless approved by the Laboratory job inspector or other duly appointed representative.
- H. Concrete Batch Trip Tickets: Concrete batch trip tickets shall be collected and retained by the Contractor. Compressive strength, slump, air, and temperature tests shall be identified by reference to a particular trip ticket. Tickets shall contain the information specified in ASTM C94. Each ticket shall also show the amount of water that may be added in the field for the entire batch that will not exceed the specified water cement ratio for the design mix. The Contractor and Owner's Testing Laboratory shall immediately notify the Architect/Engineer and each other of tickets not meeting the criteria specified.

3.5 STRUCTURAL STEEL

- A. Contract Obligations:
 - 1. Owner Responsibility: The Owner shall pay for initial shop and field inspections and tests as required during the fabrication and erection of the structural steel.
 - 2. Testing Laboratory Responsibility: The inspection by the Owner's Testing Laboratory of the Fabricator's work shall be in sequence, timely, and performed in such a manner so that corrections can be made without delaying the progress of the work. Inspections shall be performed by qualified technicians with a minimum of two years experience in structural steel testing and inspection. See "Qualifications of Testing Laboratory" section for special requirements for welding inspectors. The Testing Laboratory shall provide test reports of inspections. All test reports shall indicate types and locations of defects found during inspection, the measures required and performed to correct such defects, statements of final approval of welding and bolting of shop and field connections, and other fabrication and erection data pertinent to the safe and proper welding and bolting of shop and field connections. In addition to the parties listed in this Specification the Fabricator and Erector shall receive copies of the test reports.
 - 3. Rejection of Material or Workmanship: The Owner, Architect, Engineer, and Testing Laboratory reserve the right to reject any material or workmanship not in conformance with the Contract Documents at any time during the progress of the work. However, this provision does not allow waiving the obligation for timely, in sequence inspections.
- B. Field Inspections: The Owner's Testing Laboratory shall provide the following inspections in the field:
 - 1. Obtain the planned erection procedure, and review with the Erectors supervisory personnel.
 - 2. Check the installation of base plates for proper leveling, grout type, and grout application.

3. Check structural steel and cold-formed steel deck as received in the field for possible shipping damage, workmanship, and identification marking to conform to AISC 360 for structural steel and as specified ASTM standards for other steel and steel deck.
 4. Verify that surveys are occurring as specified to check plumbness and frame alignment as erection progresses. Review the submitted survey report.
 5. Conduct welding inspection and verification testing per detailed requirement of section D- Welding Inspection and Testing below.
 6. Conduct high-strength bolting inspection per detailed requirements of Section E – High- Strength Bolting and Testing below.
 7. Periodically inspect the steel frame joint details such as bracing and stiffening, member locations, and connection details for compliance with approved construction documents.
 8. Inspect 100 percent of the column compression and base joints for verification that gaps in contact bearing do not exceed 1/16 inch. Gaps greater than 1/16 inch but less than 1/4 inch shall be reported to the Owner and Engineer for assessment. All gaps greater than 1/4 inch shall be shimmed with non-tapered mild steel shims.
 9. Endeavor to guard the Owner against the Contractor cutting, grinding, reaming, or making any other field modification to structural steel without the prior approval of the Engineer. Report any noted unauthorized modifications to the Owner and Engineer.
- C. Weld Inspection and Testing: The Owner's Testing Laboratory shall make the following inspections and tests of the welds and welding processes. Welds performed in the fabricating shop may be inspected in the field unless continuous monitoring of the welding process is herein specified or if access in the field due to other work or shop finishes makes field inspection impractical:
1. Approve Welding Procedure Specifications submitted by the Contractor. Approve any changes submitted by the Contractor to any WPS that has already been approved. Obtain the Welding Procedure Qualification Record (WPQR) for each successful WPS qualification.
 2. Verify welder qualifications either by certification and/or by retesting. Obtain welder certificates.
 3. Verify welding electrodes to be used and other welding consumables as the job progresses.
 4. Periodically observe joint preparation, assembly practice, welding techniques including preheating and sequence, and the performance of welders with sufficient frequency to assure compliance with code and contract document requirements. Check preheating to assure conformance with AWS D1.1, Section 5.6. Verify procedure for control of distortion and shrinkage stresses.
 5. Observe joint preparation and fit up, backing strips, and runout plates for welded moment connections and column splices.
 6. Periodically provide visual inspection of the root pass of partial and complete joint penetration welds.
 7. Visually inspect 100 percent of welds for proper size, length, location, and weld quality in accordance with AWS D1.1 requirements. Unless specifically noted otherwise, all welding shall be considered statically loaded nontubular connections.
 8. Visually inspect 100 percent of the welds of anchors to embedded plates that are to be cast into concrete elements.
 9. In addition to the inspections above, perform the following:
 - a. Continuously monitor and observe joint preparation, assembly practice, welding techniques including preheating and sequence, and the performance of welders for 100 percent of complete and partial joint penetration welds, multipass fillet welds, and single- pass fillet welds greater than 5/16 inch. Check preheating to assure conformance with AWS D1.1, Section 5.6. Verify procedure for control of distortion and shrinkage stresses.
 - b. Periodically monitor welding of single-pass fillet welds that are less than or equal to 5/16 inch.
 - c. Periodically monitor the method of attaching the steel floor and roof decking to the structural frame.
 - d. Periodically monitor the welding of headed studs to floor beams.
 10. Weld Verification Testing Scope:
 - a. Perform nondestructive examination services using a qualified technician with the necessary equipment to perform the following:
 - 1) Nondestructive examination conducted in accordance with the specific requirements for the item being examined including radiographic (RT), ultrasonic (UT), magnetic particle (MT), or dye-penetrant inspection (PT). Nondestructive inspection procedures shall conform to AWS D1.1.

- 2) Interpret, record, and report results of the nondestructive tests.
 - 3) Mark for repair, any area not meeting Specification requirements. Correction of rejected welds shall be made in accordance with AWS D1.1.
 - 4) Re-examine repair areas and interpret, record, and report the results of examinations of repair welds.
 - 5) Verify that quality of welds meet the requirements of AWS D1.1..
- b. Fillet welds. provide the following:
- 1) MT test a minimum of 10 percent of the length of each fillet weld exceeding 5/16 inch.
 - 2) Periodic MT testing of representative fillet welds 5/16 inch and less but need not exceed 10 percent of all such welds, except as provided in (3) below.
 - 3) Increase MT testing rate for welders having a high rejection rate as required to ensure acceptable welds.
- c. Partial joint penetration welds, including flare-bevel groove welds. provide the following:
- 1) MT test a minimum of 25 percent of the length of each PJP weld exceeding 5/16 inch effective throat.
 - 2) Periodic MT testing of representative PJP welds 5/16 inch and less but need not exceed 10 percent of all such welds, except as provided in (3) below.
 - 3) Increase MT testing rate for welders having a high rejection rate as required to ensure acceptable welds.
- d. Complete joint penetration welds. provide the following:
- 1) All CJP welds exceeding 5/16 inch thickness shall be 100 percent UT tested per AWS D1.1 Chapter 6 Part F. The testing laboratory shall review the CJP joints to determine where geometry or accessibility precludes the use of standard scanning patterns per AWS D1.1 Chapter 6 Part F. At these locations the testing laboratory shall develop and submit for approval a written testing procedure in accordance with AWS D1.1 Annex K.
 - 2) Periodic MT testing of representative CJP welds 5/16 inch and less not to exceed 10 percent of all such welds, except as provided in (3) below.
 - 3) Increase MT testing rate for welders having a high rejection rate as required to ensure acceptable welds.
- e. Acceptance Criteria
- 1) Visual, MT, PT shall be per AWS D1.1 Table 6.1.
 - 2) UT testing shall be per AWS D1.1 6.13.1 and Table 6.2.
 - 3) Headed Studs: Perform field bend tests according to AWS D1.1 on 2 percent of the studs welded to plates, but not less than one stud per plate.
 - 4) Deformed Bar Anchors: Perform MT testing on 10 percent of deformed bar anchors larger than #5 bar.
- f. The costs of repairing defective welds and the costs of retesting by the Testing Laboratory providing services for the Owner shall be borne by the Contractor. If removal of a backing strip is required by the Testing Laboratory to investigate a suspected weld defect, such cost shall be borne by the Contractor.
- D. High-Strength Bolting Inspection and Testing: The Owner's Testing Laboratory shall perform the following inspections and test for connections joined with high-strength bolting. Bolting performed in the shop may be inspected in the field unless continuous monitoring of the bolting operation is herein specified:
1. Observe preinstallation verification testing of the pretensioning method to be used in accordance with the requirements of the "Specification for Structural Joints Using ASTM A325 and A490 Bolts". Daily check the calibration of impact wrenches used in field bolted connections.
 2. Inspect bolt installation for 100 percent of high strength bolted connections according to inspection procedures outlined in the "Specification for Structural Joints Using ASTM A325 or A490 Bolts".
 3. Perform Arbitration Testing and Inspection according to procedures outlined in the "Specification for Structural Joints using ASTM A325 or A490 Bolts" when a disagreement exists between the Testing Laboratory and the Fabricator as to the minimum tension of installed bolts that have been inspected according to paragraph above.
 4. Monitoring of Bolting Installation:
 - a. Continuous Monitoring: The Owner's Testing Laboratory shall be continuously present and monitor the bolting installation for compliance with the selected procedure for installation as specified in the "Specification for Structural Joints Using ASTM A325 and A490 Bolts" for joints

using high-strength bolts that are designated on the plans as Pretensioned (PT) or Slip-Critical (SC) type joints and that are being installed using the calibrated wrench method or the turn-of-nut without matchmarking method of installation.

- b. Periodic Monitoring: All other joint types and bolt installation methods may be monitored on a periodic basis.

3.6 NON-SHRINK GROUT FOR BASE PLATES, BEARING PLATES AND PRECAST WALL PANELS

- A. Compressive Strength Tests (by the Owner's Testing Laboratory): Compressive strength of grout shall be determined by testing grout cubes according to the requirements of ASTM C109 - Modified. Test one set of three cubes at 1 day, and one set of three cubes at 28 days.
- B. Frequency of Testing: One set of cubes (6 cubes) shall be made for every ten base plates and bearing plates or fraction thereof but not less than one set for each day's operation. One set of cubes shall be made for each day's operation of grouting wall panels.

3.7 MASONRY

- A. Verification Testing Frequency: Verification of masonry strength (f_m) will be performed at the beginning of masonry construction.
- B. Concrete Masonry Unit: For each type of concrete masonry unit indicated, verify compliance with ASTM C90 and the strength required by design. Verification may be by reviewing certification from unit producer showing compliance.
- C. Mortar:
 - 1. As construction begins, verify the proportions of the site-prepared mortar mix comply with the requirements of ASTM C270 for the type specified.
- D. Grout:
 - 1. Prior to grouting, verify the proportions of site-prepared grout mix comply with the requirements of ASTM C476 for each type of grout used.
- E. Mortar Joints: Throughout construction, verify that mortar joints are being prepared in accordance with these specifications and ACI 530.1/ASCE 6/TMS 602.
- F. Reinforcement and Connectors: Prior to grouting, verify the size, grade, type and placement of reinforcement and connectors is in compliance with specified requirements.
- G. Grouting: Prior to any grouting procedure, the grout space shall be inspected to verify that it is clean and that cleanouts, if required, are in place and conform to requirements. Verify through continuous inspection that the placement of grout is in compliance with the requirements of the contract specifications and ACI 530.1/ASCE 6/TMS 602.
- H. Anchors: Continuously inspect the installation of anchors including anchors of masonry to other structural members, frames, or construction verifying their type, size, location, and installation.
- I. Welding of Reinforcing Bars: Continuously observe the welding of reinforcing bars.
- J. Installed items: Verify that installed flashing, weep holes, construction joints, control joints and wall vents are installed in accordance with specifications.

END OF SECTION 01 45 29

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Requirements for temporary utilities, support facilities, and security and protection facilities.

1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's own forces, Architect, testing agencies, and authorities having jurisdiction.
- B. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.4 SUBMITTALS

- A. Dust-Control and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust-control and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
 - 1. Locations of dust-control partitions at each phase of the work.
 - 2. HVAC system isolation schematic drawing.
 - 3. Location of proposed air filtration system discharge.
 - 4. Other dust-control measures.
 - 5. Waste management plan.

1.5 QUALITY ASSURANCE

- A. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.

1.6 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.
- B. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:
 - 1. Keep temporary services and facilities safe, clean and neat.
 - 2. Relocate temporary services and facilities as required by progress of the Work.
 - 3. At earliest feasible time, when acceptable to Owner, change over from use of temporary service to use of permanent service.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10 mils (0.25 mm) minimum thickness, with flame-spread rating of 15 or less per ASTM E 84.
- B. Dust Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches (914 by 1624 mm).
- 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, General: 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 not less than 1 receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack and marker boards.
 - 3. Drinking water and private toilet.
 - 4. Coffee machine and supplies.
 - 5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
 - 6. 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 exposure.
 - 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
- B. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction and clean HVAC system as required in Division 01 Section "Closeout Procedures".
- C. Air Filtration Units: HEPA primary and secondary filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.
- D. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.

PART 3 EXECUTION

3.1 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.
 - 1. Locate facilities to limit site disturbance as specified in Division 01 Section "Summary."
- 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.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Connect to existing service.
 - 1. Arrange with Owner for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- C. Sanitary Facilities: Provide temporary toilets, wash 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.
 - 1. Toilets: Use of Owner's existing toilet facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- D. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

1. Prior to commencing work, isolate the HVAC system in area where work is to be performed in accordance with approved coordination drawings.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area using HEPA-equipped air filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust containment devices.
 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
- E. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- F. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- G. 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.
 2. Install lighting for Project identification sign.
- H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.
1. Provide additional telephone lines for the following:
 - a. Provide a dedicated telephone line for each facsimile machine in each field office.
 2. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.
- I. Electronic Communication Service: Provide a computer in the primary field office adequate for use by Architect and Owner to access project electronic documents and maintain electronic communications. Equip computer with not less than the following:
1. Processor: Intel Pentium D or Intel CoreDuo, 1.8 GHz processing speed.
 2. Memory: 2 gigabyte.
 3. Disk storage: 80 gigabyte hard disk drive and combination DVD-RW/CD-RW drive.
 4. Display: 19-inch (480-mm) LCD monitor with 128 Mb dedicated video RAM.
 5. Full-size keyboard and mouse.
 6. Network Connectivity: 10/100BaseT Ethernet.
 7. Operating System: Microsoft Windows XP Professional or Microsoft Windows Vista Business.
 8. Productivity Software:
 - a. Microsoft Office Professional, XP or higher, including Word, Excel, and Outlook.
 - b. Adobe Reader 7.0 or higher.
 - c. WinZip 24 or higher.
 9. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these 3 functions.
 10. Internet Service: Broadband modem, router and ISP, equipped with hardware firewall, providing minimum 384 Kbps upload and 1 Mbps download speeds at each computer.
 11. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing and spam protection in a combined application.
 12. Backup: External hard drive, minimum 40 gigabyte, with automated backup software providing daily backups.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible according to ASTM E 136. 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. Parking: Use designated areas of Owner's existing parking areas for construction personnel.
- C. 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.
- D. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.
1. Do not load elevators beyond their rated weight capacity.
 2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.
- E. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

3.4 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.
- 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.
1. Comply with work restrictions specified in Division 01 Section "Summary."
- C. 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 work day.
- D. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- E. 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 not complete, insulate temporary enclosures.
- F. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant plywood on construction operations side.
 2. Construct dustproof partitions with two layers of 6-mil (0.14-mm) polyethylene sheet on each side. Cover floor with two layers of 6-mil (0.14-mm) polyethylene sheet, extending sheets 18 inches (460 mm) up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant treated plywood.
 - a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches (1219 mm) between doors. Maintain water-dampened foot mats in vestibule.

3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 4. Insulate partitions to control noise transmission to occupied areas.
 5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 6. Protect air-handling equipment.
 7. Provide walk-off mats at each entrance through temporary partition.
- G. 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.
1. Tobacco-Free Environment: UTSW Policy SEC-205 prohibits smoking and/or tobacco products on all property that is owned, operated, occupied, or controlled by the institution. There are no designated smoking areas.
 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to 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. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting.
 5. 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.
- H. Smoke Detector Protection: In order to prevent the unintentional activation of a smoke detector during construction, renovation, or maintenance; comply with the following smoke detector protection procedure:
1. Cut off bottom of zip-top plastic bag.
 2. Secure bottom of bag the the base of smoke detector using painter's tape.
 3. Label bag with date and Contractor name.
 4. Seal the bag at the start of each work day where potential of creating dust or smoke is possible.
 5. Open the bag at the end of each day and remove the bag once Project is complete.
 6. Replace bag when it becomes dirty or damaged.
- 3.5 MOISTURE AND MOLD CONTROL
- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: 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 Phase: 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, replace or clean stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Control moisture and humidity inside building by maintaining effective dry-in conditions.
- E. Use permanent HVAC system to control humidity.

- F. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
- G. 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.
- H. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record daily readings over a forty-eight hour period. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
- I. Remove materials that can not be completely restored to their manufactured moisture level within 48 hours.

3.6 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. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.
- D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- E. 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. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 01 50 00

SECTION 01 57 19

AIRBORNE CONTAMINANTS CONTROL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Hospital airborne contaminants control policy and procedures.
- B. Ceiling access control of airborne contaminants.

1.3 DEFINITIONS

- A. Containment Areas: (Negative Pressurization) As determined by Architect and as shown on the Drawings as Project Areas. Includes area of construction, adjacent staging and storage areas, and passage areas for contractors, supplies, and waste; includes ceiling spaces above and adjacent to construction.
- B. Protection Areas: (Positive Pressurization) As determined by Architect and as shown on the Drawings as Protection Areas. Includes hospital areas adjacent to Containment Area, either occupied or used for passage, as well as areas connected to construction area by mechanical system air intake, exhaust and ductwork.
- C. "Minor" ceiling access is defined as visual observation or minor adjustments or other activity that does not disturb dust. Acoustical panels shall be replaced or access panel shall be closed immediately when the contractor leaves the work site.
- D. "Major" ceiling access describes any other access not defined as "minor."
- E. "Thorough" cleaning of surfaces which become exposed to dust shall be accomplished by the use of either a HEPA-filtered vacuum cleaner or Water Vac with HEPA Filtration on outlet. Note: Wet mop shall not be used since moisture will activate dormant fungus and mold spores in dust.
- F. Negative Air Machine: Portable mechanical units to provide a negative air pressure in the Containment Areas, as specified in this Section.

1.4 SYSTEM DESCRIPTION

- A. Design Requirements: Owner will establish acceptable, baseline levels of airborne contaminants based on air monitoring of existing conditions prior to start of Work.
 - 1. Aspergillosis and related nosocomial fungal infections are caused through inhalation by immunocompromised patients of aspergillus spores, or other related spores which can be present in the construction environment. The spores are known to be prolifically present in construction dust, debris, and earthwork excavation dust. Control of construction dust, debris, and excavation dust, as required in this Section, is imperative to help prevent outbreaks of aspergillosis or related nosocomial fungal infections in immunocompromised patients.
 - a. Inhalation of aspergillus spores or other fungal spores by immunocompromised patients can lead to serious complications and death.
 - b. Aspergillus and other related spores are present in the natural environment and thus are not a risk to healthy construction workers.
 - c. Construction workers are required to attend an orientation session.
 - 2. Airborne contaminants control is critical in hospital areas. Limit dissemination of airborne contaminants produced by construction-related activities in order to provide protection of immunocompromised and other patients, staff, diagnostic operations, or sensitive procedures or equipment, from possible undesirable effects of exposure to such contaminants.
 - a. Dust in ceilings and construction debris contains fungus spores. Conduct construction activities causing disturbance of existing dust, or creating new dust, or other airborne contaminants in tight enclosures cutting off flow of particles into patient areas.
 - b. Secure ceilings and walls in Protection Areas and other indicated areas. Follow specified procedures if access into ceiling in occupied areas is required.

3. Design system, including containment and disposal procedures, equipment, and related work, to meet specified requirements.

1.5 SUBMITTALS

- A. Progress Schedules: Submit work areas and procedure schedules for containment of airborne contaminants.
- B. 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. Identify further options if proposed measures are later determined to be inadequate. 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. Other dust-control measures.
- C. Product Data: Submit manufacturer's literature on:
 1. Vacuum cleaning machines, air compressors, pressure washers, and cleaning related equipment accessories.
 2. Biocide sanitizing fluid, coil cleaning solutions, degreasers, encapsulators.
 3. Duct access doors, access panels.
 4. Labels.
- D. Record Drawings: Upon completion of the project, submit one set of red-marked duct layout drawings showing the location of new access holes and openings installed in the duct systems to accommodate the cleaning process.
- E. Test Reports: Written results of testing specified in Part 3.

1.6 QUALITY ASSURANCE

- A. Air Samples: Owner will provide baseline particle counts and conduct periodic air sampling of areas during construction to monitor effectiveness of containment procedures.
- B. Contractor Qualifications: Company specializing in performing Work of this extent and nature with minimum five years experience.
- C. Regulatory Requirements: Ensure flammable components comply with applicable portions of local, state, and federal codes, laws, and ordinances for flame spread and smoke developed indices.

1.7 OWNER'S USE OF SPACE

- A. Accomplish work with a minimum of interruptions to Owner's operation within the building. Coordinate work with the Owner's Representative.
- B. In the event HVAC systems provide space heating the duration of system shut downs must be limited or the contractor shall provide temporary heating systems to ensure room temperatures of at least 50 degrees F. are maintained.

1.8 PROTECTION

- A. If work is being done above a lay-in ceiling and if work must be performed while the space below is occupied, provide temporary work surfaces to provide a safe working platform and protect the ceiling and the spaces below from falling objects and materials. Take necessary precautions to protect the people and spaces below from injury due to the contractor's operations.
- B. Exercise caution when handling fluids, particularly heating water, in the interstitial space. When working with fluids provide a water-tight barrier beneath the work area to catch and retain spillage before it reaches the ceiling below.
- C. Notify the Architect at least 48 hours prior to commencing work in ceiling or interstitial spaces above occupied areas to allow at-risk patients to be relocated or protected.

1.9 COORDINATION OF WORK

- A. Submit a cleaning work schedule for each HVAC unit/duct system a minimum of 30 days prior to beginning work. Indicate dates, times and activities for each phase or portion of the work. In addition, describe in detail what systems, fans, and HVAC equipment will be affected (no air flow) and what rooms, spaces or areas will require access. Include procedures proposed for the project.
- B. Coordinate work activities with other affected trades and Subcontractors.

- C. Do not begin cleaning activities until other construction activities are complete except for Testing, Adjusting, and Balancing (TAB) activities in which case TAB activities shall be performed after acceptance of cleaning activities.
- D. Prearrange and preschedule with the Architect and Owner's Representative the switching off of any HVAC unit to commence a cleaning operation.

1.10 PRE-INSTALLATION CONFERENCE

- A. Conduct pre-installation conference in accordance with Section 01 31 00.
- B. Before Work begins, conduct an orientation session including presentation by Owner's Representative for training and instructing construction and related personnel on precautions to be taken. Do not permit workers to access work areas until successfully completing orientation session.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. Negative Air Machines: Include prefilters, final filters, HEPA filters and filter static pressure gauges.
 - 1. HEPA filters: 99.97 percent efficient at 0.3 micron particle size.
 - 2. Acceptable product and manufacturer:
 - a. Micro Trap MT-C Negative Air Filtration Units by Micro-Trap, Inc.
 - b. CRSI 2000 by Control Resource System Incorporated
- B. Air Pressure Monitor: Differential switch/gauge to monitor differential pressure between construction Containment Area and Protection Area.
 - 1. Install switch/gauge in NEMA rated enclosure.
 - 2. Provide power wiring, transformers, and relays to operate the system.
 - 3. Provide audio-visual alarm that will activate upon sensing pressure differences beyond the range set points.
 - 4. Provide a switch that will enable activation of either audio, visual, or both alarms.
 - 5. Provide a manual reset switch to reset gauge after an alarm condition.
 - 6. Acceptable product and manufacturer, Switch/gauge:
 - a. Dwyer Model 3000-0 with range of 0 to 0.5 inches of water gauge, and high-low adjustable set points.
- C. Vacuum Collection Machine:
 - 1. Portable vacuum cleaning machine designed for duct cleaning mounted on wheels.
 - 2. Filter section with filter bags and final HEPA exhaust filtration.
 - 3. Anti-spark construction, made of non-ferrous material.
 - 4. Fan shall have a minimum of 4,000 CFM 1ft 1.5 inch static pressure.
 - 5. Unit shall maintain a minimum 1 inch S.P. on duct at all times.
- D. Air Compressor:
 - 1. Portable air compressor unit consisting of compressors, tanks, and controls ASME rated.
 - 2. Minimum Capacity: 17 CFM free air at 175 psig.
 - 3. Accessories: Hoses and velocity nozzles.

2.2 MATERIALS

- A. Comply with NESHAP-EPA 40 CFR 61, Subpart M-National Emission Standard for Asbestos.
- B. Carpet or Mats: Provide carpets or mats at enclosure entrances, vacuumed or changed as often as necessary to prevent accumulation of dust. At Owner's option, provide adhesive faced contamination control mats with disposable sheets in lieu of vacuumed mats. Vacuuming of areas not under negative pressure shall be with a certified HEPA-filtered vacuum.
 - 1. Acceptable product and manufacturer – Adhesive faced contamination control mat:
 - a. Tacky Mat by Liberty Industries
- C. Dust Caps: Block off existing ventilation ducts within construction area. Capping method shall be dust tight and withstand air flow.
- D. Portable Enclosures: Sufficient to seal off area tight to ceiling.
- E. Temporary Prefabricated Partition for work in Sterile Corridors:
 - 1. Acceptable product and manufacturer:
 - a. Kontrol Kube by Fiberlock Technologies, Inc.
 - 1) Adjustable Aluminum Frame #6540.

- 2) Vinyl Enclosure #6544.
- 3) Wheel Base Platform #6543.
- 4) Inspection window and pressure differential porthole.
- 5) Nilfisk 87 cfm vacuum device and manometer.
- F. Polyethylene: ASTM D210, Minimum thickness: 6 mil, FR treated.
- G. Biocide: Copper-8-quinolinolate.
 - 1. Acceptable product and manufacturer: MAG Chemical
- H. Spray Adhesive:
 - 1. Acceptable product and manufacturer: Ram-Tack Adhesive from Aramsco

PART 3 EXECUTION

3.1 PREPARATION

- A. Before any demolition or construction begins in occupied areas, a complete field review of all airborne contaminant control policies will be conducted. A checklist will be filled out and signed by the Airborne Contaminant Control Nurse and the Contractor, confirming that the area is ready for work to begin.
- B. Provide temporary barriers and other controls to control airborne contaminants. Extend barriers above ceilings as required to seal off and contain airborne contaminants.

3.2 GENERAL CEILING ACCESS DIRECTIVES

- A. Perform Work in accordance with Section 01 73 00 - Execution, applicable local standards, and approved shop drawings and work plans.
- B. Report to Owner and fill out a ceiling access form. Attach approved work tag to the ceiling access enclosure before work will be allowed to proceed.
- C. Work Tag:
 - 1. Attach a completed, approved work tag on the ceiling access enclosure before work can proceed.
 - 2. Remove work tag only after work is done and cleanup completed.
 - 3. Tags issued from Owner's representative shall be returned the same day to the office from which it was issued, after work and cleanup for the day has been completed.
- D. Spray top of ceiling panels to be removed, and surrounding affected panels, with fine water mist to settle dust prior to removal.
- E. Inform Head Nurse or department manager so that patient room doors near ceiling work will be kept closed while work is in progress.
- F. Contact Owner's Representative regarding ceiling access problems.
- G. Special Techniques:
 - 1. Provide special control of sources of contaminants and waste as determined by Owner's Representative. Contain waste materials during removal, bagging, wrapping, and chute use.
 - 2. Use wet cleaning methods and HEPA-filtered vacuum cleaners to minimize release of airborne contaminants. Disinfect contaminant and protection areas to effect final cleaning.
 - 3. Perform cleaning of heating, ventilating and air conditioning (HVAC) systems and ductwork.
 - 4. Sealing of Openings: Use duct tape or other impenetrable sealant to seal barrier wall seams, cracks around window and door frames, exhaust system ductwork, pipes, joints, and ducts. Seal penetration of dustproof enclosures on all sides and 360 degrees around penetrating objects.
 - 5. Dust Control: Take appropriate steps throughout the term of the Project to prevent airborne dust due to work under this contract. Apply water wherever practical to settle and hold dust to a minimum, particularly during demolition and moving of materials. Prevent accumulation of standing water or saturation of any materials. Use of chemical palliatives is not permitted without permission of Owner's Representative.
 - a. Spray surfaces with water during dust-producing interior demolition activities. Hard surface floors in work area, adjacent hallways and passage areas require vacuuming with HEPA-filtered vacuum cleaners during demolition and construction. Protect adjacent carpeted areas with plastic and plywood, and vacuum with HEPA-filtered vacuum cleaners.
 - b. Vacuum walk-off mats at least once daily.
 - c. Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent airborne dust from dispersing into atmosphere.

- H. Airborne contaminant enclosures or infection control enclosures shall be dust-tight. Immediately remove dust tracked outside of enclosure. Clean areas outside enclosure with HEPA-filtered vacuum or other approved method.
- I. Implement the following procedure when construction personnel are required to pass through a Protected Area to enter the Containment Area.
 - 1. Provide air lock entry vestibules in dustproof enclosures when shown on Drawings or required by Owner's Representative.
 - 2. Personnel shall wear protective clothing while passing through the Protective Area. Protective clothing shall be removed in the air lock vestibule prior to entering the Containment Area.
 - 3. When exiting the Containment Area, personnel shall put protective clothing on before reentering the Protected Area.
- J. Contractor Personnel: Instruct personnel to refrain from tracking dust into adjacent hospital areas or opening windows or doors that may allow airborne contaminants into adjacent hospital areas.
- K. Exterior Work: Direct exhaust from equipment away from building air intakes. Ensure that filters on building air intakes are operational and protected from excessive amounts of airborne contaminants.
- L. Ceiling access panels opened for investigation beyond sealed areas shall be replaced immediately when unattended.
 - 1. Whenever access panels are opened in occupied areas, for work above ceiling, provide portable enclosure enclosing ladder and seal off opening, fitted tight to ceiling.
- M. Provide thorough cleaning of existing, exposed surfaces before start of Owner's room occupancy.
- N. Removal of construction barriers and ceiling protection shall be done carefully, possibly outside of normal work hours. Vacuum and clean adjacent surfaces after removal.
- O. Perform vacuuming of areas not under negative pressure with a certified, Owner approved, HEPA-filtered vacuum.

3.3 AIRBORNE CONTAMINANT CONTROL ENCLOSURES AND BARRIERS

- A. Install dustproof enclosures for work as indicated and when required to protect areas occupied by Owner from dust, debris, and damage.
- B. It is the Contractor's responsibility to determine when a dustproof enclosure is required to protect any adjoining area; however, Contractor shall provide a dustproof enclosure where indicated and whenever requested by Owner.
- C. Airborne Contaminant Control General Requirements: Floor to structure, air-tight enclosures, and gypsum board barriers, using tape and foam padding.
 - 1. Keep traffic between Containment Areas and open areas to a minimum. Keep door to areas closed at all times. Transport materials and refuse into an area from an external site without violating patient care areas by transporting in covered containers.
 - 2. Provide negative pressure in construction areas as specified herein.
 - a. Provide adequate forced ventilation of enclosed areas to cure installed materials, to prevent excessive humidity, and to prevent hazardous accumulations of dust fumes, vapors, or gases.
- D. Dustproof Enclosures: Full height, noncombustible construction, with minimum 1/2 inch gypsum board both sides with 3-1/2 inch R-11 insulation batts to reduce noise. Use 3-inch wide duct tape to tightly seal top, bottom, and seams, to prevent spread of dust to occupied areas, including above ceiling. Secure tape with Ram-Tack spray adhesive.
 - 1. Enclosure Doors: Four foot minimum width, unless shown otherwise, solid core wood with metal frame and hardware, including closer, tightly weather-stripped to prevent flow of dust. Locate as directed and swing into construction area. Keep enclosures locked outside of working hours. Provide Owner with keys for emergency access.
 - 2. Install floor mats on both sides of construction entrance prior to starting demolition or construction. Keep inside mat damp to help remove dust and minimize tracking into adjacent clean areas, vacuum mats daily. As an alternative, provide tacky-mats and remove old surface daily.
 - 3. Obtain Owner's approval of exact location and details of enclosure construction. Precut materials for enclosure in unoccupied areas. No explosive or pneumatic driven fasteners allowed. Provide entrance vestibules as detailed. Provide carpets inside vestibule and inside enclosures at door to vestibule, and keep vacuumed daily.

- E. Enclosure outside work area (including spaces above furred ceilings): Whenever work is necessary outside of construction enclosures, the space where work is being performed, including ladders, shall be contained within a full height portable enclosure or with use of pre-fabricated units as specified herein.
 - 1. Work performed outside construction enclosure, including work in corridors and lobbies, shall be performed outside of normal working hours and shall be schedule in advance with Owner except where specified otherwise.
 - 2. Storage of construction equipment or material outside the construction enclosure is prohibited.
 - 3. Immediately clean up dust tracked outside the construction area. Contractor shall provide necessary manpower and equipment (HEPA filtered vacuum, dust mops, brooms, buckets and clean wiping rags) to keep adjacent occupied areas clean at all times.
- F. Power and Lighting: Provide sufficient temporary lighting and power ventilating equipment to ensure proper workmanship and safety everywhere.
- G. Access Provisions: Provide ramps, stairs, ladders, and similar temporary access elements as reasonably required to perform the work and facilitate its inspection during installation.
- H. Where work occurs in occupied areas, provide access opening through existing plaster, or gypsum board walls, and acoustical ceilings, and to restore walls and ceilings to original condition after work is complete and to ensure dust control within access areas.
 - 1. Provide temporary plywood panels anchored to existing steel ceiling support grid for support of workers crawling above ceiling. Panel thickness shall suit spans between existing steel support.
- I. Coordinate and phase remodeling work in certain rooms which serve other rooms with the phasing of the remodeled rooms if required, so that at no time are both rooms simultaneously inoperative. Any downtime necessitated by the remodeling work is to be fully discussed and coordinated with the Owner's Representative in advance of the shutdown.
 - 1. Dust: Generation of significant quantities of airborne dust will not be tolerated. Clean the work area prior to starting work as necessary to minimize existing dust which may become airborne during construction. Provide drop cloths and dust partitions as necessary to contain dust and debris generated by the work.
 - 2. Remove demolition material, dust, and dirt in tightly sealed, covered, rubber tired plastic dump carts. Containers shall be fitted with clean polyethylene covers, completely sealed at perimeter by wire tying or taping. Before leaving area, all containers shall be wiped clean to prevent tracking of dust. Place rugs inside barrier entrance, keep them clean or changed daily. Provide debris chutes if allowed.
 - 3. Hot Processes: Welding and flame cutting which generate smoke shall be scheduled with the Owner's fire detection system deactivated.
 - 4. Use portable vinyl tunnel or a polyethylene enclosure for single ceiling accesses. Enclosure opening shall have a 3-foot overlap of plastic to decrease risk of airborne dust.
- J. Portable vinyl tunnel or polyethylene enclosures, if used, shall remain in place until the ceiling is secured (all accesses closed).
 - 1. If access is larger than vinyl tunnel, use a portable polyethylene enclosure also enclosing the ladder. Enclosures opening shall have a 2-foot overlap of plastic to decrease risk of airborne dust.
 - 2. Secure polyethylene enclosures/barriers in place to walls and floor with use of tape. Reinforce seam on ceiling with frame and flat head screws.
 - 3. When accessing pipes, ducts, or other building infrastructure to investigate a condition, use additional procedures including masks, disposable white coveralls, and disposable shoe covers, before going into the access. Afterwards, strip off the additional procedures carefully, turning the coveralls "inside-out," and depositing the mask, coverall, and shoe covers into a plastic trash bag inside the enclosure. Secure (tie-off) plastic trash bag and discard as directed by Owner's Representative. Do not discard within "patient care areas."
 - 4. When Contractor leaves the work site, the access, especially at ceiling, shall either be completely closed or protected by an appropriate barrier.
 - 5. In patient care areas, dismantle the apparatus (tunnel or enclosure) and replace access (ceiling tiles); or complete work of access at the end of each day.
 - 6. Thoroughly clean surfaces which become exposed to dust before leaving the area of construction. Accomplish cleaning by use of either an HEPA-filtered vacuum cleaner.

3.4 ENFORCEMENT AND FINES

- A. Owner will monitor aspergillus count in vicinity of project in Protection Areas. Such areas will be located as indicated on Drawings. Whenever safe levels are exceeded, Contractor will be notified to correct conditions immediately to avoid fine and work stoppage described.
 - 1. All work shall be stopped on the project whenever a hazardous airborne contaminant control deficiency exists in occupied areas.
 - 2. Contractor shall take immediate action to correct all deficiencies.
- B. Process: Failure to maintain containment areas will result in issuance of written warning; if situation is not corrected within 8 hours of receipt of warning, Owner will have cause to stop the work.
 - 1. Failure of Contractor to correct deficiencies in containment will result in corrective action taken by the Owner and deducting all costs from the Contractor.
 - 2. Ceiling Access: Each breach of ceiling access policy will cost violators \$500.00 for each occurrence.
- C. The following will be performed by Owner's Representative:
 - 1. Periodic Rounds: A photograph will be taken to document each violation.
 - 2. Contractor and Department information will be extracted from the ceiling work tag.
 - 3. A record of all violations of required ceiling access procedures will be maintained, whether in occupied area or not.

END OF SECTION 01 57 19

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Administrative and procedural requirements for selection of products for use in Project.
- B. Product delivery, storage, and handling.
- C. Manufacturers' standard warranties on products.
- D. Special warranties.

1.3 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. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process 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 specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

1.5 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.

1.6 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 to determine that products are undamaged and properly protected.
- C. Storage:
 - 1. Store products to allow for inspection and measurement of quantity or counting of units.
 - 2. Store materials in a manner that will not endanger Project structure.
 - 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 - 4. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 - 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 6. Protect stored products from damage and liquids from freezing.
 - 7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 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 warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for 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 with the Specifications, prepare a written document using indicated form properly executed.
 - 3. Refer to Divisions 02 through 49. Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

1.8 PROHIBITION ON INCORPORATION OF HAZARDOUS MATERIALS

- A. Contractor is responsible for ascertaining that materials within the existing facility, which will be disturbed as part of the work, are free of asbestos containing materials and for performing surveys and/or providing certifications attesting regarding this.
- B. Architect and its consultants have not knowingly specified for incorporation into the work, materials or products containing hazardous materials or toxic substances (including asbestos and lead).
- C. Contractor (including its subcontractors, sub-subcontractors, and material suppliers/fabricators under its control) is prohibited from incorporating any material or products into the work containing hazardous materials or toxic substances.
- D. Architect and its consultants are not responsible for the presence of hazardous materials or toxic substances in or around the work, nor the exposure to persons who construct or subsequently occupy the work. The Architect will not provide certifications regarding the presence or absence of such materials or substances.

PART 2 PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged, free of defects, suitable for intended use, and, unless otherwise indicated, are new at time of installation.
1. Equipment installed on this project shall have local representation, local factory authorized service, and a local stock of repair parts.
 2. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 3. 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.
 4. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 5. Where products are accompanied by the term "as selected," Architect will make selection.
 6. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 7. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
1. 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.
 2. 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.
 3. Products:
 - a. Restricted List: 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.
 - b. Non-restricted List: 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. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
 4. Manufacturers:
 - a. Restricted List: 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.
 - b. Non-restricted List: 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. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
 5. 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 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.
 6. Approved Equal Product: It is not the intent of the Drawings and/or Specifications to limit products to any particular manufacturer or to discriminate against an "APPROVED EQUAL" product as produced by another manufacturer. Some proprietary products are mentioned to set a definite standard for acceptance and to serve as a reference in comparison with other products.

- a. When a manufacturer's name appears in these Specifications, it is not to be construed that the manufacturer is unconditionally acceptable as a provider of equipment for this project.
 - b. The successful manufacturer or supplier shall meet all of the provisions of the appropriate specification(s).
 - c. The specified products have been used in preparing the Drawings and Specifications and thus establish minimum qualities with which substitutes must at least equal to be considered acceptable.
 - d. The burden of proof of equality rests with the Contractor.
 - e. The decision of the designer is final.
- C. Visual Matching Specification: Where Specifications require "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 Division 01 Section "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 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.
1. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
 2. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.
 3. "Custom Color as selected by Architect" or "to match color on file in Architect's office", "match Architect's sample" means that the color selected is custom and requires custom formulations and submissions of color to obtain Architect's approval prior to application.
- E. Materials and workmanship shall comply with applicable state and national codes, Specifications, and industry standards.
1. In all cases where Underwriters' Laboratories, Inc. has established standards for a particular type materials, such material shall comply with these standards.
 2. Evidence of compliance shall be the UL "label" or "listing" under Re-Examination Service.
- 2.2 ACCEPTANCE
- A. Acceptance of materials and equipment will be based on manufacturer's published data and will be tentative subject to the submission of complete shop Drawings indicating compliance with the contract documents and that adequate and acceptable clearances for entry, servicing, and maintenance will exist.

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 60 00

SECTION 01 71 23

FIELD ENGINEERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Requirements for coordination and execution of the following:
 - 1. Field engineering services.
 - 2. Land surveying services.

1.3 RELATED REQUIREMENTS

- A. Section 01 33 00 - Submittal Procedures.
- B. Section 01 73 00 - Execution.

1.4 DESCRIPTION OF SERVICES

- A. Specific services listed are in addition to, and do not supersede general Execution and Closeout requirements.
- B. Establishing locations, dimensions, and levels of items of work.
- C. Provision for materials required to establish and maintain benchmarks and control points, including batter boards, grade stakes, structure elevation stakes, and other items.
- D. Provision of facilities and assistance necessary for Design Team to check lines and grade points placed.
- E. Preparation and maintenance of daily reports of activity of the work. Submission of reports containing key progress indicators and job conditions.
 - 1. Number of employees at the Site.
 - 2. Number of employees at the Site for each of Contractor's subcontractors.
 - 3. Breakdown of employees by trade.
 - 4. Major equipment and materials installed as part of the Work.
 - 5. Major construction equipment utilized.
 - 6. Location of areas in which construction was performed.
 - 7. Materials and equipment received.
 - 8. Work performed, including field quality control measures and testing.
 - 9. Weather conditions.
 - 10. Safety.
 - 11. Delays encountered, amount of delay incurred, and the reasons for delay.
 - 12. Instructions received from Architect or Owner, if any.

1.5 REFERENCE STANDARDS

- A. FGDC-STD-007.1 - Geospatial Positioning Accuracy Standards - Part 1: Reporting Methodology
- B. FGDC-STD-007.2 - Geospatial Positioning Accuracy Standards - Part 2: Standards for Geodetic Networks.
- C. FGDC-STD-007.4 - Geospatial Positioning Accuracy Standards - Part 4: Architecture, Engineering, Construction, and Facilities Measurement.

1.6 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00 - Submittal Procedures.
- B. Informational Submittals: Submit following packaged separately from other submittals:
 - 1. Name, address, and telephone number of Surveyor before starting survey work.
 - 2. On request, documentation verifying accuracy of survey work.
- C. Closeout Submittals: Submit following in accordance with Section 01 73 00 - Execution.
 - 1. Project Record Documents:
 - a. Copy of surveyor's log.
 - b. Six copies of final property survey for Owner's records.

1.7 QUALITY ASSURANCE

- A. Employ Land Surveyor registered to perform surveying in the State of Texas, acceptable to Owner and Architect.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 FIELD ENGINEERING

- A. Check and coordinate work for conflicts and interference and immediately advise Architect and Owner of discrepancies.
- B. Cooperate as required with Architect and Owner in observation of work and performance of field inspections.
- C. Review and coordinate work on a regular basis with shop drawings and other submittals.
- D. In general, match existing adjacent grades and maintain existing flow lines.
- E. Check the location, line and grade of every major element as the work progresses. Notify the Owner and Architect when deviations from required lines or grades exceed allowable tolerances. Include in such notifications a thorough explanation of the problem, and a proposed plan and schedule for remedying the deviation. Do not proceed with remedial work without Owner's concurrence of the remediation plan.
- F. Check all formwork, reinforcing, inserts, structural steel, bolts, sleeves, piping, other materials and equipment for compliance with shop drawings and Contract Documents requirements.
- G. Check all bracing and shoring for structural integrity and compliance with designs.

3.2 SURVEY REFERENCE POINTS

- A. Control datum is indicated on Drawings.
 - 1. Survey Control and Reference Points: Verify locations prior to starting Work. Promptly notify Architect of discovered discrepancies.
 - 2. Bench Marks: Establish and maintain minimum of two permanent bench marks on site, referenced to established control points. Record locations with horizontal and vertical data on Project Record Documents.
- B. Benchmarks and Control Points: Protect survey control points prior to starting site work; preserve permanent reference points during construction.
 - 1. Do not change or relocate benchmarks or control points without prior written approval of Architect.
 - 2. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
 - 3. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect. Base replacements on original survey control points.
- C. Existence and location of indicated existing underground utilities and construction are not guaranteed.
 - 1. Before Beginning Sitework:
 - a. Investigate and verify existence, location, and elevations of underground utilities and other construction.
 - b. Verify location and invert elevation at points of connection for sanitary sewer, storm sewer, and water-service piping.
 - 2. Furnish information necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other appurtenances located in or affected by construction.
 - 3. Coordinate with local authorities having jurisdiction.

3.3 SURVEY REQUIREMENTS

- A. Establishing building location and layout on site and first ground floor elevation is responsibility of Contractor. Each Contractor will be responsible for layout, lines, and elevation of their Work based on established datum.
- B. Survey: Work from lines and levels established by property survey.
 - 1. Establish benchmarks and markers to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Calculate and measure required dimensions within indicated or recognized tolerances.
 - 3. Do not scale Drawings to determine dimensions.
 - 4. Advise entities engaged in construction activities of marked lines and levels provided for their use.

- C. Establish elevations, lines, and levels. Locate, lay out, and periodically verify layouts, by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; and utility locations, slopes, and invert elevations;
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations, and ground floor elevations.
 - 4. As construction proceeds, check every major element for line, level, and plumb.
 - D. Surveyor's Log: Maintain and make available for references, surveyor's log of control and other survey work as work progresses. Make this log available for reference.
 - 1. Record deviations from required lines and levels, and advise Architect of deviations exceeding indicated or recognized tolerances.
 - 2. Record deviations on Project Record Drawings that are accepted and not corrected.
 - 3. Prepare certified survey showing dimensions, locations, angles, and elevations of construction and sitework on completion of foundation walls, major site improvements, and other work requiring surveying.
- 3.4 FINAL PROPERTY SURVEY
- A. Prior to Substantial Completion, prepare final property survey illustrating locations, dimensions, angles, and elevations of buildings and site work that have resulted from construction indicating their relationship to permanent bench marks and property lines.
 - 1. Show significant features (real property) for Project.
 - 2. Include certification on survey, signed by surveyor, that principal metes, bounds, lines, levels, and elevations of Project are accurately shown.
 - B. Recording: At Substantial Completion, have final property survey recorded by or with local governing authorities as official "property survey."
- 3.5 SURVEYS FOR MEASUREMENT AND PAYMENT
- A. Perform surveys to determine quantities of unit price work, including control surveys to establish measurement reference lines. Notify Architect prior to starting work.
 - 1. Contractor's Engineer Responsibilities: Sign surveyor's field notes or keep duplicate field, and calculate and certify quantities for payment purposes.
- 3.6 SUPPORT AND BRACING
- A. General Requirements: Design all support and bracing systems, if required. Provide for attachment to portions of the building structure capable of bearing the loads imposed. Design systems to not overstress building structure.

END OF SECTION 01 71 23

SECTION 01 73 00

EXECUTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. General administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Examination.
 - 2. Preparation.
 - 3. Installation.
 - 4. Coordination of Owner-installed products.
 - 5. Progress cleaning.
 - 6. Keying Process
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
 - 9. Correction of the Work.

1.3 DEFINITIONS

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

1.4 WARRANTY

- A. 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 to not void existing warranties.

PART 2 PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
 - 1. For projects requiring compliance with sustainable design and construction practices and procedures, utilize products for patching that comply with requirements of Division 01 Section "Sustainable Design Requirements."
- 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 the Architect for the visual and functional performance of in-place materials.

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.
- 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. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - a. Description of the Work.

- b. List of detrimental conditions, including substrates.
 - c. List of unacceptable installation tolerances.
 - d. Recommended corrections.
2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.
 6. The Contractor shall be responsible for loss or damage to the existing facilities caused by them and their workers, and shall be responsible for repairing or replacing such loss or damage.
 - a. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and in service maintenance of all plumbing, heating, air conditioning, and ventilating services for the new and existing facilities.
 - b. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.
 - c. The Contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.
 - d. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.
 - e. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, all Contractors shall remove and reinstall in locations approved by the Architect/Engineer all devices required for the operation of the various systems installed in the existing construction.
 - 1) This includes but is not limited to temperature controls system devices, electrical switches, relays, fixtures, piping, conduit, etc.
 - f. Outages of services as required by the new installation will be permitted but only at a time approved by the Owner.
 - 1) The Contractor shall allow the Owner two weeks in order to schedule required outages.
 - 2) The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner.
 - 3) All costs of outages, including overtime charges, shall be included in the contract amount.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner 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 caused by differing field conditions outside the control of the Contractor, submit a request for information to Architect according to requirements in Division 01 Section "Project Management and Coordination."

3.3 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Owner will locate and protect survey control and reference points.

- D. Contractor shall locate and protect survey control and reference points.
- E. Control datum for survey is that established by Owner provided survey.
- F. Control datum for survey is that indicated on drawings.
- G. Control datum for survey is _____.
- H. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- I. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- J. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- K. Utilize recognized engineering survey practices.
- L. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
- M. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations; and _____.
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations, ground floor elevations, and _____.
 - 4. Controlling lines and levels required for mechanical and electrical trades.
- N. Periodically verify layouts by same means.
- O. Maintain a complete and accurate log of control and survey work as it progresses.
- P. On completion of foundation walls and major site improvements, prepare a certified survey illustrating dimensions, locations, angles, and elevations of construction and site work.

3.4 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. In addition to compliance with regulatory requirements, conduct construction operations in compliance with NFPA 241, including applicable recommendations in Appendix A.
 - 2. Make vertical work plumb and make horizontal work level.
 - 3. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 4. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
 - 5. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.
- 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 the best possible results. 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.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. 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.
 - 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.

- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 PRECEDENCE OF MATERIALS

- A. Specifications determine the nature and setting of materials and equipment. The drawings establish quantities, dimensions and details.
- B. Installation precedence of materials shall be as follows. Note that if an interference is encountered, this shall guide the contractor in the determination of which trade shall be given the "Right-of-Way".
 - 1. Building lines.
 - 2. Structural Members.
 - 3. Soil and Drain Piping.
 - 4. Vent Piping.
 - 5. Supply, Return, and Outside Air Ductwork.
 - 6. Exhaust Ductwork.
 - 7. HVAC Water and Steam Piping.
 - 8. Condensate Piping.
 - 9. Fire Protection Piping.
 - 10. Natural Gas Piping.
 - 11. Domestic Water (Cold and Hot).
 - 12. Refrigerant Piping.
 - 13. Electrical Conduit.

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 PROGRESS CLEANING

- A. General: 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. Utilize containers intended for holding waste materials of type to be stored.
 - 4. Coordinate progress cleaning for joint-use areas where more than one installer has worked.
- 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 in Finished Areas: 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 Division 01 Section "Temporary Facilities and Controls." Division 01 Section "Construction Waste Management and Disposal."
- 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 assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

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

3.9 KEYING PROCESS

- A. New Buildings and Renovation Projects
 - 1. Receive and install construction cores provided by UTSW PM / UTSW Key Shop. Only UTSW keyway are allowed on campus.
 - a. GC may request multiple systems from UTSW Key Shop.
 - 2. Final Core Installation:
 - a. Ensure all door hardware is ready to accept final cores.
 - 1) Ensure tail pieces are provided to UTSW PM or remain attached to doors.
 - b. Schedule installation by UTSW Key Shop prior to Substantial Completion walk,
 - c. Ensure temporary room signs with room number remain in place if final signage has not been installed.
- B. General Requirements:
 - 1. Projects within leased spaces shall confirm processes per lease requirements.
 - 2. Within construction areas, spaces not required to be secured shall have plastic insert instead of construction cores.
 - 3. Doors provided with pre-installed hardware shall have plastic inserts in lieu of cores.
 - 4. GC is responsible for coordination:
 - a. To ensure all cores have been identified and are accessible to UTSW OSBC and PD.
 - b. To ensure all cores are compatible with UTSW requirements.

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. The Contractor shall at all times take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of the work.
 - 1. Include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the cribbing of any items above the floor of the construction; and the covering of items in the incomplete building

- with tarpaulins or other protective covering; the installation of electric heaters in electrical switchgear and similar equipment to prevent moisture damage.
2. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.
- B. Take particular care not to damage the building structure in performing work.
 1. All finished floors, step treads, and finished surfaces shall be covered to prevent any damage by workers or their tools and equipment during the construction of the building.
 - C. Equipment and materials shall be protected from rust both before and after installation.
 1. Any equipment or materials found in a rusty condition at the time of final inspection must be cleaned of rust and repainted as specified elsewhere in these Specifications.
 - D. Comply with manufacturer's written instructions for temperature and relative humidity.
 - E. Protect installed work from damage by construction operations.
 - F. Provide special protection where specified in individual specification sections.
 - G. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
 - H. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
 - I. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
 - J. Protect work from spilled liquids. If work is exposed to spilled liquids, immediately remove protective coverings, dry out work, and replace protective coverings.
 - K. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
 - L. Prohibit traffic from landscaped areas.
 - M. Remove protective coverings when no longer needed, reuse or recycle coverings if possible.

3.11 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. 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. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 73 00

SECTION 01 73 29
CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Section includes requirements for incidental cutting, fitting, and patching within new construction.

1.3 RELATED REQUIREMENTS

- A. Section 01 50 00 - Temporary Facilities and Controls
- B. Section 01 73 00 - Execution.
- C. Section 01 81 13 - Sustainable Design Requirements for Construction Indoor Air Quality (IAQ) Management (LEED Projects).
- D. Section 07 84 13 - Penetration Firestopping.

1.4 SUBMITTALS

- A. Submit written request to Owner and Architect to perform cutting and patching two weeks in advance of cutting or alteration which affects:
 - 1. Structural value or integrity of any element of Project.
 - 2. Integrity or effectiveness of weather exposed or moisture resistant elements or systems.
 - 3. Efficiency, operation, maintenance, or safety of operational equipment.
 - 4. Visual qualities of elements exposed to view.
 - 5. Penetrations in fire barriers.
 - 6. Work of Owner, Tenant, or separate contractor.
- B. Include in request:
 - 1. Identification of Project.
 - 2. Location and description of affected Work.
 - 3. Description of proposed Work:
 - a. Extent of cutting, fitting, patching, or alteration.
 - b. Listing of applicable trades.
 - c. Proposed products and materials.
 - d. Extent of refinishing.
 - 4. Necessity for cutting or alteration.
 - 5. Alternatives to cutting and patching.
 - 6. Effect on structural integrity of Work.
 - 7. Effect on weatherproof integrity of Work.
 - 8. Effect on fire barrier assemblies.
 - 9. Effect on the building's appearance and significant visual elements.
 - 10. Effect on utilities:
 - a. List utilities affected by cutting and patching.
 - b. List utilities that will be relocated.
 - c. List utilities that will be temporarily out-of-service. Indicate time period of service outage.
 - 11. Effect on work of Owner, Tenant, or separate contractor.
 - 12. Date and time of execution.
- C. Should conditions or schedule require change of products or methods different than original installation, submit written recommendation to Architect explaining conditions necessitating change and requirements of alternative materials or methods.
- D. Approval by Architect to proceed with cutting and patching does not waive Architect's right to later require complete removal and replacement of unsatisfactory work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Primary Products and Materials: Those required for original installation; comply with Specifications for each specific product involved.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Comply with Section 01 73 00 - Execution.
 - 1. After uncovering existing Work, examine conditions affecting installation of products and performance of Work.

3.2 PREPARATION

- A. Provide temporary supports to ensure structural integrity of affected portions of Work.
 - 1. Provide devices and methods to protect other portions of Project from damage.
 - 2. Provide protection from elements for areas which may be exposed by uncovering work; maintain excavations free of water.
- B. Provide materials and control operations to prevent spread of dust in surrounding area. Provide drop cloths or other suitable barriers.
- C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Avoid cutting in service pipes, ducts, or conduit until provisions have been made to bypass them.

3.3 PERFORMANCE

- A. Cutting and Patching: Cut into construction to provide for installation of other Work and subsequent fitting and patching required to restore surface to original condition.
- B. Cut, fit and patch, including excavation and backfill, to complete Work and to:
 - 1. Fit several parts together, to integrate with other work.
 - 2. Uncover portions of work to provide for installation of ill-timed work.
 - 3. Remove and replace defective work.
 - 4. Remove and replace work not conforming to requirements of Contract Documents.
 - 5. Remove samples of installed work as necessary for testing.
 - 6. Provide openings in elements of work for penetrations of plumbing, mechanical, and electrical work.
 - 7. Uncover work to allow for Architect's observation of covered work which has been covered up prior to required observation by Architect.
 - 8. Provide fire barrier construction and applicable repairs that meet partition requirements.
- C. Cutting and Patching: Execute in manner which does not void required or existing warranties.
 - 1. Execute by methods which will prevent damage to other Work and which will produce appropriate surfaces to receive installation of new Work:
 - a. Use hand or small power tools designed for sawing or grinding, not hammering or chopping.
 - b. Cut holes and slots as small as possible, neatly to size required, with minimum disturbance of adjacent surfaces.
 - c. Temporarily cover openings when not in use.
 - d. To avoid marring existing finished surfaces, cut or drill from exposed or finished side into concealed surfaces.
 - e. Cut through concrete and masonry using cutting machine, such as Carborundum saw or diamond-core drill.
 - 2. Execute excavating and backfilling by methods in accordance with applicable Sections of Division 31 which will prevent settlement or damage to Project.
 - 3. Execute fitting and adjustment to produce finished installation complying with specified products, functions, tolerances, and finishes.
- D. Restore surfaces which have been cut, removed, or damaged, to match existing conditions.
- E. Install products and materials to complete Work in accordance with requirements of Contract Documents.
 - 1. Weather Exposed and Moisture Resistant Elements, and Sight Exposed Surfaces: Use installer of the materials to cut and patch the materials.
- F. Cutting and Patching:
 - 1. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval of Architect.

2. Do not cut and patch structural elements in manner that would result in reduction of load carrying capacity or of load deflection ratio.
 3. Do not cut and patch operational elements or safety related components in manner that would result in reduction of their capacity to perform in manner intended, including energy performance, that would result in increased maintenance, decreased operational life, or decreased safety.
- G. Utilities and Penetrations: Fit work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
1. At penetrations of fire-rated assemblies, completely seal with firestops in accordance with Section 07 84 13 - Penetration Firestopping.
 2. Where utilities are to be removed, relocated, or abandoned, by-pass before cutting. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe, duct, or conduit to prevent entrance of moisture or matter after by-passing and cutting.
- H. Restoration: Except where indicated otherwise, restore exposed finishes of patched areas to match existing and where necessary extend finish restoration into retained adjoining surfaces in manner which will eliminate evidence of patching and refinishing. Thoroughly clean surfaces prior to application of paint and other finishes.
1. Where patching occurs in previously painted surface, provide appropriate prime coat followed by first finish coat of paint. Provide final finish coat over entire area containing patch; for continuous surface extend to nearest vertical break or intersection, for an assembly refinish entire unit. Except where indicated otherwise, finish in sheen and color to match existing.
- 3.4 CLEANING
- A. Comply with Section 01 50 00 - Temporary Facilities and Controls. Thoroughly clean areas and spaces affected by Work. Completely remove paint, mortar, oils, putty, and items of similar nature.
 - B. Restore damaged surfaces to their original condition.

END OF SECTION 01 73 29

SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Administrative and procedural requirements for the following:
 1. Salvaging nonhazardous demolition and construction waste.
 2. Recycling nonhazardous demolition and construction waste.
 3. Disposing of nonhazardous demolition and construction waste.

1.3 RELATED REQUIREMENTS:

- A. Section 02 41 00 - Demolition for disposition of waste resulting from partial demolition of buildings, structures, and site improvements.

1.4 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.
- G. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable and reusable material.

1.5 PERFORMANCE REQUIREMENTS

- A. General: Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials.

1.6 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Waste Management 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 waste management including, but not limited to, the following:
 1. Review and discuss waste management plan..
 2. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 3. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 4. Review waste management requirements for each trade.

1.7 WASTE MANAGEMENT PLAN

- A. Waste Management Plan: Before start of construction, prepare construction waste management plan on procedures to collect, segregate, and dispose of construction wastes and debris according to the requirements in this Section.
 1. Identify materials by categories to be recycled and corresponding recycling facilities.

2. Include education and training procedures for construction personnel.
3. Include procedures to enforce conformance to plan.

1.8 PROJECT MEETINGS

- A. Waste management plans and implementation shall be discussed at the following meetings:
1. Pre-demolition meeting
 2. Pre-construction meeting
 3. Regular job-site meetings
 4. Subcontractor toolbox meetings

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Unless provided by Owner, provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
1. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 2. Comply with Section 01 50 00 - Temporary Facilities and Controls for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 3. Store items in a secure area until installation.
 4. Protect items from damage during transport and storage.
 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- C. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
- D. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- E. Plumbing Fixtures: Separate by type and size.
- F. Lighting Fixtures: Separate lamps by type and protect from breakage.
- G. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.

- B. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

3.4 RECYCLING DEMOLITION WASTE

- A. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.
- B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
- C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
 - 1. Clean and stack undamaged, whole masonry units on wood pallets.
- D. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- E. Metals: Separate metals by type.
 - 1. Recycle all metals including but not limited to abandoned AC Equipment, ceiling grid, raised floor struts and stringers, piping, and conduit.
 - 2. Structural Steel: Stack members according to size, type of member, and length.
 - 3. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- F. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- G. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- H. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.
- I. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
 - 1. Store clean, dry carpet and pad in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.
- J. Carpet Tile: Remove debris, trash, and adhesive.
 - 1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.
- K. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- L. Conduit: Reduce conduit to straight lengths and store by type and size.
- M. Ceiling Tiles:
 - 1. All ceiling tile is to be palletized and shrink wrapped for recycling through ceiling tile manufacturer.
 - 2. Contact ceiling tile manufacturer for all requirements for recycling tiles.
 - 3. Ceiling tile is to be weighed and its disposal destination is to be documents by receipt from manufacturer.
- N. Light Bulbs: Fluorescent or LED light bulbs to be recycled and/or disposed of per Owner's direction.

3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 - 2. Polystyrene Packaging: Separate and bag materials.
 - 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 - 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
 - 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
 - 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
- C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
- D. Glass: Recycle all glass debris.
- E. Plastics: Recycle all plastic debris.

3.6 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Hazardous Materials: Observe all applicable codes and requirements for disposing of hazardous materials.
- C. Burning: Do not burn waste materials.
- D. Disposal: Remove waste materials and dispose of at designated spoil areas on Owner's property.

END OF SECTION 01 74 19

SECTION 01 77 00

CLOSEOUT PROCEDURES AND SUBMITTALS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- 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. Project record documents.
 - 5. Operation and maintenance data.
 - 6. Final cleaning.
 - 7. Repair of the Work.

1.3 RELATED REQUIREMENTS:

- A. Section 01 45 00 - Project Quality Control for quality requirements.
- B. Section 01 73 00 - Execution for progress cleaning of Project site.
- C. Section 01 79 00 - Demonstration and Training for requirements for instructing Owner's personnel.
- D. Section 01 91 00 - General Commissioning Requirements for requirements related to closeout and commissioning.
- E. Divisions 03 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.4 SUBMITTALS

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items: Initial submittal at time of request for Substantial Completion Inspection.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
 - 1. Submit digital preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
 - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed digital documents within ten days after acceptance.
 - 3. Submit one digital copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
 - 4. Submit revised final documents in final digital form within 10 days after final inspection.
- B. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- C. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.
- D. Commissioning:

1. Submit documentation showing completion of Commissioning prior to Substantial Completion as required in Section 01 91 00 - General Commissioning Requirements.
 - E. Closeout Manual:
 1. Submit preliminary draft in digital format. Architect and Owner will review.
 2. Submit final documents in final digital form within 10 days after final inspection.
 - F. Certification that all requirements of Section 01 79 00 - Demonstration and Training are fulfilled.
 - G. Certificates of No Asbestos Products Incorporated in Project
 - H. Certificates of Release: From authorities having jurisdiction.
 - I. Certificate of Insurance: For continuing coverage.
 - J. Field Report: For pest control inspection.
- 1.6 MAINTENANCE MATERIAL SUBMITTALS
- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.
- 1.7 OPERATION AND MAINTENANCE DATA
- A. Operation and Maintenance Data for Materials and Finishes: For Each Product, Applied Material, and Finish:
 1. Product data, with catalog number, size, composition, and color and texture designations.
 2. Information for re-ordering custom manufactured products.
 3. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
 4. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
 5. Additional information as specified in individual product specification sections.
 6. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
 - B. Operation and Maintenance Data for Equipment and Systems: For Each Item of Equipment and Each System:
 1. Description of unit or system, and component parts.
 2. Identify function, normal operating characteristics, and limiting conditions.
 3. Include performance curves, with engineering data and tests.
 4. Complete nomenclature and model number of replaceable parts.
 5. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
 6. Include color coded wiring diagrams as installed.
 7. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
 8. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
 - a. Include HVAC outdoor and exhaust air damper calibration strategy.
 - b. Include Carbon Dioxide Monitoring Protocol.
 - c. Include Carbon Monoxide Monitoring Protocol.
 - d. Include Frost Mitigation Strategy for ventilation heat-recovery system.
 9. Provide servicing and lubrication schedule, and list of lubricants required.
 10. Include manufacturer's printed operation and maintenance instructions.
 11. Include sequence of operation by controls manufacturer.
 12. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
 13. Provide control diagrams by controls manufacturer as installed.

14. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
 15. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
 16. Include test and balancing reports.
- C. Assembly of Operation and Maintenance Manuals:
1. Organization: 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:
 - a. Title page.
 - b. Table of contents.
 - c. Manual contents.
 2. 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.
 3. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file with Optical Character Recognition (OCR) for each manual type required.
 - a. 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.
 - b. File Names and Bookmarks: Enable bookmarking of 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.

1.8 PROJECT RECORD DOCUMENTS

- A. As-builts are required to show all changes in the work relative to the original contract documents; and show additional information of value to Owner's records, but not indicated in original contract documents.
 1. As built changes shall be of good drafting quality, performed by a person skilled in drafting and knowledgeable of the conventions of the trades involved.
- B. Maintenance of As-Built Drawings During Construction: During progress of the work, maintain a set of contract drawings along with specifications and shop drawings. Update these drawings weekly, at a minimum, with markup of actual installations, which vary from the work as originally shown.
 1. Mark whatever drawing is most capable of showing actual physical condition, fully and accurately, and reference all other appearances of this work to the sheet, which was updated. Include cross-reference to the official change number on the updated sheet and all additional sheets where the work is shown.
 2. Give particular attention to information on work concealed, which would be difficult to identify or measure and record at a later date.
 3. Note alternative numbers, change order numbers and similar identification for any change.
 4. Maintain and have available for review in conjunction with the regular project meetings, a current set of the as- built drawings and specifications marked with "as constructed" information. Availability for review, and acceptability, of both the format and the content is a prerequisite condition for certification of monthly pay requests by the Owner and Architect.
- C. Supplemental Drawings: Where marked-up shop drawings are intended for inclusion in the record set, mark cross-reference on contract drawings at corresponding location. Use of shop drawings as supplements to the record as-builts is encouraged for all items which require the larger scale employed on the shop drawings in order to show the work in sufficient detail to be of future use to the Owner.
 1. The supplemental document shall be identified as a "Supplementary As-Built Drawing" and shall be numbered with an extension to the contract drawing it supplements in a manner acceptable to the Owner.
- D. Record/Final As-Builts: Immediately before inspection for Certificate of Substantial Completion, submit As-Built Drawings and Specifications to Architect and Owner for review.
 1. Format: Annotated PDF Electronic file with comment function enabled.

2. Following the Architect and Owner's review of the As-Built files, and upon authorization by the Architect based on their belief that the marked-up information is accurate and complete, the Architect shall proceed with preparation of Record Drawings and Specifications.

1.9 SUBSTANTIAL COMPLETION PROCEDURES

- A. "Substantial Completion" is the stage in the progress of Work when Work or designated portion thereof is sufficiently complete in accordance with Contract Documents so Owner can occupy or utilize Work for use which it is intended.
 1. Work will not be considered suitable for Substantial Completion review until all systems and equipment are operational; all designated or required governmental inspections and certifications have been made and posted, designated instruction of Owner's personnel in operation of systems and equipment has been completed, operation and maintenance data has been satisfactorily turned over to the Owner, and all finishes are in place. In general, the only remaining Work shall be minor in nature, such that the Owner could occupy project or designated portion thereof on following day, and completion of Work by Contractor would not materially interfere or hamper Owner's normal business operations.
 2. Contractor shall certify that all remaining Work will be completed within a reasonable time, agreed upon by Owner, following date of Substantial Completion. Failure of the Contractor to complete the Work within the stipulated time shall automatically re-institute the provisions for liquidated damages due Owner as contained elsewhere in Contract Documents, or as provided by law for such period of time as may be required by Contractor to fully complete Work whether Owner has occupied the Project or not.
- B. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's pre-punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
 1. Shall contain the Contractor's comprehensive list of identified incomplete items from their inspections created prior to request for Substantial Completion Inspection.
 2. The list shall contain, at a minimum: item number, location, associated discipline and or specification section, description of item to be addressed, and responsible subcontractor.
 - a. Photos shall include captions clearly identifying the item, location, and pertinent information.
- C. 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.
 - a. Texas Department of State Health Services inspection coordination and preparation.
 - b. Texas Accessibility Standards (TAS) inspection.
 - c. State accessibility standards inspection.
 - d. Accessibility standard inspection for compliance with ANSI A117.1, Americans with Disabilities Act Accessibility Guidelines (ADAAG) and local requirements if more stringent.
 2. Submit closeout submittals including project record documents, operation and maintenance manuals, final completion construction photographic documentation, 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 where applicable.
 - 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 Architect's signature for receipt of submittals.
 5. Submit test/adjust/balance records.
 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

- D. 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. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs and photographic negatives, damage or settlement surveys, property surveys, and similar final record information.
 7. Advise Owner of changeover in heat and other utilities.
 8. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 9. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 10. Complete final cleaning requirements, including touchup painting.
 11. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- E. Substantial Completion Inspection (Punch Walk): Submit a written request for inspection (punch walk) 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 and the Contractor's list of incomplete items, 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. Punch walks requirements include requirements from all project specifications. Ensure that participants are invited for specific topics identified per specification section and respective discipline. One example is a particular representative for door hardware review.
 - a. Punch walks shall include Architect, UTSW PM, and Owner representatives, as appropriate or as indicated within individual specification sections.
 - b. Invitees may include Owner/User, UTSW Facilities Management Teams (Elevator Shop, Key Control, Utilities, Building Envelope Coordinator, Plumbing Shop, Electrical Shop, Landscaping, Facility Manager, Refrigeration, etc.), OSBC, ARC Leadership, Hospital Leadership, Clinical Leadership, and other groups as indicated.
 2. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
 3. Results of completed inspection will form the basis of requirements for final completion.

1.10 PAYMENT PROCEDURES

- A. Required documents for final payment to be released include:
1. Final release of claims and liens.
 2. Affidavit of payment of debt and claims.
 3. Consent of Surety
 4. Completed SWPPP documents and Notice of Termination
 5. Final Historically Underutilized Business Plan.
 6. Completion and Submission: Commissioning, Closeout Submittals, Maintenance Material Submittals, Operation and Maintenance Data, Project Record Documents, and Substantial Completion Procedures.
 7. Warranties and Guarantees.

1.11 REQUIREMENTS FOR FINAL ACCEPTANCE

- A. Prior to requesting Architect and Owner to schedule Final Inspection for Project, complete the following:
1. Submit a final Application for Payment.

2. 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 list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.
5. Submit Final Completion photographic documentation.

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.
 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

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, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, 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 neither planted nor 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. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - j. 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.
 - k. Remove labels that are not permanent.
 - l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
 - p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.

- q. 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 74 19 - Construction Waste Management and Disposal.
- 3.2 REPAIR OF THE WORK
- A. Complete repair and restoration operations 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 to 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.
 - 4. Replace dimmed or burned-out LED array sections, where LED lights are strobing, replace the drivers, replace dimmed or defective bulbs.

END OF SECTION 01 77 00

SECTION 01 79 00

DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

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

1.3 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 digital video recording of live instructional module.
- B. Qualification Data: For facilitator.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Digital 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 Construction Manager.
 - e. Name of Contractor.
 - f. Date of video recording.
 - 2. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. 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 in PDF electronic file format on compact disc.

1.5 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. Pre-instruction 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.

1.6 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. Include multiple sessions for shift training.
- 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 has been reviewed and approved by Architect.

PART 2 PRODUCTS

2.1 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.
 1. HVAC systems, including air-handling equipment, air distribution systems, and terminal equipment and devices.
 2. HVAC instrumentation and controls.
 3. Electrical service and distribution, including transformers, switchboards, panelboards, uninterruptible power supplies and motor controls.
 4. Packaged engine generators, including transfer switches.
 5. Lighting equipment and controls.
 6. Communication systems, including intercommunication, clocks and programming, voice and data equipment
- 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. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. 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.

PART 3 EXECUTION

3.1 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 77 00 - Closeout Procedures and Submittals.
- B. Set up instructional equipment at instruction location.

3.2 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. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 - 2. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 3. 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 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 give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING DIGITAL VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training digital 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. Video: Provide minimum 640 x 480 digital video resolution converted to format file type acceptable to Owner, on electronic media.
 - 1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.
 - 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 upon 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 in digital video format that describes the following for each Contractor involved on the Project, arranged according to Project table of contents:
 - a. Name of Contractor/Installer.
 - b. Business address.
 - c. Business phone number.
 - d. Point of contact.
 - e. E-mail 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. Audio shall be intelligible and clear.
- F. Transcript: Provide a transcript of the narration. Display images and running time captured from digital videot recording opposite the corresponding narration segment.
- G. Pre-produced Video Recordings: Provide digital video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION 01 79 00



DIVISION 02

EXISTING CONDITIONS



SECTION 02 41 00
DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish labor, materials, tools, equipment, and services for Demolition, as indicated, in accordance with provisions of Contract Documents.
- B. Completely coordinate with work of other trades.

1.2 QUALITY ASSURANCE

- A. Conduct work in accordance with OSHA and EPA requirements.
- B. National Fire Protection Association (NFPA):
 - 1. NFPA 241 Standards for Safeguarding Construction, Alteration, and Demolition Operations.
- C. Design, engineering, and construction of shoring, bracing and supports are responsibility of Contractor.
 - 1. Employ a Registered Engineer, licensed to practice structural engineering in state in which project is located.
 - 2. Design to support dead, live, and lateral, wind or seismic loads required by code or as otherwise indicated, along with construction loads during demolition until permanent construction is in place.

1.3 DESCRIPTION

- A. Work Includes:
 - 1. Demolition of portions of structures indicated.
 - 2. Removal of demolition debris.
 - 3. Protection of construction to remain, including:
 - a. Utilities.
 - b. Other items indicated.
 - 4. Salvage of items.
- B. Condition of Existing Structures to be demolished:
 - 1. Owner assumes no responsibility for actual condition of structures to be demolished.
 - 2. Owner will maintain building conditions existing at time of inspection for bidding purposes insofar as practicable.
- C. Standpipes:
 - 1. Maintain in operable condition and available for use by fire department.
 - 2. Do not demolish standpipe more than one floor below floor being demolished.

1.4 JOB CONDITIONS

- A. Perform preliminary investigations to ascertain extent of work.
 - 1. Conditions apparent by investigation shall not be allowed as claim for extra cost.
- B. Obtain and pay for permits required by authorities having jurisdiction and notify interested utilities companies prior to commencement of activities.
- C. Obtain approval of authorities having jurisdiction for work affecting existing means of egress.
 - 1. Review with and obtain approval of authorities for temporary construction which affects such areas.

2. Obtain approval of fire authorities.
- D. Separate, store and dispose of hazardous materials and toxic wastes in accordance with local and EPA regulations and criteria listed below:
 1. Disposal of fluorescent light tubes in open containers is not permitted.
 2. Disposal of ballasts and other building elements containing PCBs in open containers is not permitted.
 3. Disposal of building elements containing mercury in open containers is not permitted.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL DEMOLITION PROCEDURES

- A. Items Designated for Re-use:
 1. Remove, tag, protect from damage, store and deliver to locations designated.
 2. Brace motors attached to flexible mountings until reinstallation.
- B. Existing Utilities to Remain.
 1. Keep in service and protect against damage during demolition.
 2. Do not interrupt existing utilities serving occupied or facilities in use, except as authorized by Owner.
 3. Provide temporary services during interruptions to existing utilities, as acceptable to Owner.
- C. Conduct operations to ensure minimum interference with roads, walks, entrances, exits, and adjacent facilities.
 1. Do not close or obstruct private drives, walks or other facilities unless approved in writing.
 2. Do not close or obstruct exits from existing facilities or obstruct public thoroughfares and walks without approval of authorities having jurisdiction.
 3. Provide alternate routes around closed or obstructed traffic ways.
- D. Provide covered passageways to ensure safe passage of persons in or near areas of work.
- E. Provide barricades and safety lights as required.

3.2 PROTECTION OF FACILITIES TO REMAIN

- A. Protect Property to Remain:
 1. Conduct operations to prevent damage by falling debris or other cause to adjacent buildings, structures, and other facilities as well as persons.
 2. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement or collapse of structures.
- B. Protect occupants from injury and discomfort.
- C. Provide temporary dustproof partitions between demolition areas and occupied areas.
 1. In public areas use clean, painted 1/2 inches thick plywood.
 2. Utilize fire rated construction where required by Authorities Having Jurisdiction.
- D. Provide temporary weather protection and insulation to prevent damage to existing facilities and discomfort to persons in occupied areas.

3.3 ITEMS SALVAGED FOR OWNER

- A. Remove salvage items at appropriate stage of demolition, but early enough to prevent damage to them by demolition operations:
 1. Coordinate with Owner items Owner wishes to save.

- B. Remove salvage items as a unit:
 - 1. Clean, list, and tag for storage.
 - 2. Protect from damage.
 - 3. Salvage each item with auxiliary or associated equipment required for operation.
 - 4. Store in building designated by Owner.

3.4 ITEMS SALVAGED FOR CONTRACTOR

- A. Items of salvage value to Contractor may be removed from structure as work progresses.
- B. Transport salvaged items from site as they are removed.
- C. Storage or sale of removed items not permitted on site.

3.5 CLEAN-UP AND DISPOSAL OF DEMOLITION MATERIALS

- A. Remove debris, rubbish, and materials resulting from demolition operations.
 - 1. Remove and legally dispose of off-site.
 - 2. Do not burn materials on site.
- B. Dispose of items and materials not designated for Owner salvage or reuse.
 - 1. Promptly remove from site.
 - 2. Do not store or sell Contractor salvaged items or materials on site.
- C. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations.
- D. Return adjacent areas to condition existing prior to start of work.

END OF SECTION

SECTION 031000

CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 SUMMARY

- A. Section includes formwork, shoring, reshoring, backshoring, falsework, bracing, and other temporary supports required to form and support all cast-in-place concrete shown on the drawings.
- B. Related Requirements:
 - 1. Specification **014000** “Quality Requirements” for requirements of material testing and inspection.
 - 2. Specification **014529** “Structural Testing and Inspections” for inspection requirements associated with forming and accessories.
 - 3. Specification **018113** “Sustainable Design Requirements” for sustainable design requirements.
 - 4. Specification **032000** “Concrete Reinforcing” for reinforcement associated with cast-in-place concrete.
 - 5. Specification **033000** “Cast-in-Place Concrete” for cast-in-place concrete and related products.

1.3 REFERENCES

- A. Definitions:
 - 1. Backshores: Shores placed snugly under a stripped concrete structural member after the original formwork and shores have been removed from a small area without allowing the structural member to deflect or support its own weight or superimposed construction loads. It is assumed that backshores carry the same load as that carried by the original shores they replace.
 - 2. Formwork: The total system of support for freshly placed concrete, including the mold or sheathing that contacts the concrete and all supporting members, hardware, and necessary bracing.
 - 3. Professional Engineer: A professional engineer who is licensed to practice engineering in the state where the project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for projects with concrete formwork that are similar to that indicated for this Project in material.
 - 4. Reshores: Shores placed snugly under a stripped concrete structural member after the original forms and shores have been removed from the member, thus requiring the member to carry its own weight and superimposed construction loads at the time of installation. Reshores are assumed to carry no load at the time of installation. After the installation of reshores, superimposed construction loads are assumed to be distributed among all members connected by reshores.
 - 5. Shores: Vertical or inclined support members designed to carry the weight of formwork, concrete, and construction loads above.
- B. Reference Standards:

1. Comply with the provision of the following codes, specifications, and standards except where more stringent requirements are shown or specified:
 - a. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
 - b. ACI 301 - Specifications for Structural Concrete.
 - c. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.
 - d. ACI 347R - Guide to Formwork for Concrete; 2014.
 - e. ASME A17.1 - Safety Code for Elevators and Escalators; 2013.
 - f. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
 - g. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
 - h. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
 - i. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2013.
 - j. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2015a.
 - k. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
 - l. PS 1 - Structural Plywood; 2009.
 - m. CRSI, "Manual of Standard Practice."

1.4 RESPONSIBILITY

- A. The design, construction, and safety of all formwork shall be the responsibility of the Contractor. All forms, shores, reshores, backshores, falsework, bracing, and other temporary supports shall be engineered to support all loads imposed including the wet weight of concrete, construction equipment, live loads, lateral loads due to wind and wet concrete imbalance. The Contractor shall also be responsible for determining when temporary supports, shores, reshores, backshores, and other bracing may be safely removed.

1.5 SUBMITTALS

- A. Product Data: Submit technical data and brochures for carton forms.
- B. Shop Drawings:
 1. Formwork Drawings: Formwork drawings, prepared under the supervision and sealed by the formwork design engineer, shall be submitted for Owner's record and shall be reviewed by the Engineer for conformance to structural layout only. Such shop drawings shall indicate all dimensions and types of materials, sizes, lengths, connection details, design allowance for construction loads, anchors, form ties, shores, braces, construction joints, reveals, camber, openings, formwork coatings, and all other pertinent information.
 2. Pan Form Shop Drawings: The Contractor shall submit pan shop drawings for Engineer's review and approval. Approval will be for conformance to structural layout only.
 3. Shoring Plan: Submit drawings to indicate the number of levels of shoring, proposed time and sequence of formwork and shore removal, minimum concrete strength for stripping of forms and shore removal, assumed construction loads, amount and layout of shores (specify whether backshores or reshores), and length of time shores are to be left in place. This plan shall be strictly followed by the Contractor. Shoring plans are to be submitted for Owner's record only and will not be reviewed or returned.
- C. Temporary Structure Design Submittals: Submit the following items for the Owner's records:
 1. Design Calculations: Submit, for record purposes, calculations of all concrete formwork sealed by the formwork design engineer.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Licensed Professionals: The formwork design engineer retained by the Contractor shall be a professional engineer registered in the state where the project is located and shall be experienced in the design of concrete formwork.

PART 2 - PRODUCTS

2.1 PAN FORMS

A. Specification: Unless specified otherwise, concrete joist and pan-formed beam construction shall conform to Manual of Standard Practice, Chapter 10, as published by CRSI.

B. Material and Pan Type:

1. Material: Pans shall be fabricated either of steel that is free of dents, irregularities, sag and rust or of glass-fiber reinforced plastic that is molded under pressure with matched dies. Pan forms allowing warped surfaces, leakage of concrete at joints, and uneven surfaces beyond tolerance levels will not be acceptable.
2. Subject to pan tolerance and the surface finish required by the Surface Finish Class SF-1.1 as shown on the drawings, pan forms may be either new pans or reconditioned pans at Contractor's option. Forms may be "long forms", "flange forms", "long flange forms", or "adjustable forms" at Contractor's option. Pan splices may be lapped, reinforced butt jointed, or semi-butt jointed (using end caps welded back-to-back with 2" maximum distance between pan ends).
3. Subject to pan tolerance and the surface finish required by the Surface Finish Class SF-1.0 as shown on the drawings, pan forms may be either new pans or reconditioned pans at Contractor's option. Forms may be "long forms", "flange forms", "long flange forms", or "adjustable forms" at Contractor's option. Pan splices may be lapped, reinforced butt jointed, or semi-butt jointed (using end caps welded back-to-back with 2" maximum distance between pan ends).
4. New Pans: Subject to pan tolerance and the surface finish required by the Surface Finish Class SF-1.1 as shown on the drawings, pan forms shall be new pans only. Forms may be "long forms", "flange forms", or "long flange forms" at Contractor's option. Pan splices may be reinforced butt jointed, or semi-butt jointed (using end caps welded back-to-back with 2" maximum distance between pan ends).
5. New Pans: All pan forms used in areas designated to have Surface Finish-2.3 shall be new pans either one piece continuous from beam to beam or beam to header ("long forms", "long flange forms", or "adjustable forms") without splices or with reinforced butt joint spliced. "Flange forms" are not acceptable, nor will forms be permitted that are lapped spliced or semi-butt joint spliced (using end caps welded back-to-back). Pans shall meet tolerances and the surface finish required for Surface Finish Class 2.3.
6. New Pans. All pan forms used in areas designated to have Surface Finish-3.3 shall be new pans either one piece continuous from beam to beam or beam to header ("long forms", "long flange forms", or "adjustable forms") without splices or reinforced butt joint spliced. "Flange forms" are not acceptable, nor will forms be permitted that are lapped spliced or semi-butt joint spliced (using end caps welded back-to-back). Pans shall meet tolerances and the surface finish required for Surface Finish Class 3.3.
The pan form surfaces specified herein are intended to be architecturally exposed to view and require a high quality surface finish.

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Unless otherwise specified, formwork for exposed concrete surfaces as defined by the Surface Finish Class noted on the drawings, shall consist of plywood, metal, metal framed plywood, or other acceptable surface. Formwork shall provide a continuous straight and smooth surface conforming to the joint system as specified on the Architect's drawings. Form material shall have sufficient thickness to withstand pressure of concrete without bow or deflection. Plywood shall be exterior grade plywood panels, suitable for concrete forms, complying with U.S. Product Standard PS-1, each piece bearing a legible inspection trademark, and as follows:
1. **[Phenolic Surface Film Overlay over Hardwood Face, Class 1 or better.]**
 2. **[High Density Overlay (100/30 min. rating) on Hardwood Face, Class 1 or better.]**
 3. **[High Density Overlay (100/30 min. rating) on Softwood Face, Class 1 or better.]**
 4. **[Medium Density Overlay on Hardwood Face, Class 1 or better, mill-release agent treated and edge sealed.]**
 5. **[Medium Density Overlay on Softwood Face, Class 1 or better, mill-release agent treated and edge sealed.]**
 6. **[Structural 1, B-B, or better, mill oiled and edged sealed.]**
 7. **["B-B (Concrete Form) Plywood", Class 1, or better, mill-oiled and edge sealed.]**
- B. Non-specific formed concrete: Unless otherwise specified, the default finish for formed surfaces shall be rough-form finish constructed with plywood, lumber, metal, or other acceptable material. Lumber shall be dressed on at least two edges and one side for tight fit. The minimum grade shall be B-C, exterior grade.
- C. Textured-form finished concrete: For exposed surfaces as noted on the drawings provide units of form face design, size, arrangement and configuration that matches Architect's control sample. Provide solid backing and form supports to ensure stability of textured form liners. See Architect's drawings, specifications and control sample for special form textured finish concrete.

2.3 CYLINDRICAL COLUMNS AND SUPPORTS

- A. Round section members shall be formed with metal, fiberglass, reinforced plastic, paper, or fiber tubes, unless otherwise specified. Paper or fiber tubes shall be constructed of laminated plies using water-resistant adhesive with wax impregnated exterior for weather and moisture protection. Units shall have sufficient wall thickness to resist loads imposed by wet concrete without detrimental deformation.

2.4 CARTON FORMS

- A. Carton forms shall be manufactured using corrugated paper material with a moisture resistant exterior surface and specifically designed for foundation support. Carton forms shall be designed to support the wet weight of the concrete that is shown by the details to be poured on top of the form, but the weight assumed shall not be less than 600 pounds per square foot. Refer to the General Notes for the restriction on horizontal construction joints. The forms shall be designed in such a way that the bottom of the form will collapse when acted upon by upward movement of the soil.
1. Form Configuration: Carton forms shall be of a vertical cellular configuration only, except as permitted by Paragraph 2 below and shall be rectangular as shown on the details. The depth of the carton forms is shown on the details. Forms shall be manufactured to fit snugly against round piers and shall be baffled in such a way as to prevent concrete from flowing back into the form during the concrete pour.
 2. Other types of forms using different types of paper and different configurations will be accepted if it can be shown by independent tests that the form will properly function and will deteriorate due to moisture in an appropriate period.
 3. Products: Subject to requirements, acceptable manufacturers include, but are not limited to, the following:

- a. SureVoid Products, Inc.

2.5 PRECAST CONCRETE RETAINERS

- A. Retainers shall be used with voids or carton forms where shown on the drawings.
- B. Retainers shall have a minimum compressive strength of 2,500 PSI and be reinforced with 6x6xW1.4xW1.4 welded wire reinforcement and minimum thickness of 1 5/8".

2.6 SOIL RETAINERS

- A. Soil retainers shall be provided where specified and shown on the drawings to prevent migration of backfill under suspended foundation elements.
- B. Retainers shall be composed of high density polyethylene materials that are not adversely affected by moisture. They must be flexible, impact resistant and have sufficient strength to resist lateral loads applied by soil.
- C. Soil retainers shall extend 3 inches above the void forms and a minimum of 3 inches below the void forms. To allow for construction tolerances, the height of the soil retainer material ordered shall be at least 10 inches greater than the specified void depth. Soil retainers shall not be attached to concrete. Waler ties shall be twisted off to allow soil retainers to rise the specified void depth.
- D. Use 3/8" thickness for void spaces 8" and less. Use 1/2" thickness for void spaces greater than 8" but less than 12". Use 3/4" thickness for void spaces equal to 12". Soil retainers shall be equal to the following:
 - 1. BackFill Retainer by SureVoid
- E. For void spaces greater than 12" but less than or equal to 16", retainers shall be ribbed and made from high density polyethylene. Soil retainers shall be equal to the following:
 - 1. Motzblock by M&M Construction specialties
 - 2. SureRetainer by VoidForm Products

2.7 FORMWORK COATINGS

- A. Formwork coatings shall be of a commercial formulation that will not bond with, stain, nor adversely affect concrete surfaces or impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede curing with water or curing compounds. Provide a product that has a maximum VOC (Volatile Organic Compounds) of 50 g/l but not greater than that permitted by the local government agency having jurisdiction in the area where the project is located.
- B. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Dayton Superior; Clean Strip J1EF.
 - 2. Dayton Superior; Farm Fresh XL.
 - 3. W.R. Meadows; Duogard II.

2.8 NAILS AND FASTENERS

- A. Use only galvanized nails and fasteners for securing formwork in structures exposed to weather or unconditioned spaces such as garages, canopies, and porte-cocheres.

2.9 FORM TIES

- A. Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to minimize spalling of concrete on removal.
 - 1. Exposed Surfaces: For surfaces designated with Surface Finish Class SF-2.x or SF-3.x, furnish units that will leave no portion of the tie closer than 3/4 inch to the plane of the concrete surface and that will leave holes not larger than one inch in diameter in concrete surface when the ends or end-fasteners have been removed.
 - 2. Dampproofed Surfaces: Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.
 - 3. Exposed to Weather or Unconditioned Space: Provide removable, glass-fiber-reinforced plastic, stainless steel, or galvanized form ties that will leave no corrodible metal closer than 1 1/2 inches in surfaces that will be exposed to weather or in an unconditioned space in the final structure. The ties shall leave holes no larger than one inch in diameter in concrete surfaces when the ends or end-fasteners are removed.

2.10 CHAMFER STRIPS

- A. Provide wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

PART 3 - EXECUTION

3.1 FABRICATION AND CONSTRUCTION

- A. Design, erect, support, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic construction loads that might be applied until the concrete structure can support such loads.
 - 1. The formwork design engineer shall design the concrete formwork, formwork removal, shoring, reshoring, and backshoring.
- B. Construct forms to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages, inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of concrete mortar.
- C. Carton Forms:
 - 1. Carton forms shall be kept dry and protected until concrete is poured. Wet, compressed, or deteriorated carton forms shall not be used. Do not wrap or cover carton forms with polyethylene sheets or permanent waterproof cover as that will prevent proper deterioration of the forms.
 - 2. The Contractor shall use expandable foam to fill all gaps and holes between carton forms and at intersections with foundations.
 - 3. For slab conditions, cover carton forms with a 1/4 inch masonite protection cover board to prevent puncture and other damage during construction.
- D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
- E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

- F. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and patch forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.
- G. Chamfer exposed corners and edges as indicated, using specified chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- H. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.
- I. Pan Form Fabrication and Construction:
 - 1. Factory fabricate pan form units to specified sizes and shapes as indicated on the drawings. Units shall be designed for easy removal without damaging placed concrete. Units shall be shored properly and adjoining pan units shall be blocked if required to prevent lateral or vertical deflection of formwork during concrete placement.
 - 2. Load Distribution Ribs: Provide load distribution ribs at least 5" wide for all pans 30" wide and narrower and elsewhere where indicated on the drawings. Minimum rib spacing shall be:
 - a. None in spans less than 20 feet.
 - b. One near the center of spans 20 to 30 feet.
 - c. Two near the third points of spans over 30 feet.

Discontinue ribs between two adjacent joists or beams that have differences in span larger than 33%, between a joist and an adjacent parallel wall, and between a joist and an adjacent parallel beam that is 1 ½ or more times wider than the joist.

3.2 CLEANING AND TIGHTENING

- A. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and all other debris just prior to concrete placement. Retighten forms and bracing prior to concrete placement as required to prevent concrete mortar leaks and maintain proper alignment.

3.3 CLEANING AND RE-USE OF FORMS

- A. Forms reused in the work shall be repaired and cleaned. Split, frayed, delaminated, or otherwise damaged facing material will not be acceptable for exposed surfaces. Forms intended for successive concrete placement shall have surfaces cleaned, fins and laitance removed, and joints tightened to avoid surface offsets. New form coating compound shall be applied to reused forms. Thin form-coating compounds only with thinning agent of type, and in amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.4 TOLERANCES

- A. Unless specified otherwise, all tolerances for concrete formwork shall conform to ACI Standard 117, "Standard Tolerances for Concrete Construction and Materials". Before concrete placement the Contractor shall check lines and levels of erected formwork and make any corrections and adjustments as required to ensure proper size and location of concrete members and stability of forming systems. During concrete placement the Contractor shall check formwork and supports to ensure that forms have not displaced and that completed work will be within specified tolerances.

- B. Construct forms so as to limit the offset between adjacent pieces of formwork facing material in accordance with the surface tolerance class as defined in ACI 117 corresponding to the Surface Finish Class noted on the drawings. The offset limits shall apply to both abrupt and gradual variations in the surface.
- C. Pan Construction Surface Tolerance: Discontinuities in the concrete surface formed by pan construction shall be limited to the values noted in the surface tolerance classes of ACI 117 corresponding to the Surface Finish Classes noted on the drawings.
- D. Prior to each concrete pour, the Contractor shall engage a qualified surveyor to verify that work is within specified tolerances. The surveyor shall report in writing to the Architect, Engineer and Contractor certifying that the work is acceptable or indicating any deviations from allowable tolerances.
- E. The Owner shall hire an independent qualified surveyor to verify the proper form, line, position, and elevation of the finished concrete work. The results of each survey shall be sent to the Owner, Architect/Engineer, and Contractor and shall identify any deviation from specified tolerances. All work not in conformance with specified tolerances shall be removed at the Contractor's sole expense if so specified by the Owner.

3.5 SHORES AND SUPPORTS

- A. Comply with requirements of ACI 301 for shoring, reshoring and backshoring in concrete construction and as herein specified where more stringent.
- B. Design: Shores and reshores or backshores must be designed to carry all loads transmitted to them. A rational analysis should be used to determine the number of floors to be shored, reshored, or backshored, subject to the minimums stated in the following paragraph, and to determine the loads transmitted to the floors, shores and reshores or backshores as a result of the construction sequence. The analysis should consider, but should not necessarily be limited to, the following:
 1. Structural design load of the slab or member including live load, partition loads, and other loads for which the engineer designed the slab. The live load reduction method for the design of certain members is shown on the structural drawings. The reduced live load and an allowance for construction loads shall be taken into consideration when performing the analysis.
 2. Dead load weight of the concrete and formwork.
 3. Construction live loads, such as placing crews and equipment or stored materials.
 4. Design strength of concrete specified.
 5. Cycle time between placement of successive floors.
 6. Strength of concrete at time it is required to support shoring loads from above.
 7. The distribution of loads between floors, shores, and reshores or backshores at the time of placing concrete, stripping formwork, and removal of reshoring or backshoring.
 8. Span of slab or structural member between permanent supports.
 9. Type of formwork systems, i.e., span of horizontal formwork components, individual shore loads, etc.
 10. Minimum age of concrete where appropriate.
 11. Alignment of shores: Where possible, shores for any floor shall be placed directly above previously placed shores so that load will be transferred directly to such shores. Where shores are not vertically aligned, calculations shall include verification that the structure can support the reaction.

3.6 REMOVAL OF FORMS AND SUPPORTS

- A. Determination by Contractor's Registered Engineer: The Contractor's registered professional engineer shall determine and submit for Owner's record the time and sequence of formwork and shore removal subject to the criteria as specified below. The submittal shall clearly distinguish between reshoring and backshoring procedures.
- B. Determining in situ Strength of Concrete: The General Contractor shall be responsible for making and curing concrete cylinders, cured under field conditions, for the purpose of determining concrete strength at time of form and shore removal. Such cylinders shall be made by the Contractor and tested by his testing laboratory.

Alternatively, the in situ strength of concrete may be determined by the Maturity Method following the requirements of ASTM C 1074. An acceptable system for this method is the "intelliRock" system manufactured and supplied by EngiUS Constructive Intelligence of Stillwater, OK.

- C. Records of Weather Conditions: The Contractor shall be responsible for keeping records of weather conditions to be used in the decision on when to remove forms.
- D. Formwork Not Supporting Concrete: Formwork not supporting concrete, such as sides of beams, walls, columns and similar parts of the structure, may be removed after cumulatively (not necessarily consecutively) curing at not less than 50°F for 12 hours after placing concrete, provided the concrete is sufficiently hard so as not to be damaged by form removal operations and provided curing and protection operations are maintained. If ambient air temperatures remain below 50°F, if retarding agents are used, or if Type II and Type V Portland cement is used, then this specified minimum period shall be increased as required to safely remove the forms without damage to the concrete. Where such forms also support formwork for slab or beam soffits, the removal times of the latter shall govern.
- E. Formwork Supporting Weight of Concrete: Formwork supporting weight of concrete such as beam soffits, joists, slabs and other structural elements shall not be removed until concrete has attained at least the following percentages of the design compressive strength:
 - 1. Joists, Beam Bottoms: 70%, but not less than 2,800 psi.
 - 2. Slabs: 70%, but not less than 2,800 psi.
- F. Placing Reshores and Backshores:
 - 1. All shoring operations shall be carried out in accordance with a planned sequence as determined by the Contractor's shoring engineer.
 - 2. Shoring operations shall be performed so that at no time will areas of new construction be required to support combined dead and construction loads in excess of the available strength as determined by the design loads (as specified in the General Notes) and the developed concrete strength (as determined by field cured cylinders or maturity method) at the time of stripping and reshoring or backshoring.
 - 3. Shores (backshores or reshores) shall not be removed until the structural member supported has sufficient strength to support all applied loads.
 - 4. For backshoring operations, the forms shall be removed in such a manner that individual structural members are not allowed to deflect and carry load.
 - 5. Reshoring operations require that the structural members be strong enough to safely support their own weight before stripping of formwork.
 - 6. For reshoring operations, no structural member shall be overstressed under its own dead weight plus the weight of the floors above and construction loads assigned to the structural member by a rational analysis that accounts for the relative stiffness of each floor with due consideration of concrete age and strength. While reshoring is underway, no construction loads shall be permitted on the new construction unless it can safely support the construction loads.
 - 7. Where possible, shores shall be located in the same position on each floor so that they will be continuous in their support from floor to floor.
- G. Post-Tensioned Construction: Formwork supporting post-tensioned floor construction, including shores, reshores and backshores shall be designed to support any additional loads produced by the stressing operation. Design of the formwork shall take into account the possibility of the slab, beam, or girder lifting off the formwork during tensioning, thereby transferring the entire load to the support areas. Construct the formwork to permit movement of the member without damage during application of the post-tensioning force. Removal of formwork supporting post-tensioned construction shall be coordinated with the post-tensioning operations and formwork shall not be removed until the concrete has been stressed fully.

3.7 FIELD QUALITY CONTROL

- A. Field Inspection: Refer to Specification **014529 "Structural Testing and Inspections"** for inspection requirements associated with forming and accessories.

END OF SECTION 031000

SECTION 032000

CONCRETE REINFORCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 SUMMARY

- A. Section includes labor, materials, hardware, equipment, transportation and services required to fabricate and place all reinforcement for cast-in-place concrete including bars, welded wire reinforcement, ties and supports shown on the drawings and as specified. Prestressing reinforcement is specified in Post-Tensioned Concrete and/or Precast Concrete sections of the specifications.
- B. Related Requirements:
 - 1. Specification **014000** "Quality Requirements" for requirements of material testing and inspection.
 - 2. Specification **014529** "Structural Testing and Inspections" for testing and inspection requirements associated with concrete reinforcing.
 - 3. Specification **018113** "Sustainable Design Requirements" for sustainable design requirements.
 - 4. Specification **031000** "Concrete Forming and Accessories" for forming associated with cast-in-place concrete.
 - 5. Specification **033000** "Cast-in-Place Concrete" for cast-in-place concrete and related products.

1.3 REFERENCES

- A. Reference Standards:
 - 1. Comply with all provisions of the following codes, specifications, and standards except where more stringent requirements are shown or specified:
 - a. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 - b. ACI 301, "Specifications for Structural Concrete for Buildings."
 - c. ANSI/AWS D1.4, "Structural Welding Code – Reinforcing Steel."
 - d. CRSI, "Manual of Standard Practice."

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Quality Control: The Contractor is responsible for quality control, including workmanship and materials furnished by subcontractors and suppliers.
 - 2. Document Conflict and Precedence: In case of conflict among documents, including architectural and structural drawings and specifications, notify the Architect/Engineer prior to submitting proposal. In case of conflict between and/or among the structural drawings and specifications, the strictest interpretation shall govern, unless specified otherwise in writing by the Architect/Engineer.

- B. Preinstallation Meetings: The Reinforcing-Placing subcontractor shall attend the Pre-Concrete Conference conducted by the Concrete Contractor as described in Specification **033000** "Cast-in-Place Concrete."

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's product data with application and installation instructions for proprietary materials and items including mechanical splices, hooked anchorage systems, large-headed stud punching shear reinforcement, dowel bar replacement systems, and dowel bar sleeves. For fiber reinforcement, submit manufacturer's product data, including application rate and mixing instructions.
- B. Shop Drawings:
 - 1. Submit shop drawings for all reinforcing steel and related accessories for the Engineer's approval. Shop drawings shall show arrangement and layout, bending and assembly diagrams, bar schedules, stirrup spacing, splicing and laps of bars and shall be prepared in accordance with CRSI Standards.
 - 2. Submit shop drawings indicating which members will use fusion welding process for assembly. Shop drawings shall show complete structural details indicating the size of stirrups, the size of holding wires, and welding requirements.
- C. Certificates:
 - 1. Submit, for record, mill certificates and/or test results signed by Producer, for all reinforcement.
 - 2. Provide certification from fiber reinforcement manufacturer that fiber reinforcement complies with specified requirements.
- D. Test and Evaluation Reports:
 - 1. Submit International Code Council (ICC) Evaluation Service Reports indicating approval from ICC Evaluation Service, Inc. for mechanical splices, hooked anchorage systems, large-headed stud punching shear reinforcement and dowel bar replacement systems.
 - 2. Submit test results for deformed bar material not identifiable as outlined in Part 2 below.
- E. Special Procedure Submittals: Submit shop welding program for fusion welding including the type of the specific fusion welding machine and the quality control/inspection protocol for the shop welding.
- F. Qualification Statements: Submit welding certificates.

1.6 QUALITY ASSURANCE

- A. Testing Laboratory Requirements: The Owner's Testing Laboratory shall:
 - 1. Review the Welding Procedure Specification (WPS) submitted by the Contractor for any reinforcing steel other than ASTM A 706 that is proposed to be welded for consistency with acceptable welding practices and AWS.
 - 2. Review the welder qualifications by certification or verify by retesting and shall obtain the welder certificates.
- B. Welder Qualifications: Qualify procedures and personnel according to ANSI/AWS D1.4.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel Reinforcement:

1. Reinforcing materials shall be delivered from the mill in bundles that are identified as to heat number and manufacturer and accompanied with mill and analysis test reports and an affidavit from the supplier stating that the material conforms to the requirements of the governing ASTM specification listed herein.
2. Use reinforcing steel made from 90% recycled material, two-thirds of which shall be post-consumer material. A minimum of 50% of the material in the reinforcement must have been extracted, harvested, or recovered as well as manufactured, within 500 miles of the project site.
3. Deformed bar material that is not identifiable according to the criteria listed above shall be tested for tensile strength and bend tests according to ASTM A 615 on a sample of two bars for each ten tons or fraction thereof of unidentified material for each bar size. The bars shall be a minimum of 24 inches long. Bend tests are not required for #14 and #18 bars. Submit the results of such tests for record.
4. Reinforcing Bars: Reinforcing bars shall conform to ASTM A 615, Grade 60 or Grade 80 as noted on the drawings.
5. Reinforcing Bars: Reinforcing bars used as longitudinal reinforcing in Seismic Special Moment Frames, Special Structural Walls, Coupling Beams, and as noted on the drawings shall conform to ASTM A 706, Grade 60. As an alternate, ASTM A 615 Grade 60 reinforcement is permitted to be used such that it complies with the additional following requirements:
 - a. The actual yield strength based on mill tests shall not exceed the nominal yield strength F_y by more than 18,000 PSI.
 - b. The ratio of the actual tensile strength to the actual yield strength is not less than 1.25.
6. Reinforcing Steel: Reinforcing steel used as transverse reinforcing or as spiral reinforcing as noted on the drawings shall conform to ASTM A 1035.
7. Weldable Reinforcing Bars: All reinforcing bars noted on the drawings as being required to be welded shall conform to ASTM A 706, Grade 60.
8. Deformed Bar Anchors: 3/8" to 5/8" diameter AWS Type C studs manufactured in conformance with ASTM A 1064 with a minimum yield strength of 70,000 psi and a tensile strength of 80,000 PSI. 3/4" or larger diameter, ASTM A 706 bars of equal size with welds to steel substrate that develop the full strength of the anchor. ASTM A 615 reinforcing bars may not be substituted for deformed bar anchors. Reinforcement shall be approved by the ICC-Evaluation Service, Inc and shall have the Evaluation Service Report submitted for Engineer review. The following are acceptable products, provided that their Evaluation Service Reports are still valid at the time of intended use on the project:
 - a. Nelson Stud Welding, Inc.; Nelson D2L Deformed Bar Anchor Studs (ESR-2907).
 - b. Tru-Weld Division, TFP Corporation; Deformed Bar Anchors (ESR-2823).
9. Galvanized Reinforcing Steel: Provide galvanized reinforcing bars at the locations indicated on the drawings. Galvanized reinforcing bars shall conform to ASTM A 767 Class II (2.0 ounces zinc per square foot), hot dipped galvanized after fabrication and bending. Bars that are to be galvanized shall conform to the type of steel required for the given situation as noted on the drawings.
10. Epoxy-Coated Reinforcing Steel: Provide epoxy coated reinforcing bars at the locations indicated on the drawings. Epoxy coated reinforcing bars shall conform to ASTM A 775. Bars that are to be epoxy coated shall conform to the type of steel required for the given situation as noted on the drawings.
11. Epoxy-Coated Fabricated Reinforcing Steel: Provide reinforcing bars that are epoxy-coated after fabrication at the locations indicated on the drawings. Reinforcing bars that are epoxy-coated after fabrication shall conform to ASTM A 934. Bars that are to be epoxy-coated shall conform to the type of steel required for the given situation as noted on the drawings.
12. Plain Steel Welded Wire Reinforcement: ASTM A 1064 with a yield strength of 65,000 PSI. Provide in flat sheets only.

13. Deformed-Steel Welded Wire Reinforcement: ASTM A 1064 with a yield strength of 70,000 PSI. Provide in flat sheets only.
14. Galvanized Plain-Steel Welded Wire Reinforcement: ASTM A 1064, fabricated from galvanized steel wire into flat sheets.
15. Epoxy Coated Plain-Steel Welded Wire Reinforcement: ASTM A 884, Class A, plain steel.
16. Epoxy Coated Deformed-Steel Welded Wire Reinforcement: ASTM A 884, Class A, deformed steel.
17. Strands: Uncoated seven wire, one half inch diameter, stress relieved 270 KSI strand low relaxation type, ASTM A 416 and "Specification for Unbonded Single Strand Tendons" as published by the Post-Tensioning Institute.
18. Prestressing Bars: All prestressing bars shall be deformed threadbars conforming to ASTM A 722 with a minimum ultimate tensile strength of 150 KSI and other properties as specified on page 15-31 of the PCI Design Handbook, Seventh Edition. Threadbars, plate anchorages and couplings shall be furnished by Dywidag Systems International or Williams unless approved otherwise in writing by the Engineer.
19. Wire: Smooth wire for spiral reinforcement shall conform to ASTM A 82 with a minimum yield strength of 70,000 PSI.
20. Epoxy-Coated Plain-Steel Wire: ASTM A 884, Class A, plain-steel wire.
21. Headed Steel Stud Punching Shear Reinforcement: Punching shear reinforcement using headed studs welded to flat bars shall be manufactured in conformance with ASTM A 1044 **<and approved by the ICC Evaluation Service, Inc. as expressed in an ICC Evaluation Report for use as punching shear reinforcement for slabs and footings designed in accordance with ACI 421.1>**. The following are acceptable products for the studs and for the assemblies:

a. Studs:

- 1) Nelson Stud Welding Inc.; Nelson Punching Shear Resistor Studs (ESR-1170).
- 2) Tru-Weld Division, TFP Corporation; Tru-Weld Punching Shear Resistor Studs (ESR-2822).

b. Assemblies:

- 1) Dayton Superior Corporation; Dayton Shear Resistance System (ESR-2696).
- 2) Decon, Inc.; Decon Studrails (ESR-2494).
- 3) Dywidag Systems International USA, Inc.; Dywidag Shear System (ESR-2534).
- 4) Jobsite Stud Welding, Inc.; Jobsite Stud Welding Punching Shear Resistor Shear Rail Assemblies (ESR-3264).
- 5) SRL Industries LTD.; SRL Punching Shear Resistor Shear Rails (ESR-2938).
- 6) Suncoast Post-Tension, LTD.; Suncoast Stud Reinforcement System (ESR-2708).
- 7) Tendon Systems, LLC; Shearails.

B. Fiber Reinforcement:

1. Synthetic Micro Fiber Reinforcement: Collated, fibrillated, or monofilament polypropylene, cellulose, or multi-filament nylon fibers conforming to ASTM C 1116, Type III or Type IV. Reinforcement shall be approved by the ICC-Evaluation Service, Inc and shall have the Evaluation Service Report submitted for Engineer review. The following are acceptable products, provided that their Evaluation Service Reports are still valid at the time of intended use on the project:
 - a. The Euclid Chemical Company; Fiberstrand Series.
 - b. Forta Corporation; Econo-Mono or Econo-Net (ESR-2720).
 - c. Propex Concrete Systems Corp.; Fibermesh 300 (ESR-1165).
 - d. W.R. Grace & Company; Grace Microfibers (ESR-1506).
 - e. Nycon, Inc.; Nycon RC.
 - f. Buckeye Technologies; UltraFiber 500 (ESR-1032).
 - g. BASF Construction Chemicals; MasterFiber M or F series.
 - h. Maccaferri; Fibromac.
2. Synthetic Macro Fiber Reinforcement: Monofilament polypropylene/polyethylene fibers conforming to ASTM C 1116, Type III having an aspect ratio between 50 and 90 and a minimum tensile strength of 90 KSI. The fiber lengths shall be between 1.5 and 2 inches long. Reinforcement shall be

approved by the ICC-Evaluation Service, Inc. and shall have the Evaluation Service Report submitted for Engineer review. The following are acceptable products, provided that their Evaluation Service Reports are still valid at the time of intended use on the project:

- a. The Euclid Chemical Company; Tuf-Strand SF.
 - b. Forta Corp.; Forta-Ferro.
 - c. W.R. Grace; Strux 90/40.
 - d. Propex Concrete Systems, Corp.; Fibermesh 650.
 - e. Bekaert Corp.; Synmix.
 - f. BASF Construction Chemicals; MasterFiber MAC.
3. Steel Fibers: Provide deformed cold-drawn wire or modified cold-drawn steel fibers meeting the requirements of ASTM A 820, Types I or V, and that are listed as an acceptable product for use in the D900 series of UL Fire Rating Assemblies. The fibers shall have a minimum tensile strength of 145,000 PSI when tested in accordance with ASTM A 370. The fibers shall have a minimum aspect ratio of 50 and maximum aspect ratio of 100. Acceptable products include:
- a. Bekaert Corp; Dramix 3D 65/60 BG (Type 1), or Dramix 3D 80/60 BG (Type 1).
 - b. Propex Concrete Systems, Corp.; Novocon 1050 (Type I), Novocon 1050 HE (Type I), or Novomesh 850 (Type I).
 - c. BASF Construction Chemicals; MasterFiber FF or FS series.
 - d. Maccaferri; Wirand series.

2.2 SPLICES

- A. End Bearing Compression Splices: Members with end bearing compression splices shall have vertical bars saw cut or otherwise finished for true bearing. Bar ends shall terminate in flat surfaces within 1 1/2 degrees of a right angle to the axis of the bars and shall be fitted within three degrees of full bearing after assembly. Splice bars shall be held in concentric contact by a suitable device. The following are acceptable end bearing compression devices:
1. nVent Electric, plc.; Speed Sleeve.
 2. Other Engineer-approved product.
- B. Mechanical Tension Splices:
1. Mechanical splices shall conform to Type 2 splices.
 - a. Type 1 splice shall develop, in tension and compression, 1.25 times the specified yield strength of the splice bar.
 - b. Type 2 splice shall meet the requirements of Type 1 splice and, in addition, develop the full tensile strength of the splice bar.
 2. Splices shall be approved by the ICC-Evaluation Service, Inc and shall have the Evaluation Service Report submitted for Engineer review.
 3. The bar ends that are to attach to the splice shall be prepared and installed in accordance with the manufacturer's requirements.
 4. The following are acceptable mechanical tension splices (splices qualified for use with grade 80 bars are parenthetically noted), provided that their Evaluation Service Reports are still valid at the time of intended use on the project:
 - a. BarSplice Products, Inc.; BPI-Grip XL System (ESR-2299). (Type 1 or Type 2)
 - b. BarSplice Products, Inc.; Taper Threaded Grip-Twist System (ESR-2299). (Type 1 or Type 2)
 - c. BarSplice Products, Inc.; Position Taper Threaded Grip-Twist System (ESR-2299). (Type 1 or Type 2)
 - d. Headed Reinforcement Corporation; HRC 500/510 Xtender Mechanical Coupler System (ESR-2764). (Type 1 or Type 2)

- e. Dayton Superior Corporation; DBDI Reinforcing Bar Mechanical Splice System (ESR-2649). (Type 1 or Type 2).
 - f. Dayton Superior Corporation; Bar-Lock Coupler Systems for Splicing Reinforcement Bars, S-Series (ESR-2495). (Type 1)
 - g. Dayton Superior Corporation; Bar-Lock Coupler Systems for Splicing Reinforcement Bars, L-Series (ESR-2495). (Type 1 or Type 2)
 - h. Dayton Superior Corporation; Taperlok Reinforcing Bar Mechanical Splice Couplers (ESR-2481). (Type 1 or Type 2)
 - i. Dextra Manufacturing Co., Ltd.; Bartec Mechanical Splice System for Steel Reinforcing Bars in Concrete (ESR-1705). (Type 1 or Type 2)
 - a. nVent Electric, plc.; Lenton Standard Coupler (IAPMO-UES 0129). (Type 1 or Type 2)
 - b. nVent Electric, plc.; Lenton Ultimate Standard Coupler (IAPMO-UES 0129). (Type 1 or Type 2)
 - c. nVent Electric, plc.; Lenton Ultimate Position Coupler (IAPMO-UES 0129). (Type 1 or Type 2)
 - d. BarSplice Products, Inc.; ZAP Screwlok (qualified for use with grade 80 bars) (ER-5461). (Type 1 and Type 2)
 - e. Splice Sleeve North America; NMB Splice-Sleeve (ER-5645). (Type 1 or Type 2).
- C. Dowel Bar Replacement: All grade 60 reinforcing steel dowel bars shown on the drawings crossing concrete construction joint surfaces with inserts cast flush against the form and having reinforcing bars connected to the insert in a subsequent concrete pour shall conform to the following:
- 1. Splice connection to the insert shall develop the 1.25 times the specified yield strength and the full tensile strength of the spliced bar.
 - 2. Splices shall be approved by the ICC Evaluation Service, Inc. as expressed in an ICC Evaluation Service Report which shall be submitted for review.
 - 3. The following are acceptable products (for use only with grade 60 bars), provided that their Evaluation Service Reports are still valid at the time of intended use on the project:
 - a. Dextra Manufacturing Co., Ltd.; Bartec Mechanical Splice System for Steel Reinforcing Bars in Concrete (ESR-1705).
 - b. nVent Electric, plc.; Lenton Form Saver SA (IAPMO-UES 0129).
- D. Hooked Anchorage Replacement: Reinforcing bar terminations shall be manufactured out of ASTM A 576, ASTM A 615, or A 706 material and shall develop the full tensile strength of the bar when installed at the manufacturer's recommended depth.
- 1. The anchorage shall be approved by the ICC Evaluation Service Inc. as expressed in an ICC Evaluation Service Report which shall be submitted for review.
 - 2. The following are acceptable products (for use only with grade 60 bars), provided that their Evaluation Service Reports are still valid at the time of intended use on the project:
 - a. Dextra Manufacturing Co., Ltd; Bartec Mechanical Anchorages for Steel Reinforcing Bars in Concrete (ESR-2166).
 - b. Headed Reinforcement Corporation; HRC 555 Headed Reinforcing Bars (ESR-2935).
 - c. Headed Reinforcement Corporation; HRC 670 HeadLock (IAPMO-UES 0177).
 - d. nVent Electric plc.; Lenton Terminator (IAPMO-UES 0188).
 - e. nVent Electric plc.; Lenton Ultimate (IAPMO-UES 0188)

2.3 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: Smooth bars used to dowel across slab-on-grade construction joints shall conform to ASTM A 615, Grade 40 or ASTM A 36, plain-steel bars. Cut bars true to length with ends square and free of burrs.
- B. Epoxy-Coated Joint Dowel Bars: Smooth epoxy-coated bars used to dowel across slab-on-grade construction joints shall conform to ASTM A 775 with ASTM A 615, Grade 40 or ASTM A 36 plain-steel bars. Cut bars true to length with ends square and free of burrs.

- C. Dowel Bar Sleeves: Plastic or gage metal (26 gauge minimum) sleeves with an inside diameter of 1/16 inch greater than the dowel bar that it encases, that have the strength, durability, and design to provide free movement of the dowel relative to the concrete slab and that are specifically manufactured for this purpose.
- D. Alternate Slab-on-Grade Joint Load Transfer Systems: A system that consists of flat, ASTM A 36 plate that is saw cut into a square or rectangular shape and is embedded into or encased by a plastic sleeve that allows movement in both lateral directions but not in the vertical direction. Acceptable systems are manufactured by PNA Construction Technologies with products known by the names "Diamond Dowel System" and "PD³ Basket" and Greenstreak Group Inc. with products known as "Speed Plate" and "Double-Tapered Basket".
- E. Tie Wire: Tie wire shall be annealed steel tie wire, minimum 16 gauge.
 - a. Tie wire in architecturally exposed concrete shall be plastic coated or stainless steel.
 - b. Tie wire for epoxy-coated reinforcement shall be epoxy-coated.
 - c. Tie wire for galvanized reinforcement shall be galvanized.
- F. Holding Wire: Holding wire shall conform to ASTM A 82 or ASTM A 1064.
- G. Coating Repair Materials: Repair damaged areas of epoxy-coated or galvanized reinforcement using the following products.
 - 1. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating compatible with epoxy coating on reinforcement and complying with ASTM A 775.
 - 2. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc shall be used to repair damaged areas of galvanized reinforcement.
- H. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Use wire bar type supports complying with CRSI recommendations.
 - 1. Slabs-on-Grade: Use precast concrete bar supports (dobies) or supports with sand plates or horizontal runners designed for use on ground.
 - 2. Spread Footing Bottom Reinforcement: Use precast concrete bar supports (dobies) or chairs designed for soil-supported slabs.
 - 3. Mat Foundation: Use precast concrete bar supports (dobies), chairs designed for soil-supported slabs, or cast-in-place concrete curbs.
 - 4. Exposed to View Concrete: Provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).
 - 5. Support of Epoxy-Coated Reinforcement: Provide epoxy-coated or other dielectric-polymer-coated wire bar supports to support epoxy-coated reinforcement.
 - 6. Support of Galvanized Reinforcement: Provide galvanized wire bar supports to support galvanized reinforcement.

2.4 ALTERNATES:

- 1. Products Requiring International Code Council (ICC) Evaluation Service Reports:
 - a. For those products listed in Part 2 as requiring Evaluation Service Reports (ESRs), alternate products that do not have ESRs will be considered by the Engineer only if valid research reports or test data from an independent and approved agency is provided and use of the product receives prior approval from the Building Official.

PART 3 - EXECUTION

3.1 FABRICATION AND DELIVERY

- A. Bending and Forming: Fabricate bars of indicated sizes and accurately form to shapes and lengths indicated and required, by methods not injurious to materials. Do not heat reinforcement for bending. Bars shall be free from injurious defects, have a workman-like finish with no excessive rust and/or pitting, and have no unusual kinks or bends.
- B. Marking and Shipping: Bundle reinforcement and tag in accordance with Section 7.4.5 of the CRSI "Manual of Standard Practice." Transport and store at site so as not to damage material. Keep sufficient supply of tested, approved, and proper reinforcement at the site to avoid delays. Maintain reinforcing bars free of mud, dirt, grease, or other coating.
- C. Repair of Epoxy-Coated Reinforcing: Repair cut and damaged epoxy coatings on fabricated reinforcing before delivery with epoxy repair coating according to ASTM D 3963

3.2 PLACING REINFORCEMENT

- A. Comply with CRSI recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports and as herein specified.
- B. Before placing reinforcement and again before concrete is placed, clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
- C. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by chairs, runners, bolsters, spacers, and hangers as required. Exercise particular care to maintain proper distance and clearance between parallel bars and between bars and forms. Provide spreaders and spacers to hold steel in position. Support steel at proper height upon approved chairs.
- D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set tie wires so ends are directed into concrete, not toward exposed concrete surfaces.
- E. Support of Column and Wall Reinforcing Steel:
 - 1. It is the responsibility of the contractor to ensure that all reinforcing assemblies have adequate strength and stability to resist loads imposed during construction.
- F. Support of Spread Footing Reinforcing Steel:
 - 1. Bottom Steel: Support bottom reinforcing mat to provide the specified clearance to the bars. Spacing between supports shall not exceed 4'-0" centers each way.
 - 2. Top Steel: Support top reinforcing on steel angle frames braced in both directions or on special standee support bars. Spacing between supports shall not exceed 4'-0" centers each way. The depth of the supports shall provide the specified clearance from the bars to the top of the concrete. The design of the support steel shall be the responsibility of the Contractor.
- G. Support of Mat Foundation Reinforcing Steel:
 - 1. Bottom Steel: Support bottom reinforcing mat to provide the specified clearance to the bars. Spacing between supports shall not exceed 4'-0" centers each way.
 - 2. Top Steel: Support top reinforcing on steel angle frames braced in both directions or on special standee support bars. Spacing between supports shall not exceed 4'-0" centers each way. The depth

of the supports shall provide the specified clearance from the bars to the top of the concrete. The design of the support steel shall be the responsibility of the Contractor.

- H. Install welded wire reinforcement in as long lengths as practicable. Provide lap splice for wires of adjoining pieces per ACI 318 Chapter 25.5.3 or 25.5.4 and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.
- I. Coordinate with other trades and expedite materials and labor to avoid omissions and delay.
- J. Install waterproof membrane or vapor retarder as specified prior to placing steel for concrete slabs-on-grade.
- K. Extend reinforcement continuous through construction joints unless otherwise shown on the drawings.
- L. Slab-on-Grade Joint Dowel Bars: Support slab-on-grade joint dowel bars independently of support for slab reinforcement on soil supported slab bolsters or specially manufactured cradles such that dowel bar remains parallel to slab surface and at right angles to joint during concreting operations. Lightly coat the exposed end of the dowel with a paraffin-base lubricant, asphalt emulsion, form oil, or grease or use a dowel bar sleeve.
- M. Alternate Slab-on-Grade Joint Load Transfer Systems: Install the alternate load transfer system in accordance with the manufacturer's instructions such that the largest plane of the flat plate is parallel to the plane of the subgrade on which the slab is bearing.
- N. Provide and place additional reinforcing steel at all sleeves and openings in beams, slabs, and walls as specified on the drawings. Where sleeves or openings not shown on the drawings interrupt the reinforcement, consult with Engineer for instructions for placing and splicing of bars. Provide required additional reinforcing steel at no additional cost to the Owner.
- O. Epoxy-Coated Reinforcement: Use epoxy-coated steel tie wires to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963.
- P. Galvanized Reinforcement: Use galvanized steel tie wires to fasten galvanized reinforcement. Repair cut and damaged zinc coatings with zinc repair material.
- Q. Do not bend reinforcement that is embedded partially in concrete except in locations noted on the drawings or approved by the Engineer.

3.3 SPLICING REINFORCING STEEL

- A. Provide splices as indicated on the drawings. Splice reinforcing bars only at locations shown on the structural drawings and approved shop drawings. Unauthorized or unscheduled splices not approved by the Engineer in writing will not be accepted.
- B. All lap splices in reinforcing steel shall be contact lap splices unless detailed otherwise on the drawings.
- C. Maintain proper cover and spacing between reinforcing bars at splices.
- D. Lap unscheduled reinforcing bars not otherwise specified with a Class B lap splice. Lap welded wire reinforcement per ACI 318 Chapter 25.5.3 or 25.5.4.
- E. Reinforcing Steel Placement in Mat Foundations:
 - 1. Size, length, spacing, and location of all mat reinforcing steel is shown on the mat plans and details. See details on the drawings for required stagger pattern of top and bottom bar splices and for sequence of placing mat reinforcing steel layers.

2. The number of splices shall be minimized by using bar runs of 60'-0" as much as possible. Unless noted otherwise, continuous top reinforcing bars shall be spliced along column centerlines. Continuous bottom reinforcing bars shall be spliced mid-way between columns.
 3. Provide Class B tension lap splices for all bars #11 and smaller. Stagger splices as shown in the typical details.
 4. Avoid splices of #14 and #18 bars where possible. Where required, a mechanical tension splice as specified shall be provided. No more than 50% of such bars shall be spliced in any 5'-0" width of mat cross-section. Spliced bars shall be staggered with un-spliced bars.
- F. Manufacturer of mechanical tension splice shall be present for first day's installation.

3.4 WELDING REINFORCING STEEL

- A. Welding reinforcing steel is permitted only where specifically shown on the drawings. All welding shall conform to AWS D1.4. Only weldable reinforcing steel conforming to ASTM A 706 or deformed bar anchors conforming to ASTM A 1064 shall be permitted. ASTM A 615 bars may not be welded for structural use.
- B. Tack welding of reinforcement shall not be permitted.
- C. Fusion welding of preassembled cages shall be permitted only under the following conditions:
 1. Written approval is received from the Building Official and the Engineer.
 2. Fusion welding of holding wires to ties, stirrups, and hoops in beams, columns and grade beams to preassemble reinforcing cages is permissible. The holding wire area shall not exceed five percent of the beam, column, or grade beam cross sectional longitudinal steel area. Fusion welding is not allowed to longitudinal reinforcing steel in any beam, column, or grade beam.
 3. Fusion welding of holding wires to the ends of the reinforcing steel placed in spread footings or mats is permitted if the fusion weld occurs within six bar diameters of the free end of the bar. Fusion welding is not allowed at the end of coupled, T-headed, or weld spliced bars.
 4. Fusion welding of holding wires shall not occur on a bent portion of a reinforcing bar. Bars shall not be bent where a fusion weld occurs.

3.5 SHRINKAGE AND TEMPERATURE REINFORCEMENT

- A. Provide shrinkage and temperature reinforcement as indicated on the drawings at right angles to main top and bottom bars for all structural slabs unless detailed otherwise on the drawings.

3.6 PLACEMENT OF WELDED WIRE REINFORCEMENT

- A. Wherever welded wire reinforcement is specified as reinforcement in pan-formed beams or slabs, it shall be continuous and properly lapped per ACI 318 Chapter 25.5.3 or 25.5.4 across the entire concrete surface and not interrupted by beam or girders.

3.7 REINFORCEMENT IN JOIST DISTRIBUTION RIBS

- A. Provide reinforcement in ribs, minimum one - #5 continuous top and bottom unless indicated otherwise on the drawings.

3.8 REINFORCEMENT IN COMPOSITE STEEL DECK SLAB

- A. Composite steel deck slabs shall be reinforced as indicated on the drawings.
- B. Extra Reinforcement over Girders: Provide additional reinforcing steel over interior girders as shown on the drawings.

- C. Placement of Slab Reinforcement: Provide bolsters, high chairs, and/or additional reinforcing as shown in details on the drawings to support the reinforcing with the clear cover shown on the drawings.
- D. Fiber-Reinforced Concrete in Composite Steel Deck Slabs:
 - 1. Provide fibers of the type and at the dosage rate shown on the drawings in concrete cast over composite steel deck.
 - 2. The fiber-reinforced concrete shall be produced in accordance with ASTM C 1116 and have a residual strength of 80 PSI when tested in accordance with ASTM C 1399.

3.9 REINFORCEMENT AROUND OPENINGS IN COMPOSITE STEEL DECK SLABS

- A. For all openings in steel deck not framed with structural steel and greater than 10" in width in either direction, provide additional reinforcing steel as shown in details on the drawings.

3.10 REINFORCEMENT IN PAN-FORMED BEAM SLABS

- A. Reinforcement: Provide reinforcing in pan-formed beam slabs as shown on the drawings.
- B. Placement of Slab Reinforcement: Provide required bar supports and additional reinforcing as shown in details on the drawings to support slab reinforcing with the clear cover shown on the drawings.

3.11 REINFORCEMENT IN GRADE BEAMS

- A. Provide reinforcing in grade beams as shown on the drawings.
- B. Bar Support for Grade Beam Cages: Grade beam bottom steel shall be supported at 5'-0" maximum centers using beam bolsters that provide bottom cover to the reinforcing steel as noted on the drawings. Beam bolsters used shall be designed and manufactured for support on soil.

3.12 REINFORCEMENT IN TOPPING SLABS

- A. Provide welded smooth wire reinforcement minimum 6 x 6 W1.4 x W1.4 in all topping slabs unless specified otherwise on the drawings.
- B. Provide reinforcing in topping slabs as shown on the drawings.

3.13 REINFORCEMENT IN HOUSEKEEPING PADS

- A. Provide welded smooth wire reinforcement 6 x 6 W2.9 x W2.9 minimum in all housekeeping pads supporting mechanical equipment unless detailed otherwise on the drawings.
- B. Provide reinforcing in housekeeping pads as shown on the drawings.

3.14 MECHANICAL AND PLUMBING REQUIREMENTS

- A. Refer to Mechanical and Plumbing Drawings for concrete requiring reinforcing steel. Such reinforcement shall be furnished as part of the work of this section.

3.15 FIELD QUALITY CONTROL

- A. Field Testing and Inspection: Refer to Specification **014529 “Structural Testing and Inspections”** for testing and inspection requirements associated with concrete reinforcing.p

END OF SECTION 032000

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division **01** Specification sections, apply to work of this section.

1.2 SUMMARY

- A. Section includes all labor, materials, services, equipment, and hardware required in conjunction with or related to the forming, delivery, and pouring of all cast-in-place concrete work. Concrete paving and walks are specified in Division **32**. Architectural Concrete, Precast Concrete and Post-Tensioned Concrete are specified in other Division **03** sections.
- B. Related Requirements:
1. Specification **014000** "Regulatory Requirements" for requirements of material testing and inspection.
 2. Specification **014529** "Structural Testing and Inspections" for inspection requirements associated with cast-in-place concrete.
 3. Specification **031000** "Concrete Forming and Accessories" for forming associated with cast-in-place concrete.
 4. Specification **032000** "Concrete Reinforcing" for reinforcement for cast-in-place concrete.

REFERENCES

C. Reference Standards:

1. Codes and Standards: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified:
 - a. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 - b. ACI 301, "Specifications for Structural Concrete for Buildings."
 - c. ACI 305.1, "Specification for Hot Weather Concreting."
 - d. ACI 318, "Building Code Requirements for Structural Concrete."
 - e. CRSI, "Manual of Standard Practice."

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Quality Control: The Contractor is responsible for quality control, including workmanship and materials furnished by subcontractors and suppliers.
2. Document Conflict and Precedence: In case of conflict among documents, including architectural and structural drawings and specifications, notify the Architect/Engineer prior to submitting proposal. In case of conflict between and/or among the structural drawings and specifications, the strictest interpretation shall govern, unless specified otherwise in writing by the Architect/Engineer.
3. Materials and installed work may require testing and retesting, as directed by the governing building code or the Architect/Engineer, at any time during progress of work.
 - a. The Contractor shall provide adequate notification to the Owner's Testing Agency of construction operations including the project schedule to allow the Testing Agency to schedule inspections. Failure to notify sufficiently may result in additional costs incurred by the Testing Laboratory that may be back-charged to the Contractor by the Owner.
 - b. The Contractor shall cooperate with laboratory personnel, provide access to the work, and provide access to manufacturer's operations.
 - c. The Contractor shall make adequate arrangement with the Owner's Testing Agency for inspection of material stockpiles and facilities.
 - d. The Contractor shall provide to the laboratory certificates and representative samples of materials proposed for use in the work in quantities sufficient for accurate testing as specified.
 - e. The Contractor shall furnish casual labor, equipment, and facilities as required for sampling and testing by the laboratory and otherwise facilitate the required inspections and tests.
 - f. Inspection or testing by the Owner does not relieve the Contractor of his responsibility to perform the Work in accordance with the Contract Documents. Tests not specifically indicated to be done at the Owner's expense, including retesting of rejected materials and installed work, shall be done at the Contractor's expense. See **Structural Testing and Inspections** section of the Specifications.

4. Responsibility for Selection and Use of Concrete Admixtures and Chemical Treatments: The Contractor shall be responsible for selecting admixtures and surface treatments that are compatible with the intended use of the concrete including all final surface treatments called for within this or other specifications or on the structural or architectural drawings. The Contractor is responsible for following the manufacturer's instructions for the use of their product including abiding by any limitations placed by the manufacturer on the use of any of its products.

B. Preinstallation Meetings:

1. Design Mixture Conference: At least 30 days prior to submittal of design concrete mixtures, the Contractor shall hold a meeting or telephone conference to review the detailed requirements for preparing the design concrete mixtures. Participants shall include representatives from the Contractor, Owner's Testing Laboratory, Concrete Supplier, Architect, and Engineer.
2. Pre-Concrete Conference:
 - a. At least seven days prior to beginning concrete work, the Contractor shall conduct a meeting to review the proposed design mixtures and to discuss required methods and procedures to produce concrete construction of the required quality. Also, review requirements for submittals, status of coordinating work and availability of materials. Establish work progress schedule and procedures for materials inspection, testing, and certifications. The contractor shall send a pre-concrete conference agenda to all attendees seven days prior to the scheduled date of the conference.
 - b. The Contractor shall require responsible representatives of every party who is concerned with the concrete work to attend the conference, including but not limited to the following:
 - 1) Contractor's Superintendent.
 - 2) Laboratory responsible for the concrete design mix.
 - 3) Laboratory responsible for field quality control.
 - 4) Concrete Subcontractor.
 - 5) Ready-Mix Concrete Producer.
 - 6) Admixture Supplier.
 - 7) Concrete Pumping Contractor.
 - 8) Fiber Reinforcement Representative.
 - 9) Owner's and Architect's/Engineer's Representative.
 - c. Minutes of the meeting shall be recorded, typed and printed by the Contractor and distributed by him to all parties concerned within five days of the meeting. One copy of the minutes shall be transmitted to the following for information purposes:
 - 1) Owner's Representative.
 - 2) Architect.
 - 3) Engineer-of-Record.
 - d. The Engineer shall be present at the conference. The Contractor shall notify the Engineer at least seven days prior to the scheduled date of the conference.

C. Sequencing:

1. Provide for installation of inserts, hangers, metal ties, anchors, bolts, angle guards, dowels, thimbles, slots, nailing strips, blocking, grounds, and other fastening devices required for attachment of work. Properly locate in cooperation with other trades and secure in position before concrete is poured. Do not install sleeves in any concrete slabs, beams, or columns except where shown on the drawings or upon written approval of the Architect/Engineer.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data with application and installation instructions for proprietary materials and items, including admixtures, patching compounds, epoxies, grouts, waterstops, joint systems, curing compounds, dry-shake finish materials, hardeners, sealers, joint fillers, and others as requested by Architect/Engineer.

B. Shop Drawings:

1. Construction Joints: Submit drawings of proposed construction joint locations in concrete for slab-on-grade, mat foundations, structural floors, roofs and walls. Submit any additional or changed reinforcing that is required at construction joints that differs from that shown on the drawings.
2. Openings, Sleeves, and Cores: Submit drawings of all openings to be formed, sleeved, cored, or sawcut in cast-in-place elements. Drawings shall indicate size and location of openings, sleeves, or cores.
3. Penetrations: Submit drawings locating all horizontal and vertical penetrations in beams and joists. Drawings shall indicate location, size, orientation, and type of penetrations.

4. Embedded Items: Submit drawings showing all items to be embedded in concrete elements, including plates, angles, bolts, and any non-structural items, such as conduit. Drawings shall indicate location, size, orientation, and type of embedded item.
 - C. Samples: Submit samples of materials specified if requested by Architect/Engineer, including names, sources, and descriptions.
 - D. Certificates:
 1. Material and Mill Certificates:
 - a. Provide material and mill certificates as specified herein and in the Testing Laboratory section of the Specifications. The Manufacturer and Contractor shall sign the material and mill certificates certifying that each material item complies with specified requirements.
 - b. Provide certification from admixture manufacturers that chloride ion content complies with specified requirements.
 - E. Design Mixtures: Submit for each concrete mixture as specified herein.
 - F. Field Quality Control Submittals:
 1. Surveys: Submit report certifying that all anchor rods and reinforcing dowels into columns above are in their proper location prior to placing of concrete.
 - G. Qualification Statements: Submit certifications for adhesive anchor installers.
 - H. Minutes of Preinstallation Meetings: Submit for review.
- 1.5 QUALITY ASSURANCE
- A. Qualifications:
 1. Concrete Supplier: The concrete supplier shall have a minimum of five years of experience in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment. The supplier must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.
 2. Concrete Contractor: The concrete contractor shall have a minimum of five years of experience with installation of 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 service performance.
 3. Adhesive Anchor Installers: The individuals performing the installation of adhesive anchors that are horizontally or upwardly inclined shall be certified in accordance with the ACI/CRSI Adhesive Anchor Installer Certification program.
 - B. Survey for Anchor Rods and Reinforcing Steel Dowels: The Contractor shall use a qualified professional engineer or land surveyor to lay out the proper location of all embedded anchor rods and reinforcing steel dowels for columns above before they are encased in concrete. The surveyed locations of such elements shall be submitted to the Architect/Engineer for record, if requested.
 - C. Manufacturer Representative Presence:
 1. Post-installed anchors: The manufacturer's representative for each post-installed anchor product (adhesive, expansion, undercut, screw, or insert anchor) shall be present during the first day's installation of the product to provide instruction for the correct installation of each type of any to be installed in accordance with the manufacturer's recommendation and the current ICC-ES Evaluation Report.
 - D. Mockups: Provide mock-ups as required.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

- A. Refer to the drawings for classes and strengths of concrete required.
- B. Hydraulic Cement:
 1. Use ASTM C 150, Type I or Type III, or ASTM C 1157, Type GU or HE unless otherwise specified. Do not use Type III cement in slabs-on-grade unless approved in advance by the Engineer.
 2. Concrete Exposed to Sulfates in Soil or Water:
 - a. Exposure Class S1: For concrete designated on the drawings as Exposure Class S1, use ASTM C 150, Type II or ASTM C 1157, Type MS.
 - b. Exposure Class S2: For concrete designated on the drawings as Exposure Class S2, use ASTM C 150, Type V or ASTM C 1157, Type HS.
 - c. Alternate Cement Types for Exposure Classes S1 and S2: ASTM C 150, Type I or III cement may be used for concrete designated as Exposure Class S1 or S2 if the tricalcium aluminate (C₃A) content is less than eight percent for Exposure Class S1 or five percent for Exposure Class S2. ASTM C 150, Type I or III cement may be used for exposure to seawater if the tricalcium aluminate content does not exceed 10 percent and the water/cementitious material ratio of the concrete mix does not exceed 0.40.

- d. Exposure Class S3: For concrete designated on the drawings as Exposure Class S3, use ASTM C 150, Type V plus pozzolan or slag or ASTM C 1157, Type HS plus pozzolan or slag or ASTM C 595, Type IP (HS) or Type IS (HS). The amount of pozzolan or slag added or in a blended mix shall be such that has been determined by service record to improve sulfate resistance when used with Type V cement or the amount that when tested according to ASTM C 1012 meets the criteria of Table 4.5.1 in ACI 318-08.
- 3. Use one brand of cement, for each class of concrete, throughout the project, unless approved otherwise by the Architect/Engineer and the Owner's Testing Laboratory. Submit mill certificates certifying conformance to this specification for each brand and type of cement.
- 4. Testing of cement in lieu of mill certificate submittal will be required if:
 - a. The cement has been in storage at the mixing site for over 30 days.
 - b. It is suspected by the Owner, Architect, Engineer, or Owner's Testing Laboratory that the cement has been damaged in storage or in transit or is in any way defective.
- C. Low-alkali cement: Cement that has the additional requirement that equivalent alkalis ($\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$) do not exceed 0.60% according to ASTM C 150-00, Table 2.
- D. Fly Ash: ASTM C 618, Class C or F.
- E. Silica Fume: ASTM C 1240, Amorphous Silica.
- F. Slag Cement: ASTM C 989, Grade 100 or 120 or ASTM C 595, Type IS or Type S.
- G. Normalweight Aggregates: ASTM C 33, and as herein specified. Submit material certificates from aggregate supplier or test results from an independent testing agency certifying conformance to this specification for each source of aggregate.
 - 1. For concrete identified on the drawings as exposed to Exposure Classes C1 and C2, submit certification that aggregate does not contain any deleterious materials that react with alkalis in the concrete mix to cause excessive expansion of the concrete for concrete that is exposed to wetting, has extended exposure to humid atmosphere, or is in contact with moist ground unless low-alkali cement is used.
- H. Lightweight Aggregates: ASTM C 330. Submit material certificates from aggregate supplier or test results from an independent testing agency certifying conformance to this specification for each source of aggregate.
- I. Water: Comply with the requirements of ASTM C 1602.

2.2 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
 - 1. Subject to compliance with requirements, provide one of the following products and manufacturers:
 - a. W.R. Grace & Co.; Darex or Daravair series.
 - b. BASF Admixtures, Inc.; MB-VR, MB-AE90, or Micro-Air.
 - c. Sika Corporation; Sika AER.
 - d. The Euclid Chemical Company; Air Mix or AEA-92.
 - e. The Euclid Chemical Company; Eucon Air 30 or Eucon Air 40.
 - 2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used.
- B. Water-Reducing Admixture: ASTM C 494, Type A. See maximum permissible chloride ion content in concrete specified below.
 - 1. Subject to compliance with requirements, provide one of the following products and manufacturers:
 - a. BASF Construction Chemicals; Pozzolith series or Glenium 7000.
 - b. Sika Chemical Corp.; Plastocrete 161.
 - c. The Euclid Chemical Company; Eucon WR-75 or WR-91.
 - d. W.R. Grade & Co.; WRDA series.
 - e. The Euclid Chemical Company; Eucon NW or Eucon LW.
 - 2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used.
- C. Mid-Range Water-Reducing Admixture: ASTM C 494, Type A and Type F. See maximum permissible chloride ion content in concrete specified below.
 - 1. Subject to compliance with requirements, provide one of the following products and manufacturers:
 - a. BASF Construction Chemicals; Polyheed series or Glenium 7000.
 - b. The Euclid Chemical Company; Eucon MR.
 - c. Sika Chemical Corp.; Sikament HP.
 - d. W.R. Grade & Co.; Daracem or Mira series.
 - e. The Euclid Chemical Company; Eucon X-15 or Eucon X-20.
 - 2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used.

- D. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C 494, Type F or Type G. See maximum permissible chloride ion content in concrete specified below.
1. Subject to compliance with requirements, provide one of the following products and manufacturers:
 - a. W.R. Grace & Co.; ADVA or Daracem Series.
 - b. BASF Construction Chemicals; Rheobuild 1000 or Glenium series.
 - c. Sika Chemical Corp.; Sikament.
 - d. The Euclid Chemical Company; Eucon 37/1037 or Plastol series.
 - e. The Euclid Chemical Company; Eucon SP or Eucon RD2.
 2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used.
- E. Water-Reducing, Accelerator Admixture (Non-Corrosive, Non-Chloride): ASTM C 494, Type C or E. See maximum permissible chloride ion content in concrete specified below.
1. Subject to compliance with requirements, provide one of the following products and manufacturers:
 - a. W.R. Grace & Co.; Polarset, Gilco, Lubricon NCA, Daraset 400, or DCI.
 - b. BASF Admixtures, Inc.; Pozzutec 20+ or Pozzolith NC 534.
 - c. The Euclid Chemical Company; Accelguard 80/90, NCA, or AcN.
 - d. Sika Chemical Co.; Plastocrete 161FL.
 - e. The Euclid Chemical Company; Eucon AcN.
 2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used.
- F. Water-Reducing, Retarding Admixture: ASTM C 494, Type D. See maximum permissible chloride ion content in concrete specified below.
1. Subject to compliance with requirements, provide one of the following products and manufacturers:
 - a. W.R. Grace & Co.; Daratard series.
 - b. BASF Construction Chemicals; Pozzolith series or DELVO series.
 - c. Sika Chemical Co.; Plastiment.
 - d. The Euclid Chemical Company; Eucon Retarder series.
 2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used.
- G. Viscosity Modifying Admixture: Used to enhance plastic concrete properties such as workability, pumpability, and stability for "Self-Consolidating Concrete".
1. BASF Building Systems; Rheomac VMA series.
 2. The Euclid Chemical Company; Eucon SL or Viscrol.
 3. Sika Chemical Co.; VisoCrete series.
 4. W.R. Grace & Co.; VMAR series.
- H. Shrinkage Reducing Admixture.
1. Subject to compliance with requirements, provide one of the following products and manufacturers:
 - a. For Air-Entrained Concrete:
 - 1) Grace Construction Products; Eclipse 4500.
 - 2) The Euclid Chemical Company; Eucon SRA.
 - b. For Non Air-Entrained Concrete
 - 1) Grace Construction Products; Eclipse Floor 200.
 - 2) BASF Construction Chemicals; Tetraguard AS20.
- I. Calcium Chloride and Chloride Ion Content: Calcium chloride or admixtures containing more than 0.5% chloride ions by weight of the admixture are not permitted. For shrinkage compensating concrete, industrial slabs, and concrete designated as Exposure Class S2 or S3 as noted on the drawings, admixtures must be completely free of chloride ions.
- J. Certification: Written conformance to all the above-mentioned requirements and the chloride ion content of the admixture as tested by an accredited laboratory will be required from the admixture manufacturer at the time of design mixture review by the Engineer.

2.3 WATERSTOPS

- A. Provide waterstops at all construction joints and other joints in all foundation walls below grade and where shown on the drawings. Size to suit joints.
1. Products:
 - a. Swell Hydrophilic Waterstops:
 - 1) Manufacturers: W.R. Grace & Co.; ADCOR ES.
 - b. Polyvinyl Chloride (PVC) Waterstops: Comply with Corps of Engineers CRD-C 572. Provide flat, dumbbell type or centerbulb type as noted on the drawings.
 - c. Rubber Waterstops: Comply with Corps of Engineers CRD-C 513. Provide flat, dumbbell type or centerbulb type as noted on the drawings.

- d. Preformed Plastic Waterstops: Comply with Federal Specifications SS-S-210A "Sealing Compound for Expansion Joints".
 - 1) Manufacturers: Synko-Flex Products, Inc.
2. American Volclay Products; Bentonite Waterstop RX.

2.4 VAPOR RETARDERS

- A. Provide vapor retarder cover chosen from products specified below over prepared base material where indicated [Reference 07 26 00 "Under-slab Vapor Barrier"](#).
 1. Plastic Vapor Retarder: Provide a flexible, preformed sheet membrane conforming to ASTM E 1745 with the following properties:
 - a. Class A material.
 - b. Minimum of 15 mils thick.
 - c. Maximum water vapor permeance rating of 0.01 perms after mandatory conditioning as tested by ASTM E 96.
 - d. Manufacturer's recommended tape and mastic.
 - e. Acceptable products include the following:
 - 1) Stego Industries, LLC; Stego Wrap Vapor Barrier (15 mil).
 - 2) Epro; Ecoshield-E (15 mil).
 - 3) Raven Industries; VAPORBLOCK 15 (15 mil).
 2. Bituminous Vapor Retarders: Provide a pre-molded membrane consisting of reinforced core and carrier sheet with fortified bitumen layers, protective weather coating, and plastic anti-stick sheet conforming to ASTM E 1993 with the following properties:
 - a. Maximum water vapor permeance rating of 0.002 perms after mandatory conditioning as tested by ASTM E 96.
 - b. Manufacturer's recommended tape and mastic.
 - c. Acceptable products include the following:
 - 1) W.R. Meadows; Premoulded Membrane Vapor Seal with Plasmatic Core.
 3. Tape for Plastic Vapor Retarders: High-density polyethylene tape with pressure sensitive adhesive having a minimum width of 3.75" having a maximum water vapor transmission rate of 0.3 perms in accordance with Manufacturer's recommendations.

2.5 FLOOR AND SLAB TREATMENTS

- A. Slip-Resistive Emery Aggregate or Aluminum Granule Finish: Provide fused aluminum-oxide granules, or crushed emery, as abrasive aggregate for slip-resistive finish. The emery aggregate shall contain not less than 50% aluminum oxide and not less than 20% ferric oxide. The aluminum aggregate material shall contain not less than 95% fused aluminum-oxide granules. Use material that is factory-graded, packaged, rustproof, and non-glazing, and is unaffected by freezing, moisture, and cleaning materials.
 1. Subject to compliance with requirements, provide one of the following:
 - a. Dayton-Superior; Emery Tuff Non-Slip.
 - b. L&M Construction Chemicals, Inc.; Grip-It or Grip-It AO.
 - c. Sonneborn-ChemRex; Frictex NS.
- B. Colored, Mineral Aggregate, Dry Shake Surface Hardener: Packaged, dry, combination of materials, consisting of portland cement, graded quartz aggregate, coloring pigments (if required) and plasticizing admixtures. Use coloring pigments that are finely ground, non-fading mineral oxides, interground with cement. Color, as selected by Architect, unless otherwise indicated.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. The Euclid Chemical Company; Surfex.
 - b. L&M Construction Chemicals, Inc.; Quartz Plate.
 - c. LM Scofield Construction Chemical Co.; Lithochrome.
 - d. BASF Building Systems; Mastercron.
 - e. Dayton-Superior; Quartz-Tuff.
 - f. US Mix Co.; US Spec Dense Top.
 - g. SpecChem; Quartz Floor Hardener.
 2. Submit manufacturer's certification that product conforms to the requirements specified.
- C. Metallic Aggregate Hardener Finish: Packaged dry, combination of materials consisting of Portland Cement, specially processed and graded iron aggregate, coloring pigments (if required) and plasticizing admixtures. The hardener shall be formulated, processed, and packaged under stringent quality control. Use coloring pigments that are finely ground, non-fading mineral oxides inter-ground with cement. Color as selected by Architect unless otherwise indicated.
 1. The Euclid Chemical Company; Euco-Plate HD.
 2. BASF Building Systems; Masterplate 200.

3. Dayton-Superior; Ferro Tuff.
4. SpecChem; SPECPLATE Floor Topping.
- D. Non-Oxidizing Metallic Floor Hardener: Packaged dry, combination of materials consisting of portland cement, non-rusting aggregate and plasticizing admixtures.
 1. The Euclid Chemical Company; Diamond Plate.
 2. BASF Building Systems; Lumiplate.

2.6 CURING MATERIALS

- A. Liquid Membrane-Forming Curing and Curing and Sealing Compounds:
 1. Water-Based Dissipating Resin Type Curing Compound: Curing Compound shall be a dissipating resin type, which chemically breaks down after approximately four weeks. Membrane forming compound shall meet ASTM C 309, Types 1 or 1D, Class B with a VOC content less than 350 grams per liter.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) The Euclid Chemical Company; Kurez DR VOX.
 - 2) L&M Construction Chemicals; L&M Cure R.
 - 3) Unitex; Hydro Cure 309.
 - 4) W.R. Meadows; Sealtight 1100-Clear.
 - 5) US Mix Co.; US Spec Maxcure Resin Clear.
 - 6) SpecChem; SpecRez.
 - b. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with any covering or surface treatments to be applied. Submit any instructions that must be followed prior to any subsequent surface treatments and floor coverings.
 2. High Solids, Water-Based Acrylic Curing and Sealing Compound with Moderate Yellowing Characteristics: Water-Based membrane-forming curing and sealing compound conforming to ASTM C 1315, Type 1, Class B, classified as low odor with a VOC content less than 350 grams per liter. Product shall provide a maximum moisture loss of 0.030 kilograms per square meter in 72 hours when applied at a coverage rate of 300 square feet per gallon. Do not apply to surfaces that are to receive subsequent cementitious toppings, sealers, hardeners, ceramic tile, resilient flooring, vinyl-backed carpet, wood, terrazzo, epoxy overlays or adhesives, or other coating or finishing products.
 - a. Products: Subject to compliance with above requirements, provide one of the following products or equivalent products:
 - 1) Dayton-Superior; Safe Cure and Seal (J-19).
 - 2) The Euclid Chemical Company; Super Aqua-Cure VOX.
 - 3) L&M Construction Chemicals; Dress & Seal, 30 WB.
 - 4) BASF Building Systems; Masterkure 200W.
 - 5) SpecChem; Cure & Seal WB 25.
 - b. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with any covering or surface treatments to be applied. Submit any instructions that must be followed prior to any subsequent surface treatments.
 3. High Solids, Water-Based, Non-Yellowing Curing and Sealing Compound: Water based membrane-forming curing and sealing compound, acrylic type, complying with ASTM C 1315, Type 1, Class A classified as low odor with a VOC content less than 350 grams per liter. Do not apply to surfaces that are to receive subsequent cementitious toppings, sealers, hardeners, ceramic tile resilient flooring, vinyl-backed carpet, wood, terrazzo, epoxy overlays or adhesives, or other coating or finishing products.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) The Euclid Chemical Company; Super Diamond Clear VOX.
 - 2) L&M Construction Chemicals; Lumiseal 30 WB.
 - 3) BASF Building Systems; Kure 1315.
 - 4) Unitex; Hydro Seal 30.
 - 5) W.R. Meadows; Vocomp 30.
 - 6) US Mix Co.; US Spec Radiance UV-25.
 - 7) SpecChem; Cure & Seal WB 30.
 - b. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with any covering or surface treatments to be applied. Submit any instructions that must be followed prior to any subsequent surface treatments.
- B. Evaporation Control: Monomolecular film forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss in hot, dry, or windy weather conditions.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. The Euclid Chemical Company; Eucobar.

- b. L&M Construction Chemicals; E-Con.
 - c. BASF Building Systems; Confilm.
 - d. Dayton-Superior; Sure Film (J-74).
 - e. Sika Chemical Co.; SikaFilm.
 - f. Unitex; Pro-Film.
 - g. W.R. Meadows; Sealtight Evapre.
 - h. US Mix Co.; US Spec Monofilm ER.
 - i. SpecChem; SpecFilm RTU.
2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all coverings and surface treatments to be applied. Submit any instructions that must be followed prior to any subsequent surface treatments.
- C. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately nine ounces per square yard, complying with AASHTO M 182, Class 2.
- D. Moisture-Retaining Cover: One of the following, complying with ANSI/ASTM C 171:
- 1. Waterproof paper.
 - 2. Polyethylene film.
 - 3. Polyethylene-coated burlap.
 - 4. Polyethylene-coated natural cellulose fabric such as Greenstreak Group, Inc.; Aquacure.
 - 5. Cover for Industrial Slab: Provide a low permeance moisture-retaining cover that allows a moisture loss of no more than one pound per square yard in 72 hours when tested in accordance with ATSM C 156 for industrial slabs. The material shall be non-staining and meet with requirements of ASTM C 171.

2.7 LIQUID FLOOR TREATMENTS

- A. Chemical Hardener: Colorless aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent, containing not less than two pounds of fluosilicates per gallon.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. The Euclid Chemical Company; Surfhard.
 - b. BASF Building Systems; Lapidolith.
 - c. Dayton-Superior; Day-Chem Hardener (J-15).
 - d. L&M Construction Chemicals; Fluohard.
 - e. W.R. Meadows; Penalith.
 - f. SpecChem; Spec-O-Lith.
 - 2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all coverings or surface treatments to be received. Submit any instructions that must be followed prior to any subsequent surface treatments.
- B. Chemical Curing/Floor Hardener Compound: Sodium silicate based compound that reacts with concrete constituents to harden the surface, resulting in a surface having a maximum abrasion coefficient of 0.25 cubic centimeters per square centimeter when tested in accordance with ASTM C 418.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. The Euclid Chemical Company; Eucosil.
 - b. BASF Building Systems; Sonosil.
 - c. Dayton-Superior; Day-Chem S.1-Cure (J-13).
 - d. L&M Construction Chemicals; Chem Hard.
 - e. Unitex; Uni Cure HD.
 - f. W.R. Meadows; Med-Cure.
 - g. US Mix Co.; US Spec Permasil.
 - 2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all coverings and surface treatments to be applied. Submit any instructions that must be followed prior to any subsequent surface treatments.
- C. Liquid Sealer/Densifier: High performance, deeply penetrating concrete densifier that is an odorless, colorless, VOC-compliant, non-yellowing silicate-based solution containing a minimum solids content of 20%, 50% of which is silicate.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. The Euclid Chemical Company; Euco Diamond Hard.
 - b. L&M Construction Chemicals; Seal Hard.
 - c. W.R. Meadows; Luqui-Hard.
- D. Water and Chloride Ion Repelling Penetrating Sealer: Clear, solvent based Silane or Siloxane penetrating sealer which reacts chemically with the concrete surface to function as a Chloride Ion screen with a minimum 90% factor when tested in accordance with NCHRP #244, Series II, 100% solids, and applied in accordance with the manufacturer's recommendation.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Hydrozo 100.
 - b. Lymtal International, Inc.; Iso-flex 618-100 CRS.
 - c. Evonik Industries; Protectosil Chem-Trete BSM-400.
 - d. SpecChem; SpecSilane 100.
- E. Water and Chloride Ion Repelling Penetrating Sealer: Clear, solvent free, Silane penetrating sealer which reacts chemically with the concrete surface to function as a Chloride Ion screen with a minimum 83% factor when tested in accordance with NCHRP #244, Series II and applied in accordance with the manufacturer's recommendation.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. 40% solids:
 - 1) BASF Building Systems; Enviroseal 40.
 - 2) Lymtal International, Inc.; Iso-flex 618-40 WB.
 - 3) SpecChem; SpecSilane WB 40.
 - b. 100% solids:
 - 1) Evonik Industries; Protectosil BH-N.
- F. Moisture Vapor Reduction Sealer: ASTM C 1315 Type 1 Class A, ASTM C 309 Type 1 Class A, penetrating product to have no less than 34% solids content, leaving no sheen. Acceptable products include:
 1. Creteseal; CS2000 Spray Apply System.

2.8 RELATED MATERIALS

- A. Post-Installed Anchors:
 1. ICC Approval: Only anchors evaluated by the ICC Evaluations Service, Inc. (ICC-ES) with a published Evaluation Report, valid at the time of installation, showing it as having passed Acceptance Criteria 193 and approval for use in cracked concrete and resisting wind and seismic loads shall be approved for use.
 2. Alternate Anchor Approval: Install only anchors identified on the drawings by manufacturer and product. Substitutions using products approved by this Specification may be permitted provided complete design calculations, as required by and in accordance with the proposed product's current and valid ICC Evaluations Service Reports (ESR) and ACI 318 Appendix D, are signed and sealed by a registered professional engineer licensed in the state where the project is located and furnished to the Engineer for review and approval prior to commencement of work. The Contractor shall request design criteria for all conditions where a product substitution is considered. Failure to obtain approval for an anchor substitution may result in the request by the Engineer to remove installed anchors and replace with the product specified on the drawings at the Contractor's expense.
 3. Installation: All installation of post-installed anchors shall be in accordance with the Manufacturer's Printed Installation Instructions (MPII).
 4. Interior Use: All anchors for use in interior conditioned environments free of potential moisture shall be manufactured from carbon steel zinc plated in accordance with Federal Specification QQ-Z-325C, Type II, Class 3.
 5. Exterior or Exposed Use: All anchors for use in exposed or potentially wet environments or for attachment of exterior cladding materials shall be galvanized or stainless steel. Galvanized anchors shall conform to ASTM A 153. Stainless steel anchors shall be manufactured from 300 series stainless steel.
 6. Nuts and Washers: Nuts and washers shall be furnished from the manufacturer and used with the anchors.
 7. Anchor Types:
 - a. Expansion and Undercut Anchors in Concrete:
 - 1) Type: All expansion and undercut anchors in concrete shall be wedge type expansion, sleeve type expansion, or undercut type anchors.
 - 2) Acceptable Products and Manufacturers – Normalweight and Sand-Lightweight Concrete Not on Corrugated Steel Deck:
 - 3) Acceptable Products and Manufacturers – Normalweight and Sand-Lightweight Concrete on Corrugated Steel Deck:
 - a) Hilti, Inc.; Kwik Bolt TZ (ESR-1917).
 - b) Simpson Strong-Tie Co., Inc.; Strong-Bolt Wedge-Anchor (ESR-1771).
 - c) Powers Fasteners, Inc.; Power Stud+ SD1 Expansion Anchor (ESR-2818).
 - d) Powers Fasteners, Inc.; Power Stud+ SD2 Anchor (ESR-2502).
 - b. Screw and Insert Anchors in Concrete
 - 1) Acceptable Products and Manufacturers:
 - a) Hilti, Inc.; KWIK HUS-EZ Anchor (ESR-3027).

- b) Simpson Strong-Tie Co., Inc.; Titen HD (ESR-2713).
 - c) Powers Fasteners, Inc.; Snake+ Anchor (ESR-2272).
 - c. Adhesive Anchoring Systems in Normalweight Concrete: Product that conforms to ASTM C 881-02, Type IV, Grade 3, Class A, B, & C except gel times, and that is dispensed from a two-component cartridge system through a mixing nozzle that thoroughly mixes the two components as it is injected into the hole.
 - 1) Chemical anchoring of anchors, rods, or reinforcing steel is not allowed for fire-rated assemblies, unless specified provided for in the drawings.
 - 2) Consult with the manufacturer for the minimum temperature of the concrete substrate allowed.
 - 3) Only personnel trained to install adhesive anchors and certified in accordance with the ACI/CRSI Adhesive Anchor Installer Certification Program shall install adhesive anchors, including reinforcing steel.
 - 4) All anchors installed horizontally or upwardly inclined require continuous inspection.
 - 5) All adhesive anchors shall be installed in concrete having a minimum age of 21 days at the time of anchor installation.
 - 6) Normalweight Concrete:
 - a) Hilti, Inc.; HIT-HY 150 MAX-SD (ESR-3013).
 - b) Hilti, Inc.; HIT-HY 200 (ESR-3187).
 - c) Hilti, Inc.; HIT-RE 500-SD (ESR-2322).
 - d) ITW Red Head; EPCON G5 (ESR-1137).
 - e) ITW Red Head; EPCON S7 (ESR-2308).
 - f) Powers Fasteners, Inc.; PE 1000+ (ESR-2583).
 - g) Simpson Strong-Tie; SET-XP Adhesive (ESR-2508).
 - 7) Lightweight Concrete:
 - a) No approved products.
 - 8) These products may not be used in concrete cast over corrugated deck.
 - 9) Threaded Rods Chemically Anchored in Concrete:
 - a) Type: Threaded rods installed in holes using a chemical anchoring process shall have a 45° chiseled end on the embedded end.
 - b) Interior Application: Meet the requirements of ASTM A 307, A 36 or A 193, grade B7.
 - c) Exterior Application: Meet the requirements of ASTM A 153 galvanized steel, or F 593, Group 1 or 2, condition CW stainless steel.
- B. Bonding Compound: Polyvinyl acetate or acrylic base, for use in cosmetic and/or nonstructural repairs.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Acrylic or Styrene Butadiene:
 - 1) Dayton-Superior; Day-Chem Ad Bond (J-40).
 - 2) The Euclid Chemical Company; SBR Latex.
 - 3) W.R. Grace; Daraweld C.
 - 4) BASF Building Systems; Acrylic Additive.
 - 5) Sika Chemical Co.; SikaLatex.
 - 6) W.R. Meadows; Intralok.
 - 7) US Mix Co.; US Spec Acrylcoat.
 - 8) The Euclid Chemical Company; Akkro-7T.
 - 9) SpecChem; Acrylic Bonder.
 - b. Polyvinyl Acetate (Interior Use Only):
 - 1) The Euclid Chemical Company; Tammselfd.
 - 2) L&M Construction Chemicals; Everweld.
 - 3) Dayton-Superior; Superior Concrete Bonder (J-41).
 - 4) US Mix Co.; US Spec Bondcoat.
 - 5) SpecChem; SpecWeld.
- C. Epoxy Products: Two-component material suitable for use on dry or damp surface, complying with ASTM C 881.
 - 1. Products for Crack Repair:
 - a. Sika Chemical Co.; Sikadur 35 Hi Mod LV – injection type.
 - b. Sika Chemical Co.; Sikadur 52 – injection type.
 - c. Sika Chemical Co.; Sikadur 55 SLV – gravity feed.
 - d. The Euclid Chemical Company; Eucopoxy Injection Resin.
 - e. Dayton-Superior; Sure-Inject (J-56).
 - f. BASF Building Systems; Epofil SLV.

- g. Simpson Strong-Tie Co., Inc.; ETI-LV or ETI-GV – injection type.
 - h. Unitex; Pro-Poxy 100 LV or Pro-Poxy 50-1.
 - i. Adhesives Technology; Crackbond.
 - j. W.R. Meadows; Rezi-Weld LV.
 - k. US Mix Co.; US Spec Maxibond – injection or gravity feed.
 - l. US Mix Co.; US Spec Eposeal LVS – gravity feed.
 - m. The Euclid Chemical Company; Duralcrete LV.
 - n. SpecChem; SpecPoxy 1000.
2. Products for Epoxy Mortar Patches:
- a. Sika Chemical Co.; Sikadur Lo-Mod LV.
 - b. The Euclid Chemical Company; Duracrete Series.
 - c. Dayton-Superior; Sure Level Epoxy (J-57).
 - d. BASF Building Systems; Epofil.
 - e. Unitex; Pro-Poxy 2500.
 - f. W.R. Meadows; Rezi-Weld 1000.
 - g. US Mix Co.; US Spec EPM 3000.
 - h. The Euclid Chemical Company; Duralcrete LV.
 - i. SpecChem; SpecPoxy Binder.
3. Products for Epoxying Steel Plates to Concrete: Conform to ASTM C 881-90, Type IV, Grade 3, Class A, B, & C except gel times.
- a. Sika Chemical Co.; Sikadur 31 Hi-Mod Gel.
 - b. Dayton-Superior; Sure Anchor I (J-S1).
 - c. BASF Building Systems; Epo Gel or Rapid Gel.
 - d. Unitex; Pro-Poxy 300.
 - e. US Mix Co.; US Spec Gelbond NS.
 - f. The Euclid Chemical Company; Duralcrete Gel.
 - g. SpecChem; SpecPoxy 3000.

~~D. Frictionless Bearing Pads:~~

~~0. Types:~~

~~Frictionless bearing pads shall be a nominal 3/32" glass filled virgin Tetrafluoroethylene (TFE) conforming to ASTM D 4745 with a 10 gauge A36 steel backing plate factory bonded with a tested epoxy preformed in a heated bonding process under a controlled pressure. Provide one sliding pad tack welded to the lower supporting surface and one tack welded to the upper surface. Unless detailed otherwise on the drawings, the upper element shall be larger than the lower element on all sides by the amount of the expansion joint width shown on the drawings.~~

~~The lower frictionless bearing pads shall be a nominal 1/16" glass filled virgin Tetrafluoroethylene (TFE) conforming to ASTM D 4745 with a 10 gauge A36 steel backing plate factory bonded with a tested epoxy preformed in a heated bonding process under a controlled pressure. The upper frictionless bearing pad shall be a 20 gauge stainless steel sheet (RMS<20) resistance welded to a 10 gauge A36 steel backing plate. The lower sliding pad shall be tack welded to the lower supporting surface and the upper pad tack welded to the upper surface. Unless detailed otherwise on the drawings, the upper element shall be larger than the lower element on all sides by the amount of the expansion joint width shown on the drawings.~~

~~0. Design: The pad size and design shall conform to AASHTO "LRFD Bridge Design Specifications," Section 14. Design bearing pressure under total service load shall not exceed the manufacturer's recommendation. If Neoprene is used the compressive load shall be limited to 800 PSI.~~

~~0. Corrosion Resistance: Frictionless bearing pads for exterior or exposed usage shall be manufactured for use in an exposed climate of heat, cold, moisture, and ultraviolet rays. All backing steel in an exposed or open environment shall be shop painted with a zinc rich paint or field painted with "ZRC Cold Galvanizing Compound".~~

~~0. Acceptable Manufacturers: The following manufacturers are acceptable:~~

~~Con-Serv, Inc.~~

~~Seismic Energy Co.~~

~~Other manufacturers will be acceptable only with Engineer approval prior to bid.~~

~~P.D. Reglets: Where resilient or elastomeric sheet flashing or bituminous membrane is terminated in reglets, provide reglets of not less than 26 gauge galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.~~

- Q.E. Contraction and Construction Joint-Filler Material for Slabs-on-Grade: Provide a two-component semi-rigid, 100% solids epoxy having a minimum Shore A Hardness of 80 when tested in accordance with ASTM D 2240. Subject to compliance with requirements, provide one of the following:
1. The Euclid Chemical Company; Euco 700.
 2. Conspec Marketing and Manufacturing Co.; Inc.; Spec-Joint CJ.
 3. BASF Building Systems; Masterfill 300 I.
 4. Metzger/McGuire Co.; MM-80.
 5. W.R. Meadows; Rezi-Weld Flex.
 6. US Mix Co.; US Spec SR-50 EJJ.
 7. SpecChem; SpecPoxy CJ.
- R.F. Bondbreaker for Construction Joints in Slabs-on-Grade: A dissipating bondbreaking compound containing no silicones, resins, or waxes, and that conforms to ASTM C 309. Subject to compliance with requirements, acceptable manufacturers include the following:
1. Dayton-Superior Corporation, Inc.; Sure-Lift.
 2. Conspec Marketing and Manufacturing Co.; Tilt-Eez.
 3. SpecChem; SpecTilt 100.
- S.G. Joint-Filler Strips for Isolation Joints in Slabs-on-Grade: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.
- T.H. Rigid-Cellular-Polystyrene Boards use as Fill under Topping Slabs or Slabs-on-Grade: Provide rigid, expanded (EPS) or extruded (XPS) cellular polystyrene boards that conform to ASTM D 6817 or ASTM C 578 with a minimum density of 19] kilograms per cubic meter. Subject to compliance with requirements, acceptable manufacturers include the following:
1. Dow Chemical Company; STYROFOAM Brand.
 2. R-Control Buiding Systems; R-Control EPS Geofoam – All grades.
 3. Carpenter Co.; EPS Geofoam.
 4. Knauf Polystyrene; Knauf Geofoam.
 5. Premier Industries; Insulfill.

2.9 REPAIR MATERIALS

- A. Self-Leveling Mortars, Underlayment Compound: Freeflowing, self-leveling, pumpable cementitious base compound. Follow manufacturer's instruction regarding the use of a bonding agent.
1. Products: Unless specified otherwise, provide one of the following:
 - a. BASF Building Systems; Sonoflow.
 - b. Sika Chemical Co.; Sikatop 111.
 - c. The Euclid Chemical Company; Flo-Top or Super Flo-Top.
 - d. Dayton-Superior; Levelayer I.
 - e. US Mix Co.; US Spec Self-Leveling Underlayment.
 - f. The Euclid Chemical Company; Level Magic.
 - g. SpecChem; SpecFlow.
- B. Polymer Patching Mortar: Polymer and microsilica modified cementitious-based compounds.
1. Products:
 - a. Horizontal Application:
 - 1) The Euclid Chemical Company; Thin Top Supreme, Concrete Top Supreme.
 - 2) Sika Chemical Co.; Sikatop 121 or 122.
 - 3) BASF Building Systems; Emaco R310 CI.
 - 4) BASF Building Systems; Sonopatch 100 or 200.
 - 5) US Mix Co.; US Spec H2 or NuTop.
 - 6) The Euclid Chemical Company; Speed Crete PM.
 - 7) SpecChem; RepCon H.
 - b. Upwardly Inclined Application:
 - 1) The Euclid Chemical Company; Verticoat/Verticoat Supreme.
 - 2) Sika Chemical Co.; Sikatop 123.
 - 3) BASF Building Systems; Emaco R350 CI.
 - 4) BASF Building Systems; Sonopatch 200.
 - 5) US Mix Co.; US Spec V/O Patch.
 - 6) The Euclid Chemical Company; Speed Crete PM.
 - 7) SpecChem; RepCon V/O.
- C. High Strength Flowing Repair Mortar: For forming and pouring structural members, or large horizontal repairs, provide flowable one-part, high strength microsilica polymer modified repair mortar with 3/8" aggregate. The product shall achieve 9,000 PSI at 28-days at a nine inch slump.
1. Products:

- a. BASF Building Systems; Road Patch.
 - b. US Mix Co.; US Spec STR Mortar.
 - c. The Euclid Chemical Company; Eucocrete.
 - d. The Euclid Chemical Company; Tamms Form and Pour.
 - e. SpecChem; RepCon 928.
- D. Anti-Corrosive Epoxy/Cementitious Adhesive: Water-based epoxy/cementitious compound for adhesion and corrosion protection or reinforcing members (20 hour maximum open time).
- 1. Products:
 - a. The Euclid Chemical Company; Duralprep A.C.
 - b. Sika Chemical Co.; Armatec 110.
 - c. BASF Building Systems; Sonoprep Plus.
- 2.10 PROPORTIONING AND DESIGN OF CONCRETE MIXTURES
- A. The Contractor shall submit design concrete mixtures for each class of concrete indicated on the structural drawings and in the Specifications for approval by the Engineer and Owner's Testing Laboratory at least 15 working days prior to the start of construction. If required, the Contractor shall engage the services of an independent Testing Laboratory to assist in preparing the design mixtures. The Contractor shall not begin work with a particular mixture until that design mixture has been approved.
- B. The Contractor, acting in conjunction with his Concrete Supplier and his Testing Laboratory, shall submit in writing, with his design mixtures, the method used to select mixture proportions. Either of the following methods, as outlined in ACI 301, may be used:
- 1. Field Experience Method.
 - 2. Laboratory Trial Mixture Method.
- C. Required types of concrete and compressive strengths shall be as indicated on the Structural Drawings.
- D. All design mixtures shall state the following information:
- 1. Design mixture number or code designation by which the Contractor shall order the concrete from the Supplier.
 - 2. Identify design mixture usage (i.e., columns, shear walls, footings, slab-on-grade, etc.).
 - 3. Wet and dry unit weights.
 - 4. Compressive strength and associated age (28-day, 56-day, etc.).
 - 5. Aggregate type, source, size, gradation, fineness modulus.
 - 6. Cement type and brand.
 - 7. Fly ash or other pozzolan type and brand (if any).
 - 8. Admixtures including air entrainment, water reducers, high-range water reducers, accelerators, and retarders.
 - 9. Design slump or slump/flow.
 - 10. Proportions of each material used.
 - 11. Water/cementitious ratio and maximum allowable water content.
 - 12. Method by which the concrete is intended to be placed (bucket, chute, or pump).
 - 13. Required average strength qualification calculations per ACI 301 4.2.3.3a and 4.2.3.3b. Submit separate qualification calculations for each production facility that will supply concrete to the project.
 - 14. Documentation of Average Strength (Trial Mixture Data or Field Test Data) per ACI 301: When field test data is used to qualify average strength, submit separate documentation for each production facility that will supply concrete to the project.
 - 15. Field test data submitted for qualification of average strength under ACI 301 shall include copies of the Concrete Testing Agency's reports from which the data was compiled.
- E. Low Alkali Concrete: For concrete identified on the drawings as Exposure Classes C1 and C2, the total alkali contribution from cementitious materials in the concrete mix shall not exceed 4.0 pounds per cubic yard of concrete unless the aggregate used is certified to contain no deleterious materials that react with alkalis in the concrete mix as defined in ASTM C 33. This requirement may be met by the use of low-alkali cement.
- F. Supplementary Cementitious Materials: Fly ash and/or ground granulated blast-furnace slag replacement of Portland cement shall be within percentage replacement levels listed on the drawings unless noted otherwise. Every effort should be made to reduce the amount of cement to the minimum practical amount, and still achieve performance requirements contained in the Contract Documents.
- 1. Cement replacement shall not exceed a percentage level that has been shown by experience on other projects to exhibit satisfactory performance using materials from identical sources as proposed for this project. As an alternate, trial concrete batches can be performed to identify design mixtures that maximize cement replacement while meeting strength requirements per ACI 318 Section 5.3 and finishability criteria.

2. The use of fly ash or slag in architecturally exposed structural concrete shall be coordinated with the Architect, Engineer, and Contractor.
 3. If fly ash is used, it must be at a minimum replacement percentage of 15%.
 4. Overall replacement percentages with combined fly ash and slag shall not exceed the maximum identified with slag or be less than the minimum identified with fly ash for each type of element. In addition, the replacement percentage of fly ash within the combined mixture shall not exceed the maximum identified with fly ash alone.
 5. Replacement percentages exceeding the maximum may be permitted at the discretion of the Architect, Engineer of Record, and Contractor.
 6. For concrete identified on the drawings as being subject to Exposure Class F3, the maximum amount of supplementary cementitious materials shall not exceed the limits noted in Table 4.2.2.7.b.2 "Maximum cementitious materials requirements for concrete exposed to deicing chemicals" of ACI 301.
 7. Except for Mass Concrete, the Contractor may submit for approval a revised design mixture with lower supplementary cementitious material percentages than herein specified should finishability or other issues arise due to changing weather conditions.
- G. Aggregate: Comply with the following special requirements:
1. For exposed concrete, provide aggregates from a single source.
 2. For exposed surfaces subject to Exposure Class C1 or C2, do not use aggregates containing spalling-causing deleterious substances.
 3. For slabs and other designated concrete, combined aggregate gradation shall be 8% - 18% for large top size aggregates (1 1/2 inches) or 8% - 22% for smaller top size aggregates (1 inch or 3/4 inch) retained on each sieve below the top size and above the No. 100. Deviations from this gradation may be allowed upon the approval of the Engineer subject to the following limitations:
 - a. The percent retained on two adjacent sieves shall be not less than 5%.
 - b. The percent retained on three adjacent sieves shall be not less than 8%.
 - c. If the percent retained on two adjacent sieves is less than 8%, the total percent retained on either of those sieves and the adjacent outside sieve shall be not less than 13%.
- H. Admixtures:
1. Admixtures to be used in concrete shall be subject to the approval of the Engineer and Owner's Testing Laboratory and shall be used for the purpose intended by the manufacturer to produce concrete to meet the specified requirements.
 2. Quantities of admixtures to be used shall be in strict accordance with the manufacturer's instructions.
 3. Air Content Requirements: For concrete subject to Exposure Class F1, F2 or F3 as noted on the drawings, use air-entrainment admixtures to provide concrete such that the air content at the point of placement shall conform to the requirements of ACI 301 Table 4.2.2.7.b "For Exposure Category F: Freezing and thawing exposures" within plus or minus 1.5%. Required air content levels may be reduced by 1.0 percent for concrete strengths above 5,000 PSI.
 - a. Interior steel troweled surfaces subjected to vehicular traffic shall not have more than 3% total air content.
 - b. Surfaces scheduled to receive hardeners shall not have more than 3% total air content.
 - c. Air-entraining admixtures are not permitted in industrial slabs.
- I. Lightweight Structural Concrete:
1. Comply with the requirements of ACI 301, Section 7.
 2. Provide concrete with a dry unit weight of not more than 116 pounds per cubic foot and not less than 110 pounds per cubic foot. Design mixture to produce strengths as indicated on the drawings with a split cylinder strength factor ($f_{ct}/(f_c)^{0.5}$) of not less than 5.7.
- J. Adjustments of Concrete Mixtures: Design mixture adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant. Such adjustments shall be provided at no additional cost to the Owner. Any adjustments in approved design mixtures including changes in admixtures shall be submitted in writing to the Engineer and Owner's Testing Laboratory for approval prior to field use.
- K. Chloride Ion Content:
1. Unless noted otherwise, the maximum water soluble chloride ion concentration in hardened concrete measured at ages from 28 to 42 days contributed from all ingredients including water, aggregates, cementitious materials, and admixtures shall not exceed the limits specified in ACI 301 Table 4.2.2.7.a.1 "Requirements for establishing suitability of cementitious materials combinations exposed to water-soluble sulfate" depending on to which Corrosion Exposure Class (C0, C1 or C2) the concrete is subject as noted on the drawings. Water-soluble chloride ion tests shall conform to ASTM C 1218. One test shall be run for each class of concrete before the design mixture submittal and each time a change is made to the design mixture (such as change in aggregate type or source).

2. The chloride ion content in all concrete used for prestressed or post-tensioned concrete shall not exceed 0.06 percent by weight of cement.
3. The Concrete Supplier shall certify that the chloride ion content in all concrete design mixtures used on the project does not exceed the limits stated above.

2.11 CONCRETE MIXING

- A. Ready-Mix Concrete: Comply with requirements of ANSI/ASTM C 94 and the Structural Testing and Inspections section of the specifications.

2.12 SOURCE QUALITY CONTROL

- A. Source Inspection: Refer to Specification **014529 "Structural Testing and Inspections"** for inspection requirements associated with cast-in-place concrete.
- B. Source Inspection:

PART 3 - EXECUTION

3.1 SLUMP LIMIT

- A. The slump, as measured in the field where concrete cylinders are taken, shall be within plus or minus one inch of the design slump noted in the approved Design Mixture submittal. Self-Consolidating Concrete shall have a slump/flow of plus or minus two inches of the design slump/flow noted on the approved Design Mixture submittal. Water may be added to the concrete in the field only to the extent that the prescribed water/cementitious ratio noted in the approved Design Mixture submittal is not exceeded. The responsibility for adding water to trucks at the job site shall rest only with the Contractor's designated representative. The Contractor is responsible that all concrete placed in the field is in conformance with the Contract Documents.

3.2 VAPOR RETARDER INSTALLATION

- A. [Reference 07 26 00 "Under-slab Vapor Barrier"](#). Install and repair damaged vapor retarder in accordance with ASTM E 1643 and manufacturer's instructions.
- B. Lap all seams per manufacturer's instruction (6" minimum lap) and seal all joints in the field with the specified pressure sensitive tape. Heat-welded joints done in a shop prior to delivery is an acceptable method to minimize the number of field joints.
- C. Seal all pipe penetrations through the vapor retarder with a boot made from the vapor retarder material and tape or mastic.

3.3 JOINTS IN CONCRETE

- A. Construction Joints: Locate and install construction joints as indicated on the drawings or if not shown on drawings, located so as not to impair strength and appearance of the structure, as acceptable to Architect/Engineer.
 1. Keyways: Provide keyways with a depth of one tenth of the member thickness (1 1/2" minimum or as shown on the drawings) in construction joints only where shown on the drawings.
 2. Joint Construction: Place construction joints in the center one third of suspended spans and grade beams and as shown on the drawings for slabs-on-grade and walls unless shown otherwise. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise shown on the drawings. Dowels that cross construction joints shall be supported during concreting operations so as to remain parallel with the slab or wall surface and at right angles to the joint. Submit all construction joint locations as a shop drawing submittal.
 3. Waterstops: Provide waterstops in construction joints as indicated on the Architectural and Structural Drawings. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions.
 4. Isolation Joints in Slabs-on-Grade: Construct isolation joints (without dowels) in slabs-on-grade at points of contact between slabs-on-grade and vertical surfaces only where specifically detailed on the drawings. Install joint-filler strips at joints where indicated. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated on the drawings. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together. Provide construction joints with dowels at all locations unless isolation joints are detailed.
- B. Contraction Joints in Slabs-on-Grade and Unbonded Topping Slabs: Install contraction joints at locations and spacings as indicated on the drawings or if not shown on drawings, located so as not to impair strength

and appearance of the structure, as acceptable to Architect/Engineer. Maximum joint spacing shall be per the drawings and be perpendicular to the slab surface. Use one of the two following methods (sawed or formed) to create the joints. Do not use the formed joint in areas subject to vehicular traffic or in industrial slabs.

1. Sawed Joints:
 - a. Primary Method: Early-Entry, dry-cut method, using Soff-Cut saws. Finisher must have documented successful experience in the use of this method prior to this project. Install cuts within one to four hours, depending on air temperature, after final finish as soon as the concrete surface is firm enough to not be torn or damaged by the blade at each saw cut location. Use 1/8 inch thick blade, cutting to a depth of one quarter of the slab thickness but not less than one inch. Cut to a depth of one third of the slab thickness for slabs reinforced with steel fibers or synthetic fibers.
 - b. Optional Method (where Soff-Cut System method equipment is not available, subject to limitations): This method may not be used when there is no dowel passing through the contraction joint. Use a conventional saw to cut joints within four to 12 hours after finishing as soon as the concrete has hardened sufficiently to prevent aggregates from being dislodged by the saw. Complete cutting before shrinkage stresses become sufficient to produce cracking. Use 1/8 inch thick blade, cutting to a depth of one quarter of the slab thickness but not less than one inch. Cut to a depth of one third of the slab thickness for slabs reinforced with steel fibers.
2. Formed Joints: Form contraction joints by inserting premolded plastic hardboard or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. The depth is to be one quarter of the slab thickness, but not less than one inch. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.
3. Joint Filler: Provide in both contraction and saw-cut construction joints when specified.
 - a. Remove dirt and debris from the joint by vacuuming immediately prior to filling joint. Clean the joint of curing compounds and sealers.
 - b. Filler material shall be applied to the joints when the building is under permanent temperature control, but no less than 90 days after slab construction.
 - c. Follow the manufacturer's recommended procedure for installing filler material. The joint filler must be flush with the adjacent concrete. A concave profile on the top of the joint filler is unacceptable and will be grounds for removal and replacement.
4. The Contractor shall protect the joints from damage caused by wheeled traffic or other sources during construction until a joint-filler material (if specified) has been installed.

3.4 INSTALLATION OF EMBEDDED ITEMS

- A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto unless directed otherwise by these specifications. Install reglets to receive top edge of foundation sheet waterproofing where specified by the Architect, and to receive thru-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles and other conditions.
- B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.
- C. Do not install sleeves in any concrete member except where shown on the structural drawings or approved by the Architect and Engineer.
- D. Securely fasten embedded plates, angles, anchor rods and other items to be built into the concrete to the formwork or hold in place with templates. Insertion of these items into concrete after concrete placement is prohibited.

3.5 CONCRETE PLACEMENT

Pre-placement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.

- A. Concrete Batch Trip Tickets: The Contractor shall collect and retain concrete batch trip tickets. Compressive strength, slump, air content, and temperature tests shall be identified by reference to a particular trip ticket. Tickets shall contain the information specified in ASTM C 94. Each ticket shall also show the amount of water that may be added in the field for the entire batch that will not exceed the specified water cement ratio

- for the design mixture. The Contractor and Testing Laboratory shall immediately notify the Architect/Engineer and each other of tickets not meeting the criteria specified.
- B. Causes for Rejection of Concrete: The Contractor shall reject concrete delivered to the site for any of the following reasons:
1. Wrong class of concrete (incorrect design mixture number).
 2. Environmental condition limits shall be as follows unless appropriate provisions in concrete practices have been made for cold or hot weather:
 - a. Cold Weather: Air temperature must be 40°F and rising or the average daily temperature cannot have been lower than 40°F for three consecutive days unless the temperature rose about 50°F for at least one-half of any of those 24 hour periods.
 - b. Hot Weather: Environmental conditions must be such that cause an evaporation rate from the concrete surface of 0.2 pounds per square foot per hour or less as determined by the figure "NRMCA Nomograph for Estimating Evaporation Rate on the Basis of Menzel Formula" in Appendix A of ACI 305.1.
 - c. Concrete may be placed at other environmental condition ranges only with the approval of the job inspector for the Testing Laboratory or other duly appointed representative.
 3. Concrete with temperatures exceeding 95°F.
 4. Air contents outside the limits specified in the design mixtures.
 5. Slumps outside the limits specified.
 6. Water added to the mix that exceeds the maximum allowed water-to-cementitious material ratio.
 7. Excessive Age: Concrete shall be discharged within 90 minutes of plant departure or before it begins to set if sooner than 90 minutes and it shall be discharged before the drum has revolved 300 revolutions, unless approved by the Testing Laboratory job inspector or other duly appointed representative.
- C. Coordinate the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.
- D. Comply with ACI 301 and as herein specified:
1. Concrete Temperature: The maximum acceptable concrete temperature at the truck discharge point shall be 95°F.
 2. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation. Spread concrete using short-handled, square-ended shovels, or come-alongs.
 3. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
 4. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use internal vibrators of the largest size and power that can properly be used in the work.
 5. Do not vibrate Self-Consolidating Concrete.
 6. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to penetrate rapidly placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
 7. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed. Place concrete for beams, girders, brackets, column capitals, haunches, and drop panels at the same time as concrete for slabs. Do not place concrete over columns and walls until concrete in columns and walls is no longer plastic and has been in place at least one hour.
 8. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners of forms, eliminating air and stone pockets that may cause honeycombing, pitting, or planes of weakness.
 9. Bring slab surfaces to correct level with straightedge and strikeoff. Use highway straightedges, bull floats, or darbies to smooth surface free of humps or hollows before excess moisture or bleedwater appears on the surface. Do not disturb slab surfaces prior to beginning finishing operations.
 10. Maintain reinforcing in proper position during concrete placement operations.
 11. Protect adjacent finish materials against damage and spatter during concrete placement.

12. Placing Concrete by Pump: If concrete is placed by using a pump, the grout used for pump priming must not become a part of the completed structure unless an engineered grout design mix and grout location are approved in advance by the Engineer.

3.6 FINISH OF FORMED SURFACES

- A. General: Formed surfaces shall have the finishes as described below and as shown on the drawings after formwork is removed and repairs made.
- B. Matching Mockup Finish: In all areas where a special finish is required or a mock-up is required below, Contractor shall prepare a 100 square foot mock-up to match the required finish. The mock-up should match the finish on a sample panel furnished to the Contractor. If a sample is not furnished, provide finish to match SF2.0 or any other finish specified for the project. Protect mock-up from damage for the duration of project. Approval of mock-up by Architect is required before proceeding with application of finish in project.
- C. Classifications and Finish Requirements:
1. Surface Finish 1.0 (SF-1.0):
 - a. No formwork facing material is specified.
 - b. Patch voids larger than 1-1/2 inch wide or 1/2 inch deep.
 - c. Remove projections larger than 1.0 inch.
 - d. Provide surface tolerance Class D as specified in ACI 117.
 - e. Tie holes need not be patched.
 2. Surface Finish 1.1 (SF-1.1):
 - a. No formwork facing material is specified.
 - b. Patch voids larger than 1 inch wide or 1/2 inch deep.
 - c. Remove projections larger than 1/2 inch.
 - d. Provide surface tolerance Class C as specified in ACI 117.
 - e. Tie holes need not be patched.
 3. Surface Finish 2.0 (SF-2.0):
 - a. Provide specified formwork-facing material.
 - b. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - c. Patch tie holes.
 - d. Remove projections larger than 1/4 inch.
 - e. Provide surface tolerance Class B as specified in ACI 117.
 - f. Provide mock-up of concrete surface appearance.
 4. Surface Finish 2.1 (SF-2.1):
 - a. Provide specified formwork-facing material.
 - b. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - c. Patch tie holes.
 - d. Remove projections larger than 1/4 inch.
 - e. Provide surface tolerance Class B as specified in ACI 117.
 - f. Provide specified rubbed finish after formwork removal.
 - g. Provide mock-up of concrete surface appearance.
 5. Surface Finish 2.2 (SF-2.2):
 - a. Provide specified formwork-facing material.
 - b. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - c. Patch tie holes.
 - d. Remove projections larger than 1/4 inch.
 - e. Provide surface tolerance Class B as specified in ACI 117.
 6. Surface Finish 2.3 (SF-2.3):
 - a. No formwork-facing material is specified.
 - b. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - c. Patch tie holes.
 - d. Remove projections larger than 1/4 inch.
 - e. Provide surface tolerance Class B as specified in ACI 117.
 7. Surface Finish 3.0 (SF-3.0):
 - a. Provide specified formwork facing material.
 - b. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - c. Remove projections larger than 1/8 inch.
 - d. Patch tie holes.
 - e. Provide surface tolerance Class A as specified in ACI 117.
 - f. Provide mock-up of concrete surface appearance.
 8. Surface Finish 3.1 (SF-3.1):
 - a. Provide specified formwork-facing material.

- b. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - c. Patch tie holes.
 - d. Remove projections larger than 1/8 inch.
 - e. Provide surface tolerance Class A as specified in ACI 117.
 - f. Provide specified rubbed finish after formwork removal.
 - g. Provide mock-up of concrete surface appearance.
9. Surface Finish 3.2 (SF-3.2):
- a. Provide specified formwork-facing material.
 - b. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - c. Patch tie holes.
 - d. Remove projections larger than 1/8 inch.
 - e. Provide surface tolerance Class A as specified in ACI 117.
10. Surface Finish 3.3 (SF-3.3):
- a. No formwork-facing material is specified.
 - b. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - c. Patch tie holes.
 - d. Remove projections larger than 1/8 inch.
 - e. Provide surface tolerance Class A as specified in ACI 117.
- D. Standard Finish: Provide SF-1.0 on all concrete surfaces not exposed to view in the final condition unless otherwise specified.
- E. Exposed Finishes: Provide SF-2.0 on all concrete surfaces exposed to view in final condition unless otherwise specified.
- F. Rubbed Finishes: Remove forms as early as permitted by these specifications and perform any necessary repairs and patches.
- 1. Smooth Rubbed Finish: Provide smooth rubbed finish to scheduled or specified concrete surfaces where indicated, not later than one day after form removal. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.
- G. Related Unformed Surfaces: At tops of walls, horizontal offsets and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.
- 3.7 MONOLITHIC SLAB FINISHES
- A. Place, consolidate, strike off, and level concrete, eliminating high spots and low spots, before proceeding with any other finish operation. Do not add water to the surface of the concrete during finishing operation.
- B. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo and other bonded applied cementitious finish flooring material, and as otherwise indicated. After placing slabs, plane surface to tolerance specified below. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms, or rakes.
- C. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated. After screeding, consolidating and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using a hand float, a bladed power float equipped with float shoes, or a powered disk float, when the bleed water sheen has disappeared and the concrete surface has stiffened sufficiently to permit the operation. Check and level surface plane to a tolerance as specified below. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- D. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint or other thin film finish coating system. After floating, begin first trowel finish operation by hand or power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with a level surface to a tolerance as specified below. Grind smooth surface defects that would telegraph through applied floor covering system.
- E. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply initial trowel finish as specified above, then immediately follow with slightly scarifying surface by fine brooming.
- F. Slip-Resistive Broom Finish: Apply slip-resistive broom finish to garage floors and ramps less than 6% slope, exterior concrete platforms, steps, and ramps and elsewhere as indicated. Immediately after float

finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application. For concrete containing fibers, broom once only in one direction.

- G. Roller-Bug Finish: Provide a roller-bug finish with minimum 1/4" amplitude to all ramps exceeding a 6% slope. Extend the finish as least 12 feet beyond the beginning and ending of the greater-than-6% ramp. The finish shall be imprinted on the concrete by the use of a roller-bug tamper.
- H. Chemical-Hardener Finish: Apply chemical-hardener finish to interior concrete floors where indicated. Apply liquid chemical-hardener after complete curing and drying of the concrete surface. Apply proprietary chemical hardeners, in strict accordance with manufacturer's printed instructions. After final coat of chemical-hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.
- I. Liquid Sealer/Densifier Finish: Apply liquid sealer/densifier finish to exposed interior concrete floors where indicated. Apply after complete curing and drying of the concrete surface and in strict accordance with manufacturer's printed instructions.
- J. Penetrating Sealer Finish: Apply a chloride-and-water-repelling-penetrating-sealer finish to surfaces as described below and where indicated on the drawings. Apply liquid penetrating sealer after complete curing and drying of the concrete surface. Apply proprietary sealers in strict accordance with manufacturer's printed instructions. The Contractor shall verify the compatibility of the sealer product with the paint used to stripe parking decks and coordinate the sequencing of the sealing and striping operations. Apply to the following surfaces:
 - 1. Sloping and horizontal surfaces of parking garages.
 - 2. Top surfaces of exposed exterior balconies.
- K. Slip-Resistive Aggregate Finish: Apply slip-resistive aggregate finish to concrete stair treads, platforms, ramps, and elsewhere as indicated on the Architect's or Structural Drawings.
 - 1. After completion of float finishing, and before starting trowel finish, uniformly spread 25 pounds of dampened slip-resistive aggregate per 100 square feet of surface. Tamp aggregate flush with surface using a steel trowel, but do not force below surface. After broadcasting and tamping, apply trowel finishing as herein specified.
 - 2. After curing, lightly work surface with a steel wire brush, or an abrasive stone, and water to expose slip-resistive aggregate.
- L. Colored, Mineral Aggregate Surface Hardener: Provide colored, mineral aggregate surface hardener to monolithic slab surface indicated.
 - 1. Apply dry shake materials for colored wear-resistant finish at rate of not less than 100 pounds per 100 square feet, unless greater amount is recommended by material manufacturer.
 - 2. Cast a trial slab approximately 20 feet by 20 feet to determine actual application rate, color, and finish as acceptable to Architect/Engineer.
 - 3. Immediately following first floating operation using wood floats, uniformly distribute approximately two thirds of required weight of dry shake material over concrete surface, and embed by means of power floating using float shoes or pan floats. Follow floating operation with second shake application, uniformly distributing remainder of dry shake material at right angles to first application, and embed by power floating.
 - 4. After completion of broadcasting and floating, apply trowel finish as herein specified. Cure slab surface with curing compound recommended by dry shake hardener manufacturer. Apply curing compound immediately after final finishing.
- M. Non-Oxidizing Metallic Floor Hardener: Slabs in areas noted on the drawings shall receive an application of the non-oxidizing, metallic floor hardener applied at the rate of 150 pounds per 100 square feet. Immediately following the first floating operation using wood floats, uniformly distribute approximately two thirds of the required weight of the hardener over the concrete surface by mechanical spreader and embedded by means of power floating using float shoes or pan floats. The hardener shall be floated in and the second application made. The surface shall be floated again to bond properly the hardener to the base concrete slab. The surface shall then be troweled at least twice to a smooth dense finish.

3.8 CONCRETE FINISH MEASUREMENT AND TOLERANCES

- A. Testing Procedure: ASTM E 1155.
- B. Tolerance on Floor Elevations: Construction tolerance on absolute floor elevation from the specified elevation as shown on the drawings shall be as specified below, taken from ACI 117:
 - 1. Slab-on-Grade Construction: $\pm 3/4"$.
 - 2. Top Surfaces of Formed Slabs Measured Prior to Removal of Supporting Shores: $\pm 3/4"$.
 - 3. Top Surfaces of All Other Slabs: $\pm 3/4"$.
- C. Random Traffic Floor Finish Tolerances:

1. Specified overall values for flatness (SOF_F) and levelness (SOF_L) shall conform to the values listed below for the floor surface classification noted for each slab category noted.
 - a. Conventional:
 - 1) SOF_F: 20.
 - 2) SOF_L: 15.
 - b. Moderately Flat:
 - 1) SOF_F: 25.
 - 2) SOF_L: 20.
 - c. Flat:
 - 1) SOF_F: 35.
 - 2) SOF_L: 25.
 - d. Very Flat:
 - 1) SOF_F: 45.
 - 2) SOF_L: 35.
 2. Minimum local values for flatness (MLF_F) and levelness (MLF_L) shall equal 3/5 of the SOF_F and SOF_L values, respectively, unless noted otherwise. The MLF_F and MLF_L values shall apply to the minimum areas bounded by the column lines and half-column lines, or the minimum areas bounded by the construction and contraction joints, whichever are the smaller areas.
 3. The SOF_L and MFL_L tolerance values shall apply only to level slabs-on-ground or to level, uncambered suspended slabs that are shored such that it cannot deflect from the time the floor is placed to the time it is measured.
 4. Slabs specified to slope shall have a tolerance from the specified slope of 3/8" in 10 feet at any point.
- D. Construction Requirements to Achieve Specified Floor Finish Tolerances:
1. Forms shall be properly leveled, in good condition, and securely anchored including special attention to ends and transitions.
 2. Bearing surfaces for straightedges such as form edges or previously poured slabs shall be kept clean of laitance, sand, gravel, or other foreign elements.
 3. Screeds shall be maintained in good condition with true round rolling wheels and level cutting edges. The use of optical sighting equipment such as lasers is recommended for checking levelness and straightness. The Contractor shall promptly adjust or replace equipment when test results indicate substandard work.
 4. Highway straightedges are recommended for use in lieu of bullfloats for all slab placement and finishing operations. If mineral, non-oxidizing metallic, or metallic floor hardeners are used, the slab shall be wood bullfloated immediately after the straightedge.
- E. Contractor Responsibility for Concrete Floor Finish Requirements: Floor finish requirements shown below (flatness and levelness tolerances) are minimum requirements that apply unless stricter requirements are contained in instructions for installation of applied floor products in which case the Contractor is responsible for attaining the values prescribed by the manufacturer of such products.
- F. Concrete Floor Finish Tolerance for Slab-on-Grade Construction:
1. Concrete Placement: Concrete shall be placed and screeded to predetermined marks set to elevations prescribed on the drawings.
 2. Finish Tolerances of Random Traffic Floor Surfaces:
 - a. Slabs in nonpublic areas, mechanical rooms, surfaces to received raised computer flooring, surfaces to have thick-set tile or a topping, and parking structures: Conventional.
 - b. Carpeted Areas: Moderately Flat.
 - c. Exposed Slabs in Public Spaces, Slabs to Receive Thin-Set Flooring: Flat.
- G. Concrete Floor Finish Tolerance for Shored, Cast-in-Place Suspended Slab Construction:
1. Concrete Placement: Formwork shall be set and securely braced so that soffits are positioned to allow scheduled concrete member sizes and thicknesses within tolerances specified in ACI 117. Concrete shall be placed and screeded to predetermined marks on the form surface conforming to elevations prescribed on the drawings.
 2. Camber: Formwork camber, as indicated on the drawings, shall be set to provide a uniform, smooth soffit profile in each direction. Minimum slab thickness, as specified on the drawings, shall be maintained throughout the slab surface to a tolerance as specified in ACI 117. Tolerance on camber shall be ±1/4". Levelness F-Number tolerances specified below do not apply to areas of the floor where camber or intentional slope is shown.
 3. Finish Tolerances of Random Traffic Floor Surfaces:
 - a. Slabs in Nonpublic Areas, Mechanical Rooms, Surfaces to Received Raised Computer Flooring, Surfaces to Have Thick-Set Tile or a Topping, and Parking Structures: Conventional.
 - b. Carpeted Areas: Moderately Flat.

- c. Exposed Slabs in Public Spaces, Slabs to Receive Thin-Set Flooring: Flat.
 - d. Movie or Television studios: Super Flat.
 - 4. Extra Concrete: The contractor shall include in his bid any additional concrete required to achieve the specified slab surface finish tolerance.
 - 5. Concrete Placement at Column Bays Supported by Unshored Transfer Girders: Concrete in floor areas supported by unshored transfer girders shall be placed and screeded to predetermined marks placed over the slab conforming to elevations as specified on the drawings. At least the minimum slab thickness, as specified on the drawings, shall be maintained throughout the slab surface. The Contractor shall conform to the F_F values specified above.
- H. Concrete Floor Finish Tolerance – Unshored Steel Deck on Shored or Unshored Steel Beam or Steel Joist Floor Construction:
 - 1. Concrete Placement: Concrete over steel deck shall be placed and screeded level and flat to the tolerance specified below, maintaining at least the minimum slab thickness at all locations as specified on the drawings. The Contractor shall increase the slab thickness as required to compensate for steel deck deflection, and in unshored beam construction, residual beam camber and beam deflection in order to achieve a level and flat floor within specified tolerances.
 - 2. Finish Tolerance of Random Traffic Floor Surfaces:
 - a. Slabs in Nonpublic Areas, Mechanical Rooms, Surfaces to Received Raised Computer Flooring, Surfaces to Have Thick-Set Tile or a Topping, and Parking Structures: Conventional.
 - b. Carpeted Areas: Moderately Flat.
 - c. Exposed slabs in public spaces, slabs to receive thin-set flooring: Flat.
 - d. Eighty percent (80%) of the final floor surface shall fall within an envelope of 0.75" centered about the mean elevation of all the readings. The mean elevation of all readings shall not deviate from the specified design grade by more than ± 0.375 ".
 - 3. Extra Concrete: The Contractor shall include in his bid any additional concrete required to achieve the specified slab surface finish tolerance and to compensate for steel deck deflection, beam camber and beam deflection.
- I. Remedial Measures for Slab Finish Construction Not Meeting Specified Tolerances:
 - 1. Application of Remedial Measures. Remedial measures specified herein are required whenever either or both of the following occur:
 - a. The composite overall values of F_F or F_L of the entire floor installation measure less than specified values.
 - b. Any individual test section measures less than the specified absolute minimum F_F or F_L value.
 - 2. Modification of Existing Surface:
 - a. If, in the opinion of the Architect/Engineer or Owner's Representative, all or any portion of the substandard work can be repaired without sacrifice to the appearance or serviceability of the area, then the Contractor shall immediately undertake the approved repair method.
 - b. The Contractor shall submit for review and approval a detailed work plan of the proposed repair showing areas to be repaired, method of repair, and time to affect the repair.
 - c. Repair method(s), at the sole discretion of the Architect/Engineer or Owner's Representative, may include grinding (floor stoning), planing, retopping with self-leveling underlayment compound or repair topping, or any combination of the above.
 - d. The Architect/Engineer or Owner's Representative maintains the right to require a test repair section using the approved method of repair for review and approval to demonstrate a satisfactory end product. If, in the opinion of the Architect/Engineer or Owner's Representative, the repair is not satisfactory an alternate method of repair shall be submitted or the defective area shall be replaced.
 - e. The judgment of the Architect/Engineer or Owner's Representative on the appropriateness of a repair method and its ability to achieve the desired end product shall be final.
 - f. All repair work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.
 - 3. Removal and Replacement:
 - a. If, in the opinion of the Architect/Engineer or Owner's Representative, all or any portion of the substandard work cannot be satisfactorily repaired without sacrifice to the appearance or serviceability of the area, then the Contractor shall immediately commence to remove and replace the defective work.
 - b. Replacement section boundaries shall be made to coincide with the test section boundaries as previously defined.
 - c. Sections requiring replacement shall be removed by sawcutting along the section boundary lines to provide a neat clean joint between new replacement floor and existing floor.

- d. The new section shall be reinforced the same as the removed section and doweled into the existing floor as required by the Engineer. No existing removed reinforcing steel may be used. All reinforcing steel shall be new steel.
- e. Replacement sections may be retested for compliance at the discretion of the Architect/Engineer or Owner's Representative.
- f. The judgment of the Architect/Engineer or Owner's Representative on the need for replacement shall be final.
- g. All replacement work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.

3.9 CONCRETE CURING AND PROTECTION

A. General:

1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Maintain concrete with minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of concrete. Limit moisture loss to a maximum of 0.05 pounds per square foot per hour for concrete containing silica fume and 0.2 pounds per square foot per hour for all other concrete before and during finishing operations. If using an evaporation retarder, apply in accordance with manufacturer's instructions after screeding and bull floating, but before power floating and troweling.
2. Curing shall commence as soon as free water has disappeared from the concrete surface after placing and finishing. The curing period shall be seven days for all concrete except high early strength concrete that shall be cured for three days minimum.
3. Alternatively, curing times may be reduced if either of the following provisions is complied with:
 - a. If tests are made of cylinders kept adjacent to the structure and cured by the same methods, curing measures may be terminated when the average compressive strength has reached 70% of the specified compressive strength.
 - b. If the temperature of the concrete is maintained at a minimum of 50°F for the same length of time required for laboratory cured cylinders of the same concrete to reach 85% of the specified compressive strength, then curing may be terminated thereafter.
4. Curing shall be in accordance with ACI 301 procedures. Avoid rapid drying at the end of the curing period.

B. Curing Formed Surfaces: Where wooden forms are used, cure formed concrete surfaces, including undersides of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. When forms are removed, continue curing by one or a combination of the methods specified below, as applicable:

1. Columns and Shear Walls Not Exposed to View: Moist cure in forms or by one or a combination of Methods 1, 2, or 3 specified below. Use a high-solids, liquid membrane-forming curing and sealing compound conforming to ASTM C 1315, Type I, Class A or B for Method 3.
2. Columns and Shear Walls Exposed to View: Moist cure in forms or by one or a combination of Methods 1, 2, or 3 specified below. Use a high-solids, non-yellowing, liquid membrane-forming curing and sealing compound conforming to ASTM C 1315, Type 1, class A for Method 3.
3. Sides and Soffits of Beams and Pan-Joist Ribs, Soffits of Slabs: Moist cure in forms or by one or a combination of Methods 1, 2, or 3 specified below. Use a liquid membrane-forming dissipating resin curing compound conforming to ASTM C 309, Type 1, class A or B for Method 3.
4. Basement Walls, Sides of Exterior Retaining Walls: Moist cure in forms or by one or a combination of Methods 1, 2, or 3 specified below. Use a liquid membrane-forming dissipating resin curing compound conforming to ASTM C 309, Type 1, class A or B for Method 3.

C. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by one or a combination of the methods specified below, as applicable. The Contractor shall choose a curing method that is compatible with the requirements for subsequent material usage on the concrete surface.

1. Ramps and Horizontal Surfaces of Parking Areas, Exposed Exterior Balconies: Cure using only Methods 1 or 2 as specified below.
2. Floors in Non-Public Spaces that are Left Exposed to View and Not Receiving Sealers or Hardeners, Floors Involved in Under-Floor Air Distribution Systems: Apply one coat of a high-solids, water-based, non-yellowing, liquid membrane-forming curing and sealing compound conforming to ASTM C 1315, Type 1, Class A or B in accordance with Method 3 as specified below.
3. Floors that are to Receive Subsequent Cementitious Toppings, Sealers, Hardeners, Ceramic Tile, Acrylic Terrazzo, Vinyl Composition Tile, Sheet Vinyl, Linoleum, Vinyl-Backed Carpet, Rubber, Athletic Flooring, Synthetic Turf, Wood, Epoxy Overlay or Adhesive, or Other Coating or Finishing

- Products: Cure using Methods 2 or 3 as specified below. Use a water-based dissipating resin type curing compound conforming to ASTM C 309, Type 1, class A or B for Method 3.
4. Industrial Slabs: Cure using Methods 1 or 2 as specified below for seven days. The temperature of applied water shall be within 10°F of concrete surface temperature.
 5. All Other Surfaces: Cure using Methods 1, 2, or 3 as specified below. Use a water-based dissipating resin type curing compound conforming to ASTM C 309, Type 1, class A or B for Method 3.
- D. Curing Methods:
1. Method 1 – Moisture Curing: Provide moisture curing by one of the following methods:
 - a. Keep concrete surface continuously wet by covering with water.
 - b. Continuous water-fog spray.
 - c. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water, and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.
 2. Method 2 – Moisture-Retaining Cover Curing: Provide moisture-retaining cover curing as follows:
 - a. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape. Water may be added to concrete surface to prevent drying before the cover is installed, but the surface shall not be flooded with water if a non-absorptive cover is used.
 3. Method 3 – Curing or Curing and Sealing Compound: Provide curing, liquid membrane-forming curing, or curing and sealing compound as follows:
 - a. Apply specified compound to concrete slabs as soon as final finishing operations are complete (within two hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Do not allow to puddle. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period. Apply second coat for sealing two to three hours after the first coat was applied.
 - b. Do not use membrane-forming curing and sealing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring (such as ceramic or quarry tile, glued-down carpet, vinyl composition tile, linoleum, sheet vinyl, rubber, athletic flooring, synthetic turf, or wood), paint, or other coatings and finish materials. Dissipating resin type cures are acceptable in these locations.

3.10 HOT WEATHER CONCRETING

- A. Definition:
1. Conditions warranting hot weather concreting practices are defined as any combination of high air temperature, low relative humidity, and wind velocity tending to impair the quality of fresh or hardened concrete or otherwise result in abnormal properties. If conditions cause an evaporation rate of 0.2 pounds per square foot per hour or greater as calculated by the figure "NRMCA Nomograph for Estimating Evaporation Rate on the Basis of Menzel Formula" in Appendix A of ACI 305.1, then precautions shall be taken to prevent plastic shrinkage cracks from occurring.
- B. Specification: Follow hot weather concreting practices specified below when required to limit the concrete temperature at the truck discharge point to the stated maximum acceptable temperature.
- C. Records: Under hot weather conditions, the Contractor shall keep records of outside air temperature, concrete temperature at truck discharge and general weather conditions.
- D. Hot Weather Concreting Requirements: The following items, all or in part as required, shall be followed to limit the concrete temperature to the stated maximum acceptable temperature and to minimize the possibility of plastic shrinkage cracks from developing.
1. Design the concrete mixtures specifically for hot weather conditions replacing some cement with fly ash or other pozzolan and using a water reducing retarding admixture (ASTM C 494 Type D).
 2. Use the largest size and amount of coarse aggregate compatible with the job.
 3. Use sunshades and/or windbreaks.
 4. Delay construction of indoor slabs-on-grade until the walls and roof are constructed.
 5. Cool and shade aggregate stockpiles.
 6. Use ice as part of the mixing water or cool the water with liquid nitrogen. Do not place concrete that contains unmelted ice.
 7. Limit the number of revolutions at mixing speed to 125 maximum.
 8. Reduce time between mixing and placing as much as possible.

9. Do not add water to ready-mixed concrete at the job site unless it is part of the amount required initially for the specified water-cement ratio and the specified slump.
10. Schedule concrete placement for early morning, late afternoon, or night.
11. Have all forms, equipment, and workers ready to receive and handle concrete.
12. Maintain one standby vibrator for every three vibrators used.
13. Keep all equipment and material cool by spraying with water including exteriors of forms, reinforcing steel, subgrade, chutes, conveyors, pump lines, tremies, and buggies.
14. Protect slab concrete at all stages against undue evaporation by applying a fog spray or mist above the surface or applying a monomolecular film. Where high temperatures and/or placing conditions dictate, use water-reducing retarding admixture (Type D) in lieu of the water-reducing admixture (Type A) as directed by the Owner's Testing Laboratory.
15. Provide continuous curing, preferably with water, during the first 24 hours using wet burlap, cotton mats, continuous spray mist, or by applying a curing compound meeting ASTM C 1315. Continue curing for three days minimum.
16. Cover reinforcing steel with water soaked burlap so that steel temperature will not exceed ambient air temperature immediately before placement of concrete.
17. As soon as possible, loosen forms and run water down the inside. When forms are removed, provide a wet cover to newly exposed surfaces.

3.11 COLD WEATHER CONCRETING

A. Definition:

1. Concrete shall not be placed when the outside air temperature is 40°F or less unless cold weather concreting practices are followed as specified below.
2. Cold weather concreting practices should also be followed whenever the average daily air temperature is expected to be less than 40°F for more than three successive days. The average daily air temperature is the average of the highest and lowest temperature occurring during the period from midnight to midnight. The requirement for adhering to these cold-weather concreting practices may be terminated when the air temperature is above 50° F for more than half of any 24 hour duration.
3. Cold-weather concreting practices invoked shall keep the temperature of the concrete immediately after placing within the following temperature ranges:
 - a. 55° to 75° F for sections less than 12 inches in the least dimension.
 - b. 50° to 70° F for sections 12 to 36 inches in the least dimension.
 - c. 45° to 65° F for sections 36 to 72 inches in the least dimension.
 - d. 40° to 60° F for sections greater than 72 inches in the least dimension.
4. Concrete Protection: Protect the concrete immediately after placing and during the defined protection period such that the concrete does not freeze nor fall below the temperature levels stated in the above paragraph. For concrete not loaded during construction, the protection period shall be for a minimum of three days if cold-weather conditions persist. The time may be reduced to a minimum of two days if Type III cement or an accelerating admixture is used or if an additional 100 pounds of cement per cubic yard is added to the concrete mix. Concrete fully loaded during construction shall be protected during cold weather conditions for whatever time is required to obtain the required strength as determined by nondestructive strength tests (Windsor probe, Swiss Hammer Test) on the in-place concrete. Protect concrete surfaces from freezing for the first 24 hours even if cold-weather conditions do not officially exist due to high volatility in ambient temperatures.
5. Protection Deficiency: If the temperature requirements during any portion of the protection period are not met but the concrete surface did not freeze, the protection period shall be extended until twice the deficiency expressed in degree-hours is made up. Deficiency degree-hours are defined as the average deficiency in temperature below the required value times the number of hours the deficiency persisted. Make-up degree hours are the average increase in temperature above the minimum value times the hours required to make up twice the deficiency degree-hours. Contact the Architect/Engineer if the concrete surface was allowed to freeze during the protection period.
6. Protection Removal: As the protection is being removed the decrease in temperature measured at the surface of the concrete in a 24 hour period shall not exceed the following:
 - a. 50° F for sections less than 12 inches in the least dimension.
 - b. 40° F for sections 12 to 36 inches in the least dimension.
 - c. 30° F for sections 36 to 72 inches in the least dimension.
 - d. 20° F for sections greater than 72 inches in the least dimension.
7. The maximum concrete temperature heated by artificial means at point of placement shall not exceed 90°F.

- B. Records: Under cold weather conditions, the Contractor shall keep records of outside air temperature, concrete temperature as placed and general weather conditions. The temperature record shall be taken no less than two times per 24 hour duration.
- C. Cold Weather Concreting Requirements: The following items, all or in part as required, should be followed to assure acceptable concrete in cold weather conditions:
 1. Design the concrete mixture to obtain high early strength by using higher cement content, a high early strength cement (Type III), or a specified non-chloride accelerator (ASTM C 494 Type C or E).
 2. Protect the concrete during curing period using insulating blankets, insulated forms, enclosures, and/or heaters.
 3. Concrete cured in heated enclosures shall have heaters vented to prevent exposure of concrete and workmen to noxious gases.
 4. Frozen subgrade shall be thawed prior to concrete placement and snow and ice shall be removed from forms.
 5. Temperature of embedments in concrete must be heated to above 32°F prior to placing concrete
 6. Heat the mixing water and then blend hot and cold water to obtain concrete no more than 10°F above the required temperature.
 7. Heat the aggregates by circulating steam in pipes placed in the storage bins for air temperatures consistently below 32°F. When either water or aggregate is heated to over 140°F, combine them in the mixer first to obtain a maximum temperature of the mixture not to exceed 140°F in order to prevent flash set of the concrete.
 8. Uniformly thaw aggregates far in advance of batching to prevent moisture variations in the stockpile.
 9. Cover warmed stockpiles with tarps to retain heat.
 10. Place air entraining admixture in the batch after the water temperature has been reduced by mixing with cooler solid materials.
 11. Use wind screens to protect concrete from rapid cooling.
 12. Place vertical pump lines inside the building, if possible, for concrete being pumped.
 13. Maintain artificial heat as low as possible to reduce temperature stresses during cooling.
 14. Avoid water curing of concrete except for parking garage structures. Apply the required curing compound to unformed surfaces as soon as possible to prevent drying of concrete from heated enclosures.
 15. Delay form stripping as long as possible to help prevent drying from heated enclosures and to reduce damage to formed surfaces caused by premature stripping.
 16. Provide triple thickness of insulating materials at corners and edges vulnerable to freezing.
 17. Wrap protruding reinforcing bars with insulation to avoid heat drain from the warm concrete.
 18. Gradually reduce the heat at the end of the heating period to reduce likelihood of thermal shock.

3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor rods for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads and landings and associated items. Cast-in safety inserts and accessories as shown on drawings. Screed, tamp and finish concrete surfaces as scheduled.

3.13 INVESTIGATION OF LOW CONCRETE STRENGTH TEST RESULTS

- A. Contractor Responsibility for Low Strength Concrete:
 1. If the average of any three consecutive strength tests falls below the required f'_c for a class of concrete but no individual strength test is more than 500 PSI below the required f'_c , the Contractor shall immediately notify the Engineer by telephone or email and take immediate steps to increase the average of subsequent strength tests.
 2. If any individual strength test falls more than 500 PSI below the required f'_c , the Contractor shall immediately notify the Engineer by telephone or e-mail and take immediate steps to assure that the load-carrying capacity of the structure is not jeopardized.
- B. Additional Field Tests to Confirm Low Concrete Strengths:

1. The cost of all investigations of low-strength concrete, as defined by any individual strength test being more than 500 PSI below the required f_c , shall be borne by the Contractor.
2. Code-Prescribed Acceptance: The only accepted field-test methods of determining actual in-situ concrete strength is by the way of core tests as prescribed by ACI 318.
3. Non-Destructive Tests: If any individual strength test falls more than 500 PSI below the required f_c , the Engineer may request that non-destructive field tests be performed on the concrete in question using Swiss Hammer, Windsor Probe, or other appropriate methods as approved by the Engineer. Report the comparative test results of the suspect concrete under consideration with identical tests done on concrete of known strength and of the same class. The Engineer considers these test results as only approximate indicators of strength and may not necessarily, by themselves, resolve the low concrete strength issue. These test results will be considered as additional information by which to make an informed judgment. The Engineer reserves the right to accept the concrete based on the results of these approximate tests or order that core tests be taken as prescribed below. At the Contractor's option, the approximate non-destructive field-tests may be waived and core tests immediately initiated.
4. Core Tests: If, in the opinion of the Engineer, the likelihood of low-strength concrete is confirmed and it has been determined that the load-carrying capacity of the structure is significantly reduced as a result, the Engineer may request that core tests be taken from the area in question as directed by the Engineer. There shall be a minimum of three cores taken for each strength test more than 500 PSI below the required f_c in accordance with ASTM C 42. If concrete in the structure will be dry under service conditions, cores shall be air dried (temperature 60° to 80°F, relative humidity less than 60 percent) for seven days before test and shall be tested dry. If concrete in the structure will be more than superficially wet under service conditions, cores shall be immersed in water for at least 40 hours and tested wet. The Contractor shall fill all holes made by drilling cores with an approved drypack concrete.
5. Acceptance Criteria for Core Test: Concrete in an area represented by core tests shall be considered adequate if the average of three cores is equal to at least 85% of the required f_c and no single core is less than 75% of the required f_c . If approved by the Engineer, locations of erratic core strengths may be retested to check testing accuracy.
6. Load Test: If the concrete strength is not considered adequate based on core tests and the structural adequacy remains in doubt, the Engineer may order a load test as specified in ACI 318 be conducted for the questionable portion of the structure.
7. Strengthening or Demolition of the Structure: If the structural adequacy of the affected portion of the structure remains in doubt following the load test, the Engineer may order the structure to be strengthened by an appropriate means or demolished and rebuilt at the Contractor's expense.

3.14 CONCRETE SURFACE REPAIRS

A. Defective Areas:

1. Formed Surfaces: Concrete surfaces requiring repairs shall include all cracks in excess of 0.01" and any other defects that affect the durability or structural integrity of the concrete. Voids, including honeycombing and rock pockets, and tie holes shall be repaired as required by the specified Surface Finish.
2. Unformed Surfaces: Concrete surfaces requiring repair shall include all surface defects such as crazing, cracks in excess of 0.01" wide or cracks that penetrate to reinforcement or through the member, popouts, spalling, and honeycombs.

B. Classification:

1. Structural Concrete Repair: Major defective areas in concrete members that are load carrying (such as shear walls, beams, joists and slabs), are highly stressed, and are vital to the structural integrity of the structure shall require structural repairs. Structural concrete repairs shall be made using a two-part epoxy bonder, epoxy mortar, or specified polymer repair mortar. The Engineer shall determine the locations of required structural concrete repairs.
2. Cosmetic Concrete Repair: Defective areas in concrete members that are non-load carrying and minor defective areas in load carrying concrete members shall require cosmetic concrete repair when exposed to view and not covered up by architectural finishes. Cosmetic concrete repairs may be made using a polymer repair mortar and compatible bonding agent. The Architect/Engineer shall determine the locations of required cosmetic concrete repairs. Stains and other discolorations that cannot be removed by cleaning and are exposed to view will require cosmetic repair. Cosmetic concrete repair in exposed-to-view surfaces will require Architect's approval prior to patching operation.
3. Slab Repairs: High and low areas in concrete slabs shall be repaired by removing and replacing defective slab areas unless an alternate method, such as grinding and/or filling with self-leveling

underlayment compound or repair mortar is approved by the Architect/Engineer. Repair of slab spalls and other surface defects shall be made using epoxy products as specified above and as determined by the Engineer. The high strength flowing repair mortar may be used for areas greater than one inch in depth.

3.15 FIELD QUALITY CONTROL

- A. Field Testing and Inspection: Refer to Specification **014529 “Structural Testing and Inspections”** for testing and inspection requirements associated with cast-in-place concrete.

END OF SECTION



DIVISION 05

METALS



SECTION 05 50 00
METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish labor, materials, tools, equipment, and services for Miscellaneous Metal Fabrications, as indicated, in accordance with provisions of Contract Documents.
- B. Completely coordinate with work of other trades.

1.2 REFERENCES

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. ASTM A27 Standard Specification for Steel Castings, Carbon, for General Application
 - b. ASTM A36 Standard Specification for Carbon Structural Steel
 - c. ASTM A47 Standard Specification for Ferritic Malleable Iron Castings
 - d. ASTM A48 Standard Specification for Gray Iron Castings
 - e. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - f. ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - g. ASTM A148 Standard Specification for Steel Castings, High Strength, for Structural Purposes
 - h. ASTM A197 Standard Specification for Cupola Malleable Iron
 - i. ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 psi Tensile Strength
 - j. ASTM A325 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
 - k. ASTM A354 Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
 - l. ASTM A500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
 - m. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - n. ASTM A668 Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
 - o. ASTM A992 Standard Specification for Structural Steel Shapes
 - 2. American Society of Mechanical Engineers (ASME):
 - a. ANSI/ASME-A17.1 Handbook on Safety Code for Elevators and Escalators
 - 3. American Institute of Steel Construction (AISC)
 - a. Steel Construction Manual
 - 4. American Iron and Steel Institute (AISI):
 - a. Specification for the Design of Cold-Formed Steel Structural Members.
 - 5. American Welding Society (AWS):
 - a. ANSI/AWS C1.1M/C1.1 Recommended Practices for Resistance Welding
 - b. ANSI/AWS D1.1 Structural Welding Code - Steel.
 - c. ANSI/AWS D1.3 Structural Welding Code - Sheet Steel.
 - 6. National Association of Architectural Metals Manufacturers (NAAMM):

- a. Class 1, Architectural, per NAAMM AMP-555, Code of Standard Practice for the Architectural Industry.

1.3 SUBMITTALS

- A. Product Data:
 1. For each type of material and accessory.
- B. Shop Drawings:
 1. Plans and elevations showing members and connections.
 2. Anchors and accessory items.
- C. Project Information:
 1. Structural calculations for Miscellaneous Metals Fabrications indicating design conforms to specified design criteria, sealed by the Specialty Structural Engineer.
 - a. Submit concurrent with Shop Drawings.

1.4 QUALITY ASSURANCE

- A. Provide Miscellaneous Metals Fabrications engineered to support dead, live, and lateral (wind or seismic) loads where indicated or required by code.
 1. Comply with Section 01 71 21 Specialty Engineering Requirements.
 2. Include headers and reinforcing members around openings.
 3. Required details defining method of fastening throughout system and attachments to supporting primary structure included in engineering requirement.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Materials Listed:
 1. Base: As noted.
- B. Galvanizing Repair Paint:
 1. Base:
 - a. Tnemec.
 2. Optional:
 - a. ZRC Worldwide.
 - b. Sherwin-Williams.
- C. Shop Primer:
 1. Base:
 - a. As recommended by finish coat manufacturer for substrate.
 2. Optional:
 - a. Sherwin-Williams.
 - b. Tnemec.
- D. Non-shrink Grout:
 1. Base:
 - a. Dayton Superior Corporation.
 2. Optional:
 - a. Sauereisen.
 - b. CGM Building Products.
- E. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 MATERIALS

- A. Structural Steel:
 - 1. Structural W and T shapes: ASTM A992, 50 ksi yield point.
 - 2. Other steel shapes and plate: ASTM A36.
 - 3. Pipe: ASTM A53 Grade B.
 - 4. Tubing: ASTM A500, Grade B, 46 ksi minimum.
- B. Cast Steel:
 - 1. ASTM A27, Grade-65-35; and ASTM A148, Grade-80-50.
- C. Steel Forgings:
 - 1. ASTM A668.
- D. Bolts:
 - 1. ASTM A307, ASTM A325, ASTM A354.
- E. Filler Metal:
 - 1. AWS Standards.
- F. Cast Iron:
 - 1. ASTM A48, Class 30, minimum 30,000 psi tensile strength.
- G. Malleable Iron:
 - 1. ASTM A47 and ASTM A197.
- H. Aluminum:
 - 1. ASTM B308 for particular alloy in standard shapes and extrusions.
 - 2. ASTM B26 for castings.
- I. Stainless Steel:
 - 1. ASTM A484 and ASTM A276.
 - 2. Concealed: Type 302 or Type 304.
- J. Fasteners:
 - 1. Galvanized or stainless where built into exterior walls.
 - 2. Select fasteners for type, grade and class required.
 - 3. Bolts and Nuts: Regular hexagon head ASTM A307, Grade A.
 - 4. Lag Bolts: Square or octagonal head type.
 - 5. Machine Screws: Zinc-Nickel plated steel.
 - 6. Wood Screws: Flat head carbon steel.
 - 7. Plain Washers: Round carbon steel.
 - 8. Lock Washers: Helical spring carbon steel.
- K. Non-shrink Grout:
 - 1. Compressive strength: 9000 psi at 7 days.
 - 2. Base Product: 1107 Advantage Grout by Dayton Superior.
- L. Abrasive Warning Tape:
 - 1. Self-adhering, tape with slip resistant mineral surface
 - 2. Color: Safety Yellow
 - 3. Width: 2 inches, except where noted otherwise
 - 4. Tape Type 2:

- a. Base Product: Safety-Walk 530 Conformable by 3M
- b. Backing: Aluminum foil
- c. Thickness: 0.035 inches
- d. Use Type 2 at top and bottom rungs of ladders.

2.3 FABRICATION

- A. Form to shapes indicated with straight lines, sharp angles, and smooth curves.
- B. Shop-fabricate in as large assemblies as practicable.
- C. Anchorage Accessories:
 1. Items required securing wood to metal, wood to masonry, metals to masonry or concrete, metal to metal or metal to other items.
- D. Drill or punch holes with smooth edges for temporary field connections and attachment of work by other trades.
 1. Conceal fastenings where practicable.
- E. Make permanent shop and field connections with continuous fillet type welds.
 1. Grind exposed welds smooth.
- F. Supply items required to complete construction and installation.
- G. Meet requirements specified under Structural Steel for fabricating items of structural nature or use.

2.4 FINISHES

- A. Items not to receive coatings:
 1. Surfaces scheduled to be fireproofed with spray-on material.
 2. Machined surfaces.
 3. Surfaces adjacent to field welds.
 4. Contact surfaces of bolt connections at slip connections.
 5. Top flanges of beams to receive shear connectors.
 6. Items for which no coating or field finish is specified.
- B. Shop Primer for Interior Non-wet Items:
 1. Primer: Coordinate with field applied finish systems specified in Section 09 91 23.
 2. Apply primer for interior finish paint to following surfaces not receiving other coating:
 - a. Surfaces exposed on interior.
 3. Clean thoroughly before priming; remove mill scale, rust, dirt, oil, and grease in accordance with SSPC-SP3.
 4. Apply in accordance with paint manufacturer's instructions.
 - a. Apply minimum 0.002 inch, dry film thickness.
- C. Finish Painting:
 1. Interior: See Section 09 91 23.

2.5 METAL FABRICATIONS

- A. Steel Support Angles, Support Frames, and Loose Lintel Steel Members:
 1. ASTM A36 steel, sizes and configurations as indicated.
 2. Items to be hot dip galvanized:
 - a. Items to be permanently exposed to weather, high humidity, or wet conditions.
 - b. Items set into exterior walls.
 3. Shop prime interior items not required to be galvanized.

B. Miscellaneous Equipment Supports:

1. ASTM A36 steel, Sizes and configurations as indicated.
2. Examples of items included:
 - a. Supports for Folding Partitions, Operable Walls, Coiling Doors, and Grilles.
 - b. Supports for ICU Doors.
 - c. Support of Medical Equipment including Surgical Lights, Power Columns. And other items indicated.
 - d. Ceiling hung toilet partitions.
 - e. Other miscellaneous support items as indicated.
3. Items to be hot dipped galvanized:
 - a. Items to be permanently exposed to weather, high-humidity, or wet conditions.
 - b. Items set into exterior walls.
4. Shop Prime interior items in non-wet areas.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify suitability of substrate to accept installation.
- B. Installation constitutes acceptance of responsibility for performance.
- C. Verify wall backing has been installed for wall-mounted items specified in this Section.
 1. See Section 09 22 16.

3.2 INSTALLATION

- A. General:
 1. Set work level, true to line, plumb.
 2. Weld field connections and grind smooth.
 3. Conceal fastenings where practical.
 4. Secure metal to wood with lag screws of adequate size with appropriate washers.
 5. Secure metal to concrete with embedded anchors, setting compounds, caulking and sleeves, or setting grout.
 - a. Use expansion bolts, toggle bolts, or screws for light duty service.
 6. Meet structural requirements for erecting items of structural nature.
 7. Do not field splice fabricated items unless size requires splicing.
 8. Weld splices.
 9. Provide fabricated items complete with attachment devices as required to install.

3.3 TOUCH-UP AND REPAIR

- A. Verify installations are neat and flush in appearance, and that there are no burrs, projections, or defects on exposed surfaces that might snag fingers or clothing. Correct deficiencies.
- B. Touch-up damage to powder coat finishes in manner satisfactory to Architect.
- C. Galvanic Repair:
 1. After galvanized units have been erected and anchored apply galvanizing repair paint in accordance with manufacturer's recommendations.
 2. Surface Preparation: Remove contaminates in accordance with SSPC SP-1.

END OF SECTION



DIVISION 06

WOOD, PLASTICS, AND COMPOSITES



SECTION 06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish labor, materials, tools, equipment, and services for Rough Carpentry, as indicated, in accordance with provisions of Contract Documents.
- B. Completely coordinate with work of other trades.

1.2 REFERENCES

- A. Lumber Grading Rules and Species:
 - 1. US Department of Commerce (DOC):
 - a. PS 20 American Softwood Lumber Standard.
 - 2. Western Wood Products Association (WWPA).
 - 3. Southern Forest Products Association (SFPA).
- B. Plywood Grading Rules and Recommendations:
 - 1. US Department of Commerce (DOC):
 - a. Softwood plywood: PS1 Structural Plywood.
 - 2. American Plywood Association (APA).
- C. Preservative and Fire Retardant Treatment Standards:
 - 1. American Wood Protection Association (AWPA):
 - a. AWPA U1 User Specification for Treated Wood.
 - b. AWPA T1 Processing and Treatment Standard.
 - 2. Underwriters Laboratories (UL)
 - 3. ASTM International requirements:
 - a. ASTM E84 Standard Test Method for Surface Burning Characteristics
 - b. ASTM D2898 Standard Method of Accelerated Weathering of Fire Retardant Treated Wood for Fire Testing
 - c. ASTM D3201 Standard Test Method for Hygroscopic Properties of Fire-Retardant Wood and Wood-Based Products

1.3 SUBMITTALS

- A. Product Data:
 - 1. For each type of material and accessory.
- B. Shop Drawings:
 - 1. Fabricated items.
 - 2. Fastener Patterns: Full-size templates for fasteners in exposed framing.
- C. Project Information:
 - 1. Certification of fire retardant treated material.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: 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.

B. Factory Marking:

1. Identify type, grade, moisture content, inspection service, producing mill, and other qualities.
2. Mark each piece of fire retardant treated material with Underwriters Laboratory Classification mark and fire-retardant treatment for identification.
3. International Building Code (IBC):
 - a. Requirements for identification and labeling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Fire-retardant Treated Lumber and Plywood:

1. Base:
 - a. Hoover Treated Wood Products, Inc.
2. Optional:
 - a. Arxada.
 - b. Koppers Performance Chemicals.
 - c. Viance, LLC.

2.2 MATERIALS

A. Dimensional Lumber and Plywood:

1. Thoroughly seasoned, non-treated, well-fabricated materials.
2. Longest practical lengths and sizes.
3. Application, except where treated types are indicated:
 - a. Non-structural framing, blocking, backing, nailers, grounds, and similar members.
 - b. Other locations where indicated.

B. Fire-retardant Treated Lumber and Plywood (FRT):

1. Flame spread index: Less than 25.
2. Smoke developed index: Less than 450.
3. Free of halogens, sulfates, chlorides, arsenic, ammonium phosphate, formaldehyde, and urea formaldehyde.
4. Kiln dried after treatment, (KDAT).
5. FRT material for interior and above grade locations:
 - a. Base: PyroGuard by Hoover Treated Wood Products, Incorporated
 - b. Optional:
 - 1) Dricon FS by Arxada.
 - 2) FirePro by Western Wood Preservers, Ltd.
 - c. Natural wood products treated to add fire-retardant qualities.
 - d. Type A: not more than 28 percent moisture when tested according to ASTM D3201.
 - e. Interior and above grade applications include but not limited to:
 - 1) Platforms and Stages.
 - 2) Wood in concealed spaces.
 - 3) Framing, blocking, cants, and nailers within roof covering and waterproofing systems.
 - 4) Interior wood items in direct contact with exterior concrete and exterior masonry walls.
 - 5) Window frame blocking within non-rated exterior walls.
 - 6) Plywood backing panels for electrical, telecommunication equipment.

- 7) Similar locations where wood products are indicated and building code does not permit non-fire-resistive treated products.
 - 8) Above grade dimensional lumber and plywood, unless indicated otherwise.
 - a) Exception: Upgrade to exterior grade where scheduled in the following article.
- C. Adhesives for bonding furring, sleepers, sills, and similar items to concrete or masonry:
1. Approved for indicated use by adhesive manufacturer.
 2. Comply with ASTM D3498.
- D. Water-Repellent Preservative:
1. Treat of exposed ends of posts and beams.
 2. National Wood Window and Door Association (NWWDA) tested and accepted formulation.

2.3 FASTENERS

- A. General:
1. Provide fasteners of size and type indicated that comply with requirements specified for material and manufacture.
 2. Where rough carpentry is exposed to weather, in contact with earth, pressure-preservative treated, or in area of high relative humidity:
 - a. Use fasteners with hot dip zinc coating complying with ASTM A153.
 - b. Use fasteners of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1.
- F. Bolts: ASTM A307, Grade A steel bolts with ASTM A563 hex nuts and washers.
- G. Expansion Anchors:
1. Tested in accordance with ASTM E488.
 2. Anchor bolt and sleeve assembly:
 - a. Masonry assemblies: Sustain load equal to 6 times load imposed when installed in unit.
 - b. Concrete assemblies: Sustain load equal to 4 times load imposed when installed in unit.
 3. Interior applications:
 - a. Carbon-steel components.
 - b. Zinc plated to comply with ASTM B633, Class Fe/Zn 5.
 4. Exterior and wet applications:
 - a. Stainless Steel components, ASTM F593 and ASTM F594 Alloy Group 1 or 2.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine conditions under which work is to be installed.
- B. Verify measurements, dimensions, and details before proceeding.
- C. Coordinate location of furring, nailers, blocking, grounds, and similar supports.
- D. Correct unsatisfactory conditions.

3.2 INSTALLATION OF ROUGH CARPENTRY

- A. Form to shapes indicated.

- B. Cut and fit accurately.
- C. Set work to required levels and lines, plumb and true.
- D. Shim as required.
- E. Provide wood grounds or nailers as required for attachment of other work and surface applied items.
- F. Grounds:
 - 1. Dressed, key beveled lumber.
 - 2. Minimum 1-1/2-inch wide by thickness required to bring face of ground even with finish material.
 - 3. Remove temporary grounds when no longer required.
- G. Wall Blocking:
 - 1. Provide in-wall fire-treated wood blocking reinforcement where following items are required to be wall-mounted to interior walls:
 - a. Architectural casework, millwork, cabinets, shelving, wardrobes, and bookcases.
 - b. Handrails at stairwells.
 - c. Between studs at height of wall-mounted door stop, behind stop.
 - 2. Metal wall backing:
 - a. See Section 09 22 16.
- H. Anchor work to support applied loading.
 - 1. Provide washers under bolt heads and nuts.
 - 2. Fasten plywood in accordance with APA recommendations.
 - 3. Use fasteners of size that will not penetrate members where opposite side will be exposed to view or receive finish materials.
 - 4. Predrill holes to avoid splitting wood with fasteners.
 - 5. Do not drive threaded friction type fasteners.

3.3 INSTALLATION OF FIRE RETARDANT TREATED WOOD

- A. Fire retardant treated lumber and plywood used in structural applications shall be applied according to lumber and plywood strength tables provided by manufacturer.
- B. Use only fasteners approved by the manufacturer of fire retardant treated or preservative treated wood.
- C. Field Cuts:
 - 1. Dimensional Lumber: Do not rip or mill fire retardant treated lumber.
 - a. Cross cuts, joining cuts, and drilling holes are permitted.
 - 2. Plywood: Fire retardant treated plywood may be cut in any direction.
 - 3. Field treat cuts and holes in preservative and fire retardant treated material in accordance with AWPA M4.

END OF SECTION



DIVISION 07

THERMAL AND MOISTURE PROTECTION



SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish labor, materials, tools, equipment, and services for Flashing and Sheet Metal, as indicated, in accordance with provisions of Contract Documents.
- B. Completely coordinate with work of other trades.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 2. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - 3. ASTM B209 Standard Specification for Aluminum-Alloy Sheet and Plate
 - 4. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes
 - 5. ASTM B308/B308M Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles
 - 6. ASTM F2329/F2329M Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
- B. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
 - 1. Architectural Sheet Metal Manual

1.3 SUBMITTALS

- A. Product Data:
 - 1. For each type of material and accessory.
- B. Shop Drawings:
 - 1. Dimensioned drawings of profiles and shapes.
 - 2. Plans and elevations to show locations of each shape.
- C. Samples:
 - 1. For finish, color, and color range selection.
- D. Contract Closeout Information:
 - 1. Warranty

1.4 WARRANTY

- A. Furnish 20 year finish warranty on PVDF coated sheet metal, covering color, fade, chalking and film integrity.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Formed Sheet Metal:
 - 1. Base:
 - a. AlumaKlad/ColorKlad.

2. Optional:
 - a. Berridge Manufacturing Company.
 - b. Petersen Aluminum, PAC-CLAD.
- B. Other Materials:
 1. Base Manufacturers as noted.
- C. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 MATERIALS

- A. Sheet Metal – Galvanized Steel with PVDF coating.
 1. ASTM A653/A653M galvanized steel, Z275 G90.
 2. Minimum thickness: 0.024 inches or as noted for individual fabrications.
 3. Smooth
 4. PVDF coating: Minimum 1 mil fluorocarbon coating, 70% PVDF.
- B. Sheet Metal - Stainless Steel:
 1. Type 304 with ASTM-A480 Finish No.4 where exposed.
 - a. Type 302 or 304 where concealed.
 2. Minimum thickness: 0.025 inches or as noted for individual fabrications.

2.3 SHEET METAL FABRICATIONS

2.4 ACCESSORIES

- A. Fasteners:
 1. Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by flashing manufacturer.
 2. Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 3. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
 4. Blind Fasteners: High strength aluminum or stainless steel rivets suitable for metal being fastened.
 5. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 6. Fastener Materials:
 - a. Fasteners for Galvanized Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329/F2320M.
- B. Dissimilar metal and cementitious materials protection:
 1. Alkali resistant bituminous paint.
 2. Tnemec ThemeTar 46-413.
- C. Sealants: Specified in Section 07 92 13.

2.5 FABRICATION

- A. General:
 1. Fabricate true and sharp to profiles and sizes indicated.
 2. Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA Architectural Sheet Metal Manual, which apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated.
 3. Shop fabricate items to greatest extent possible.

4. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 5. Form sheet metal flashing and trim without oil canning, buckling, and tool marks, true to line and level indicated, with exposed edges folded back to form hems.
 6. Conceal fasteners and expansion provisions where possible. Exposed fasteners not allowed on faces exposed to view.
- B. Fabrication Tolerances:
1. Fabricate sheet metal flashing and trim to tolerance of 1/4 inches in 20 feet on slope and location lines as indicated and within 1/8 inches offset of adjoining faces and alignment of matching profiles.
- C. Sealed Joints: Form movable joints in metal to accommodate elastomeric sealant.
- D. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep. Fill with butyl sealant concealed within joints.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Seams in metals with painted, coated, or lacquered finishes:
1. Fabricate nonmoving seams with flat-lock seams.
 2. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.
- G. Seams in Stainless Steel sheet metals:
1. Fabricate nonmoving seams with flat-lock seams.
 2. Tin edges to be seamed, form seams, and solder.
- H. Do not use graphite pencils to mark metal surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify suitability of substrates to accept work.
1. Verify continuous wood blocking is sloped 1:12 and covered with one layer of building paper or roofing membrane.
- B. Installation constitutes acceptance of conditions and responsibility for performance.

3.2 INSTALLATION - GENERAL

- A. Install in accordance with details and recommendations of SMACNA, current edition.
- B. Set shop fabricated interior and exterior preformed corners and intersections.
- C. Set top edges of flashings into reglets as indicated.
- D. Fasten materials at recommended intervals.
- E. Provide slip joints to allow for thermal movement.
1. Use SMACNA Table 3-1, Design J9 - J12, with caulked lap.
 2. Maximum spacing: 10 feet on center.
 3. Provide slip joint in conjunction with splices and corners.
- F. Caulk joints with 2 beads of sealant on each overlap: See Section 07 92 13.
- G. Turn down cap flashing over base flashings 4 inches and caulk.
- H. Form flashings to provide spring action with exposed edges hemmed or folded.

- I. Provide dissimilar metals and materials protection where dissimilar metals come in contact, or where sheet metal contacts mortar or concrete.
- J. Provide miscellaneous sheet metal items not specifically covered elsewhere as indicated or as required to provide a weathertight installation.

3.3 CLEAN-UP

- A. Upon completion of work, repair damaged areas.
- B. Repair finish of PVDF coated flashing which fades or is damaged.
- C. Clean stains and debris.
- D. Remove protective coverings.

END OF SECTION

SECTION 07 84 00
FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish labor, materials, tools, equipment, and services for Firestopping, in accordance with provisions of Contract Documents.
- B. System Description:
 - 1. Through Penetration Firestop Systems for protection of penetrations through following fire resistance rated assemblies, including both blank openings and openings containing penetrating items:
 - a. Floor assemblies.
 - b. Wall and partition assemblies.
 - c. Fire rated smoke barrier assemblies.
 - d. Existing, fire and smoke rated assemblies.
 - 2. Fire Resistive Joint Assemblies for linear voids where fire rated floor, roof, or wall assemblies abut one another, including following types of joints:
 - a. Top and bottom of wall interface with overhead roof or floor structure:
 - 1) Coordinate with acoustical sealant specified in Section 07 92 16.
 - 2) These products may also be provided as an accessory to Non-structural Metal Framing in Section 09 22 16.
 - 3) Select products to maintain acoustical, smoke and fire ratings indicated.
 - b. Fire Rated Expansion Joints: Specified in Section 07 95 13.
- C. Completely coordinate with work of other trades.

1.2 REFERENCES

- A. UL:
 - 1. UL 263, Fire Tests of Building Construction and Materials
 - 2. UL 723, Surface Burning Characteristics of Building Materials
 - 3. UL 1479, Fire Tests of Through Penetration Firestops
 - 4. UL 1489, Fire Tests of Fire Resistant Pipe Protection Systems Carrying Combustible Liquids
 - 5. UL 2079, Tests for Fire Resistance of Building Joint Systems
 - 6. UL Fire Resistance Directory:
 - a. Through Penetration Firestop Systems (XHEZ).
 - b. Joint Systems (XHBN).
 - c. Fill, Void, or Cavity Materials (XHHW).
 - d. Firestop Devices (XHJI).
 - e. Forming Materials (XHKU).
 - f. Wall Opening Protective Materials (CLIV).
 - g. Fire Resistance Ratings (BXRH)
- B. ASTM International (ASTM):
 - 1. ASTM E84 Surface Burning Characteristics of Building Materials
 - 2. ASTM E119 Fire Tests of Building Construction and Materials
 - 3. ASTM E136 Test Method for Behavior of Materials in a Vertical Tube Furnace at 750F
 - 4. ASTM E814 Fire Tests of Through Penetration Fire Stops

5. ASTM E1399 Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems
 6. ASTM E1725, Standard Test Method for Fire Tests of Fire Resistive Barrier Systems for Electrical System Components.
 7. ASTM E1966 Test Method for Fire Resistive Joint Systems
 8. ASTM E2174 Standard Practice for On-site Inspection of Installed Fire Stops
 9. ASTM E2307 Standard Test Method for Determining the Fire Endurance of Perimeter Fire Barrier Systems Using the Intermediate-Scale, Multi Story Test Apparatus (ISMA)
 10. ASTM E2393 Standard Practice for On-site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers
 11. ASTM G21 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
- C. National Fire Protection Association (NFPA):
1. NFPA 70 National Electrical Code
 2. NFPA 101 Life Safety Code
 3. NFPA 221 Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls
 4. NFPA 251 Fire Tests of Building Construction and Materials
- D. Firestop Contractors International Association (FCIA):
1. FCIA Firestop Manual of Practice (MOP).
- E. International Firestop Council (IFC):
1. Recommended IFC Guidelines for Evaluating Firestop Engineering Judgments.
 2. Inspectors Field Pocket Guide.

1.3 SUBMITTALS

- A. Product Data:
1. Product technical data, including:
 - a. Manufacturer's listed design number.
 - b. Manufacturer's installation instructions.
 - c. Manufacturer's specification and technical data for each material including the
 - d. composition and limitations.
 - e. Data sheet for all products and accessories used.
- B. Shop Drawings:
1. Detailed drawings of special conditions:
 - a. Provide UL listing for each type of firestopping assembly to be used.
 - b. When UL listing is not available, provide a written Engineering Judgment in accordance with IFC Recommended Guidelines.
 - 1) Engineering Judgments shall be sealed by a Fire Protection Engineer licensed in [the state the project is located in].
- C. Project Information:
1. UL reports with illustration of systems, system numbers, temperature ratings, and products proposed for use on project.
 2. Contractor Certification per [FM 4991,] UL, HAFSC, or all.
 3. Contractor Certification as UL Qualified Firestop Contractor.
- D. Contract Closeout Information:
1. Provide electronic PDF file of firestop documentation to include following:

- a. Written statement that all fire-rated penetrations have been sealed using products specified in accordance with UL [and FM] requirements for required rating.
 - b. Documentation of all listed systems installed and all engineering judgments.
 - c. Firestop system photograph of each type.
 - d. Installation log.
 - e. IFC guidelines for Engineering Judgments.
 - f. Building Code sections relevant to firestop systems.
2. Provide documentation of Special Inspection of Firestopping.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:

1. Certified, licensed or approved by firestopping manufacturer, trained to install firestop products per specified requirements.
2. Licensed by State or local authority, where applicable.
3. Shown to have successfully completed not less than 5 comparable scale projects.
4. FM Approved in accordance with FM Standard 4991 – Approval of Firestop Contractors.
5. UL Qualified Firestop Contractor.

B. Identification Labels for Firestop Assemblies:

1. Follow guidelines set in Chapter 7 of International Building Code.
2. Coordinate with Section 09 29 00.

C. Identification Labels for Firestop Penetrations:

1. Label penetration on both sides of wall or slab.
2. Label each penetration or group of similar penetrations with a permanent label marked with the following information:
 - a. UL system number.
 - b. Rating.
 - c. Products used.
 - d. Installation date.
 - e. Installer name.
 - f. Penetration reference number unique to each location.

D. Pipe insulation shall not be removed, cut away or otherwise interrupted at wall penetrations or floor openings.

1. Provide products appropriately tested for the thickness and type of insulation utilized.

E. Cabling where frequent cable moves, additions, and changes are likely to occur in future:

1. Where cable trays are used:
 - a. Utilize re-enterable products (e.g., removable intumescent blocks) specifically designed for retrofit.
2. Where cable trays are not used:
 - a. Utilize fire rated cable pathway devices.
 - b. Where not practical, re-enterable products designed for retrofit may be used.

F. Protect penetrations passing through fire resistance rated floor-to-ceiling assemblies contained within chase wall assemblies with products tested by being fully exposed to fire outside of chase wall.

1. Identify systems within UL Fire Resistance Directory with the words: Chase Wall Optional.

G. Fire-resistive Joint Sealant:

1. Provide flexible fire resistive joint sealants to accommodate normal and thermal building movement without seal damage.
 2. Provide fire resistive joint sealants designed to accommodate a specific range of movement.
 - a. Test in accordance with cyclic movement test criteria as outlined in: ASTM E1399, ASTM E1966 or UL 2079.
 3. Provide fire resistive joint systems subjected to an air leakage test.
 - a. Conduct in accordance with UL 2079, with published L-Ratings for ambient and elevated temperatures.
 4. Coordinate firestopping with acoustical sealant requirements in Section 07 92 16.
- H. Subject smoke barrier containment systems to air leakage test.
1. Conduct in accordance with UL 1479, with published L-Ratings for ambient and elevated temperatures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Firestopping:
1. Base:
 - a. Hilti Inc.
 2. Optional:
 - a. 3M
 - b. Rectorseal.
 - c. Specified Technologies, Inc.
 - d. Tremco, Inc.
 - e. United States Gypsum Company.
- B. Forming Materials:
1. Base:
 - a. Hilti Inc.
 2. Optional:
 - a. Rockwool.
 - b. Thermafiber.
- C. Fire Rated Enclosures:
1. Base:
 - a. Tenmat, Inc.
 2. Optional:
 - a. EZ Barrier, Inc.
- D. Other manufacturers desiring approval comply with Section 01 61 00.
1. See systems Volume 2 of UL Building Materials Directory.

2.2 DESIGN CRITERIA

- A. Provide firestop systems in compliance with following requirements:
1. Obtain firestop system for each type of penetration and construction condition from a single firestop systems manufacturer.
 2. Firestop products and systems shall bear classification marking of qualified testing and inspection agency.
 3. Firestopping tests, performed by qualified, testing and inspection agency.

- a. UL or other agency, performing testing and follow up inspection services for firestop systems, acceptable to local authorities having jurisdiction.
- 4. Existing applications for which no tested and listed classified system is available through a manufacturer:
 - a. Provide Engineering Judgment or Equivalent Fire Resistance Rated Assembly (EFRR) for submittal derived from similar UL system designs or other tests approved by local authorities having jurisdiction, prior to installation.
 - b. Engineering judgment drawings must follow requirements set forth by International Firestop Council.
 - c. Fire Protection Engineer providing Engineering Judgements to be NFPA Certified.
- 5. Mold Resistance:
 - a. Less than 1 per ASTM G21.

2.3 MATERIALS

- A. Through Penetration Firestop Systems:
 - 1. VOC content not to exceed 250 g/L.
 - 2. Base Products:
 - a. FS-ONE MAX Intumescent Firestop Sealant.
 - b. CFS-S SIL GG Elastomeric Firestop Sealant.
 - c. CFS-S SIL SL Elastomeric Firestop Sealant.
 - d. CP 620 Fire Foam.
 - e. CP 606 Flexible Firestop Sealant.
- B. Fire Resistive Joints:
 - 1. VOC content not to exceed 250 g/L.
 - 2. Base Products:
 - a. CFS-SP WB Firestop Joint Spray.
 - b. CFS-S SIL GG Elastomeric Firestop Sealant.
 - c. CFS-S SIL SL Elastomeric Firestop Sealant.
 - d. CP 606 Flexible Firestop Sealant.
 - 3. Coordinate with pre-applied firestopping in Section 09 22 16.
- C. Firestop Devices:
 - 1. Factory assembled collars lined with intumescent material sized to fit specific outside diameter of penetrating item.
 - 2. Base Products:
 - a. CP 680 / CID-U / CFS-CID MD-P Cast-in-Place Firestop Device.
 - b. CP 680 / CID-U / CFS-CID MD-M Cast-in-Place Firestop Device.
 - c. CP 681 Tub Box Kit.
 - d. CFS-DID Firestop Drop-In Device.
- D. Intumescent Pads, Wall Opening Protective Materials:
 - 1. Intumescent, non-curing pads or inserts for protection of electrical panels, switch and receptacle boxes, medical gas outlets and valve boxes and other items recessed in face of fire rated walls.
 - 2. Base Product:
 - a. CFP-ES Endo-Shield Low Bio Persistent Endothermic Mat.
 - b. CFS-P PA Firestop Putty Pad.
 - c. CP 617 Firestop Putty Pad.
 - d. Hilti Biox Insert.

E. Fire Rated Cable Pathways:

1. Steel raceway and intumescent pads with adjustable smoke seal sleeve.
2. Fire rating equal to rating of barrier device penetrates.
3. Pathway devices:
 - a. Allow 0 to 100 percent fill of cables.
 - b. Adjust automatically to cable additions or subtractions.
4. Size to accommodate quantity and size of electrical wires and data cables indicated plus 100 percent expansion.
5. Provide cable management devices with gang plates for single or multiple devices.
6. Base products:
 - a. CFS-MSL Modular Sleeve.
 - b. CFS-MSL Modular Sleeve Floor Grid System.
 - c. CP 653 BA Speed Sleeve.
 - d. CFS-SL GP Gangplate.
 - e. CFS-SL GP CAP Gangplate Cap.
 - f. CFS-CC Firestop Cable Collar.
 - g. CFS-SL SK Firestop Sleeve.
 - h. CFS-SL RK Retrofit Sleeve.
 - i. CFS-COS Composite Sheet.

F. Smoke and Acoustic Cable Pathways:

1. Non-rated steel raceway with adjustable smoke seal polyurethane sleeve for single cables and cable bundles.
2. Re-penetrable and self-closing.
3. Base product:
 - a. CS-SL SA Smoke and Acoustic Sleeve.

G. Single Cable and Cable Bundles to 1 inch Diameter:

1. CFS-D Firestop Cable Disc.

H. Endothermic Mat:

1. Low Bio Persistent Endothermic Mat evaluated for protection of cable pathways and liquid fuel lines, for firestopping of through-penetrations and membrane-penetrations, and for achieving T-ratings.
2. Endothermic mat shall be LBC Red list compliant, with foil scrim on both sides.
3. Base Products:
 - a. CFP-ES Endo-Shield Low Bio Persistent Endothermic Mat.

I. Firestop Putty:

1. Intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers, or silicone compounds.
2. Provide firestop putty at, but not limited to, the gap between wire, cabling, or both, exiting an open end of conduit, where conduit penetrates one or both sides of a smoke or fire rated wall assembly.
3. Base products:
 - a. CP 618 Firestop Putty Stick.
 - b. CFS-PL Firestop Plug.

J. Wrap Strips:

1. Single component intumescent elastomeric strips faced on both sides with a plastic film:

2. Base Products:
 - a. CP 643N Firestop Collar.
 - b. CP 644 Firestop Collar.
 - c. CP 648E/648S Wrap Strips.
- K. Firestop Blocks and Plugs:
1. Non-curing, flexible intumescent device.
 2. Re-enterable.
 3. Base products:
 - a. CFS-BL Fire Block.
 - b. CFS-PL Firestop Plug.
- L. Mortar:
1. Portland cement based dry-mix product formulated for mixing with water at Project site to form a non-shrinking, water-resistant, homogenous mortar.
 2. Base product:
 - a. CP 637 Firestop Mortar.
- M. Silicone Sealants:
1. Moisture curing, single component, silicone elastomeric sealant for horizontal surfaces pourable or non-sag or vertical surface non-sag.
 2. Base product:
 - a. CFS-S SIL GG Elastomeric Firestop Sealant.
 - b. CFS-S SIL SL Elastomeric Firestop Sealant.
- N. Pre-formed materials for use with fire-resistance-rated construction joints:
1. Base Products:
 - a. CFS-TTS Firestop Top-Track Seal.
 - b. CFS-TTS MD Firestop Top-Track Seal Metal Deck System.
 - c. CFS-BTS Firestop Bottom-Track Seal.
- O. Preformed Mineral Wool:
1. CP 767 Speed Strips
 2. CP 777 Speed Plugs
- P. Fire Sealant:
1. Single component latex or acrylic formulations that upon cure do not re-emulsify during exposure to moisture.
 2. Base Products:
 - a. CFS-S SIL GG Elastomeric Firestop Sealant.
 - b. CFS-S SIL SL Elastomeric Firestop Sealant.
 - c. CFS-SP WB Firestop Joint Spray.
- Q. Composite Sheet:
1. Non-curing, re-penetrable material.
 2. Base Products:
 - a. CP 675T Firestop Board.
 - b. CFS-BL FireBlock.
- R. Forming Materials:
1. Materials listed as components in laboratory approved designs.

2. Mineral Wool:
 - a. Base Product: SAF by Thermafiber, or
 - b. Similar product specifically named as components in laboratory approved designs.
- S. Perimeter Fire Containment:
1. Specified in Section 07 84 53.
 2. Pre-formed materials for use as part of a Perimeter Fire Barrier System between fire-resistance-rated floors and exterior wall assemblies:
 3. Base Product:
 - a. CFS-EOS Quick Seal Preformed Firestop Device.
- T. Acoustical Sealant:
1. Specified in Section 07 92 16.
 2. Base Products:
 - a. CS-TTS SA Smoke and Acoustic Track Seal
 - b. CFS-BTS Bottom Track Seal.
 - c. CS-S SA Light Smoke and Acoustic Sealant
 - d. CP 506 Smoke and Acoustic Sealant
 - e. CP 572 Smoke and Acoustic Spray
- U. Through Penetration Firestop Systems:
1. Comply with building code and fire code as locally adopted and amended.
 2. Requirements for single membrane penetrations and through penetration firestops are identical.
 - a. Unless otherwise noted, treat penetrants which pass through a single membrane same as though passed through entire fire resistive assembly.
 3. Select each firestop system based on actual field conditions, including penetration type, shape, size, quantities, and physical position within opening.
 4. See Drawings for indication of the required ratings of fire resistive wall, floor, and roof assemblies.
 - a. Indicated ratings are minimum and may be exceeded.
 5. Firestop assemblies at fire rated walls:
 - a. Minimum fire (F) rating for firestop assemblies in walls shall equal that of wall, but not less than 1 hour.
 - b. Minimum temperature (T) rating of firestop assemblies in walls may equal zero.
 - c. Smoke barrier:
 - 1) In addition to (F) rating, (L) rating of maximum 5 cfm/SF.
 - d. Non-rated walls and smoke partitions with no fire resistive requirement:
 - 1) Assembly with (L) rating.
 6. Firestop assemblies at fire rated floors and roofs:
 - a. Minimum fire (F) and temperature (T) ratings of firestop assemblies used in floors or roof shall equal hourly rating of floor or roof being penetrated, but not less than 1 hour.
 - 1) Exception 1: T-rating may equal zero when portion of penetration, above or below floor, is contained within a wall.
 - 2) Exception 2: Firestops are not required for floor penetrations within a 2-hour rated shaft enclosure.
- V. Voids in Wall with No Penetrations:
1. Fill with approved through penetration firestopping system.
 2. Contractor's option: Patch void in wall with like construction.

W. Penetrating Ducts with Dampers:

1. Utilize only firestop materials which are included in damper's classification.
2. Do not install firestop systems that hamper performance of fire dampers.

X. Cable Trays and Similar Devices:

1. Provide re-enterable products specifically designed for removal and re-installation at openings within walls and floors designed to accommodate voice, data, and video cabling.

Y. Electrical panels and devices, medical gas outlets and valve boxes, and other items recessed in to face of rated walls:

1. Where electrical devices are placed on opposite sides of wall and are less than 24 inches apart measured horizontally, install intumescent pads over back of devices in approved manner or maintain continuity of rated barrier within wall cavity surrounding recessed item.

Z. Fire Resistive Joint Assemblies:

1. Where joint will be exposed to elements, fire resistive joint sealant must be approved by manufacturer for use in exterior applications and shall comply with ASTM C920.
2. Head of Wall Assemblies:
 - a. Use at top of fire rated and smoke barrier walls and partitions where they abut floor and roof structures above.
 - b. Select systems with D designation, rated for dynamic movement capability.
 - c. Select systems that can accommodate deflection of structure above.
 - d. Maximum Leakage for Fire resistive Joints in Smoke Barriers: 5 cfm or less per linear foot as tested in accordance with UL 2079.
 - e. Seal non-fire rated sound control walls and smoke partitions with acoustical sealant as specified in Section 07 92 16.
3. Minimum F and T ratings:
 - a. The minimum fire rating for firestop assemblies in walls shall equal that of wall, but not less than 1 hour.
 - b. The minimum temperature rating of firestop assemblies in walls may equal zero.
4. Acceptable Systems:
 - a. Metal stud and drywall partitions: Select system from UL HW-D-0000 Series.
 - 1) For metal stud partitions installed on flat concrete slab use one piece, pre-formed polyurethane foam firestop seal designed for use with standard head joint top tracks and bottom joint tracks or slip-type head joints to maintain continuity of the fire resistance rated assembly indicated.
 - 2) Provide in width and configuration required to accommodate depth and installation of studs and designed to saddle over the top track or under the bottom track.
 - b. Concrete and Masonry Walls: Select system from UL HW-D-1000 Series.
5. Fire rated Expansion Joints:
 - a. See Section 07 95 13.

AA. Fire Rated Enclosures:

1. Provide where required as part of a UL Fire Resistance Directory design for fixtures mounted in rated walls or ceilings.
 - a. Field constructed enclosures meeting Fire Resistance Directory designs will be accepted.
2. Include accessories and install according to enclosure manufacturer's written instructions.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
- B. Field verify existing fire-rated construction and provide firestopping as necessary.
- C. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellents, and any other substances that may inhibit optimum adhesion.
- D. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
- E. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install firestop systems in accordance with manufacturer's instructions and conditions of testing and classification as specified in UL or other acceptable third party testing agency listing.
- B. Penetrations through fire resistive floor assemblies shall be sealed with firestop system providing minimum Class 1 W-rating as tested in accordance with UL 1479 to ensure air and water resistant seal.
- C. Protect materials from damage on surfaces subjected to traffic.
- D. Identification Labels:
 - 1. Identify each firestop assembly as defined in Quality Assurance.
 - 2. Do not locate identification labels, tags, or both, on finished surfaces and where exposed to view by public.

3.3 IDENTIFICATION

- A. Provide identification in accordance with FCIA MOP and FM 4991.
 - 1. Identify firestop systems with pressure-sensitive, self-adhesive, preprinted labels.
 - 2. Attach labels permanently to surfaces of construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems.
 - 3. The following information shall be on the label:
 - a. Firestop Joint Systems:
 - 1) The words "Warning-Firestop System-Do Not Disturb. Notify Building Management of Any Damage."
 - b. Through-Penetration Firestop Systems:
 - 1) The words "Warning-Through Penetration Firestop System-Do Not Disturb. Notify Building Management of Any Damage."
 - c. Installing Contractor's name and Contact Information.
 - d. Through-Penetration firestop listing designation.
 - e. Date of Installation.
 - f. Through-Penetration firestop system manufacturer.
 - g. Installer's Name.

3.4 FIELD QUALITY CONTROL

- A. Provide Special Inspection of all firestopping in accordance with IBC Chapter 17 and Specification Section 01 45 23.
 - 1. Owner shall engage a qualified independent inspection agency to inspect firestop systems in accordance with ASTM E2174, Standard Practice for On-site Inspection of Installed Fire

Stops, and ASTM E2393, Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.

- B. Construct mock up on site to include typical through penetration and fire resistive joint applications for project.
- C. Maintain areas of work accessible until inspection by authorities having jurisdiction.
- D. Where deficiencies are found, repair or replace assemblies to comply with requirements.

3.5 ADJUSTING AND CLEANING

- A. Remove equipment, materials, and debris, leaving area in undamaged, clean condition.
- B. Clean surfaces adjacent to sealed openings free of excess materials and soiling as work progresses.
- C. Perform patching and repair of firestopping systems damaged by other trades.

END OF SECTION

SECTION 07 84 13

PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Penetrations in fire-resistance-rated walls.
- B. Penetrations in horizontal assemblies.
- C. Penetrations in smoke barriers.

1.3 RELATED REQUIREMENTS

- A. Section 07 84 43 - Joint Firestopping for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.
- B. Section 09 29 00 - Gypsum Board for wall identification requirements.

1.4 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.
- C. UL 1479 - Standard for Fire Tests of Penetration Firestops.
- D. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems.
- E. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated including VOC content.
- B. Product Schedule: For each penetration fire stopping system. Include location and design designation of qualified testing and inspecting agency.
 - 1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration fire stopping condition, submit illustration, with modifications marked, approved by penetration fire stopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- C. Qualification Data: For qualified Installer.
- D. Installer Certificates: From Installer indicating penetration fire stopping has been installed in compliance with requirements and manufacturer's written recommendations.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration fire stopping.
- F. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved UL and found to comply with its "Qualified Firestop Contractor Program Requirements."
- B. Installer Qualifications: A firm experienced in installing penetration fire stopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration fire stopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
 - 1. A manufacturer's direct representative (not distributor or agent) shall be on-site during initial installation of firestop systems to train appropriate Contractor personnel in proper selection and installation procedures.

C. Pre-installation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration fire stopping when ambient or substrate temperatures are outside limits permitted by penetration fire stopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration fire stopping 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 openings and penetrating items to ensure that penetration fire stopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration fire stopping.

1.9 SYSTEM APPLICATION DEVIATION

- A. The products shall be installed in accordance with manufactures recommendations/ requirements. Modification to the application shall require a written engineer's judgement from the manufacture acknowledging that the product is appropriate for the application. The documentation shall become part of the permanent record of the building.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Penetration fire stopping shall comply with the following requirements:
 - 1. Penetration fire stopping tests are performed by a qualified testing agency acceptable to Owner.
 - 2. Penetration fire stopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
 - a. Penetration fire stopping products bear classification marking of qualified testing and inspecting agency.
 - b. Classification markings on penetration fire stopping correspond to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek ETL SEMKO in its "Directory of Listed Building Products."

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hilti, Inc.
 - 2. 3M Fire Protection Products

2.3 PENETRATION FIRESTOPPING

- A. Provide penetration fire stopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration fire stopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration fire stopping with ratings determined per ASTM E814 or UL 1479 / UL 2079, based on testing at a positive pressure differential of 0.01-inch.
 - 1. Fire-resistance-rated walls include fire walls, smoke-barrier walls, and fire partitions.
 - 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Provide penetration fire stopping with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch.
 - 1. Horizontal assemblies include floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.
 - 2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
 - 3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
- D. Penetrations in Smoke Barriers: Provide penetration fire stopping with ratings determined per UL 1479.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at 0.30-inch wg at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.
- F. Re-penetrable, round or square cable management devices for use with new cable bundles penetrating gypsum or masonry walls, the following products are acceptable:
 1. Hilti Speed Sleeve (CP 653) with integrated smoke seal fabric membrane
 2. Hilti Firestop Cable Collar (CFS-CC)
 3. Hilti Smoke and Acoustic Sleeve (CS-SL SA) for non-fire rated construction
 4. Hilti Firestop Sleeve (CFS-SL SK)
 5. Hilti Gangplate (CFS-SL GP) for use with multiple cable management devices
 6. Hilti Gangplate Cap (CFS-SL GP CAP) for use at blank openings in gangplate for future penetrations
- G. Re-penetrable, round or square cable management devices for use with existing cable bundles penetrating gypsum or masonry walls, the following products are acceptable:
 1. Hilti Firestop Cable Collar (CFS-CC)
 2. Hilti Retrofit Sleeve (CFS-SL RK) for use with existing cable bundles
 3. Hilti Gangplate (CFS-SL GP) for use with multiple cable management devices
 4. Hilti Gangplate Cap (CFS-SL GP CAP) for use at blank openings in gangplate for future penetrations
- H. VOC Content: Provide penetration fire stopping that complies with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 1. Architectural Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- I. Accessories: Provide components for each penetration fire stopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration fire stopping manufacturer and approved by qualified testing and inspecting agency for fire stopping indicated.
 1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-wool-fiber or rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fillers for sealants.
 2. Temporary forming materials.
 3. Substrate primers.
 4. Collars.
 5. Steel sleeves.
- J. Mold Resistance: Provide penetration firestopping with mold and mildew resistance rating of 0 as determined by ASTM G21

2.4 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Firestop Board: Lightweight firestop board, polyurethane foam material designed for large openings.
- E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- F. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- G. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

- H. 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.
- I. Blocks: Intumescent flexible block. Non-curing, reusable solution for medium to large openings. No compression required.
- J. 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.
- K. Foams: Multicomponent, Liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- L. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions and Spray mastic formulation for use with a power sprayer. For use in top-of-wall joints, curtain wall/edge of slab, expansion joints.
- M. Firestop Sleeve Device: Factory assembled sleeves formed from galvanized steel and lined with intumescent material designed to fit specific diameter of penetration.
- N. Polyurethane Firestop Foam: Two component polyurethane foam created through chemical reaction of polyol, water and poly isocyanate, plus flame retardants and other additives (all included in the polyol component). Foam cures within one minute at room temperature to produce non-shrinking smoke-tight firestopping system and does not require additional firestop coating.

2.5 MIXING

- A. For those products requiring mixing before application, comply with penetration fire stopping 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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing penetration fire stopping 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 fire stopping.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration fire stopping. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: 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.
- C. Masking Tape: Use masking tape to prevent penetration fire stopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire stopping's seal with substrates.

3.3 INSTALLATION

- A. General: Install penetration fire stopping 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 fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire stopping.
- C. Install fill materials for fire stopping by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 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.
- D. Following product installation, appropriate measure shall be taken to prevent damage to the product by weather or other construction related hazards. Failure to appropriately protect the product may reduce the effectiveness; therefore, damage sections will be completely removed and reapplied at the contractor's cost.

3.4 IDENTIFICATION

- A. Identify penetration fire stopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of fire stopping edge so labels will be visible to anyone seeking to remove penetrating items or fire stopping. 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 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 fire stopping 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 fire stopping is 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 fire stopping and install new materials to produce systems complying with specified requirements.

3.6 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. Firestop Systems with No Penetrating Items (FS-1): Comply with the following:
 - 1. Pipes, plastic or metal, conduit in vertical runs, installed through cast-in-place firestop devices.
 - a. Acceptable UL-Classified Systems with FA 1000 Series Systems equivalent to, but not limited to, the following:
 - 1) FA1016, FA1017, FA2053, FA2054 by Hilti.
 - 2) CP 680 Cast-in Firestop Device by Hilti
- D. Firestop Systems with No Penetrating Items (FS-2): Comply with the following:
 - 1. Acceptable UL-Classified Systems with CAJ 0000 Series Systems equivalent to, but not limited to, the following: CAJ0055, CAJ0070 by Hilti or CAJ0012, CAJ0102 by Grace.
 - 2. Type of Fill Materials: One or more of the following:
 - a. Latex sealant.

- b. Silicone sealant.
 - c. Acrylic sealant.
 - d. Intumescent putty.
 - e. Mortar.
 - f. Preformed intumescent blocks.
 - g. Pillows/Bags
- E. Firestop Systems for Metallic Pipes, Conduit, or Tubing (FS-3): Comply with the following:
- 1. Acceptable UL-Classified Systems with CAJ, WL, or FC 1000 Series Systems, equivalent to, but not limited to, the following: CAJ1184, CAJ1291, CAJ1277, CAJ1382, CAJ1388, WL1054, WL1249, WL1462, WL1506, FC1009 by Hilti or CAJ1403, CAJ1235, CAJ1406, WL1152, WL1207, FC1020 by Grace.
 - 2. Type of Fill Materials: One or more of the following:
 - a. Latex sealant.
 - b. Silicone sealant.
 - c. Acrylic sealant.
 - d. Intumescent putty.
 - e. Mortar.
 - f. Polyurethane firestop foam.
- F. Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing (FS-4): Comply with the following:
- 1. Acceptable UL-Classified Systems with CAJ, FA, or WL 2000 Series Systems, equivalent to, but not limited to, the following: CAJ2109, FA2053, WL2078, WL2128 by Hilti or CAJ2212, CAJ2171, CAJ2210, WL2167, WL2185, WL2170, WL2259 by Grace.
 - 2. Type of Fill Materials: One or more of the following:
 - a. Intumescent sealant.
 - b. Intumescent putty.
 - c. Intumescent wrap strips.
 - d. Firestop device.
 - e. Firestop sleeve device.
 - f. Latex sealant.
- G. Firestop Systems for Electrical Cables (FS-5): Comply with the following:
- 1. Acceptable UL-Classified Systems with CAJ, FC, or WL 3000 Series Systems, equivalent to, but not limited to, the following: CAJ3095, CAJ3283, FA3060, FC3012, WL3065, WL3112, WL3334 by Hilti or CAJ3185, CAJ3199, CAJ3234, FC3018, FC3060, WL3179 by Grace.
 - 2. Type of Fill Materials: One or more of the following:
 - a. Intumescent sealant.
 - b. Latex Sealant
 - c. Pillows/bags
 - d. Intumescent putty.
 - e. Silicone foam.
 - f. Pre-formed firestop sleeve.
- H. Firestop Systems for Insulated Pipes (FS-6): Comply with the following:
- 1. Acceptable UL-Classified Systems with CAJ or WL 5000 Series Systems, equivalent to, but not limited to, the following: CAJ5091, FA5017, WL5029 by Hilti or CAJ5222, WL5171 by Grace.
 - 2. Type of Fill Materials: One or more of the following:
 - a. Intumescent sealant.
 - b. Silicone foam.
 - c. Intumescent wrap strips.
 - d. Pre-formed intumescent blocks.
 - e. Latex sealant.
 - f. Firestop sleeve device.
- I. Firestop Systems for Miscellaneous Electrical Penetrants (FS-7): Comply with the following:
- 1. Acceptable UL-Classified Systems with CAJ 6000 Series Systems equivalent to, but not limited to, the following: CAJ6006, CAJ 6017, CAJ6042, WL6019, by Hilti or CAJ6012, CAJ6013, CAJ6027 by Grace.
 - 2. Type of Fill Materials: One or more of the following:
 - a. Intumescent sealant.

- b. Latex sealant
 - c. Intumescent putty.
 - d. Mortar.
 - e. Pre-formed intumescent blocks
- J. Firestop Systems for Miscellaneous Mechanical Penetrations (FS-8): Comply with the following:
- 1. Acceptable UL-Classified Systems with CAJ 7000 Series Systems equivalent to, but not limited to, the following: CAJ7046, CAJ7051, by Hilti or CAJ7067, CAJ7075, CAJ7082 by Grace.
 - 2. Type of Fill Materials: One or both of the following:
 - a. Intumescent sealant.
 - b. Latex sealant.
 - c. Mortar.
 - d. Acrylic sealant.
 - e. Silicone sealant.
- K. Firestop Systems for Groupings of Penetrations (FS-9): Comply with the following:
- 1. Acceptable UL-Classified Systems with CAJ or WL 8000 Series Systems, equivalent to, but not limited to, the following: CAJ8056, CAJ8096, WJ8007, WL8014, WL8019 by Hilti or CAJ8042, CAJ8101, CAJ8133, WL8007 by Grace.
 - 2. Type of Fill Materials: One or more of the following:
 - a. Latex sealant.
 - b. Mortar.
 - c. Intumescent wrap strips.
 - d. Firestop device.
 - e. Intumescent composite sheet.
 - f. Pre-formed intumescent blocks.

END OF SECTION 07 84 13

SECTION 07 84 43

JOINT FIRESTOPPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Joints in or between fire-resistance-rated constructions.
- B. Joints in smoke barriers.

1.3 RELATED REQUIREMENTS

- A. Section 07 21 00 - Thermal Insulation for floor-to-wall joints indicated as perimeter fire-containment systems between perimeter edge of fire-resistance-rated floor assemblies and back of non-fire-resistance-rated exterior curtain walls.
- B. Section 07 84 13 - Penetration Firestopping for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.
- C. Section 09 22 16 - Non-Structural Metal Framing for firestop tracks for metal-framed partition heads.

1.4 REFERENCE STANDARDS

- A. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems
- B. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials
- C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems
- D. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus
- E. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.
 - 1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- C. Qualification Data: For qualified Installer.
- D. Installer Certificates: From Installer indicating fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fire-resistive joint systems.
- F. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."
- B. Installer Qualifications: A firm experienced in installing fire-resistive joint systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its fire-resistive joint system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

- C. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:
 - 1. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:
 - a. Fire-resistive joint system products bear classification marking of qualified testing agency.
 - b. Fire-resistive joint systems correspond to those indicated by reference to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek ETL SEMKO in its "Directory of Listed Building Products."

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure fire-resistive joint 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 fire-resistive joint systems are installed according to specified requirements.
- B. Coordinate sizing of joints to accommodate fire-resistive joint systems.
- C. Notify Owner's testing agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on day preceding each series of installations.

PART 2 PRODUCTS

2.1 FIRE-RESISTIVE JOINT SYSTEMS

- A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E1966 or UL 2079:
 - 1. Joints include those installed in or between fire-resistance-rated walls, floor or floor/ceiling assemblies, and roofs or roof/ceiling assemblies.
 - 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.
 - 3. Manufacturers:
 - a. A/D Fire Protection Systems Inc.
 - b. Hilti, Inc.
 - c. Nelson Firestop Products.
 - d. RectorSeal Corporation.
 - e. Specified Technologies Inc.
 - f. 3M Fire Protection Products.
- C. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079.
 - 1. L-Rating: Not exceeding 5.0 cfm/ft (0.00775 cu. m/s x m) of joint at 0.30 inch wg (74.7 Pa) at both ambient and elevated temperatures.
 - 2. Manufacturers:
 - a. Hilti, Inc.
 - b. Nelson Firestop Products.
 - c. RectorSeal Corporation.
 - d. Specified Technologies Inc.
 - e. 3M Fire Protection Products.

- D. VOC Content: Provide fire-resistive joint systems that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Architectural Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- E. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems 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: Clean joints immediately before installing fire-resistive joint systems 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 fill materials.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by fire-resistive joint 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.
- C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

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 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 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 fill materials for fire-resistive joint systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply fill materials so they contact and adhere to substrates formed by joints.
 - 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. Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so labels will be visible to anyone seeking to remove or penetrate joint 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 - Fire-Resistive Joint System - 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 (AS NEEDED)
- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections at Contractor or project cost.
 - B. Where deficiencies are found or fire-resistive joint systems are damaged or removed due to testing, repair or replace fire-resistive joint systems so they comply with requirements.
 - C. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and installations comply with requirements.
- 3.6 CLEANING AND PROTECTING
- A. Clean off excess fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint 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 fire-resistive joint 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 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.
- 3.8 FIRE-RESISTIVE JOINT SYSTEMS
- A. Where UL-classified fire-resistive joint systems are indicated, they refer to alphanumeric designations listed in UL's "Fire Resistance Directory" under product Category XHBN.
 - B. Floor-to-Floor, Fire-Resistive Joint System (FRJS-1):
 1. Acceptable UL-Classified Products:
 - a. FFD1011, FFD1012, FFD1013, FFD1026 by Hilti.
 - b. FFD1024 & FFD1027 – Grace Flamesafe
 2. Assembly Rating: Refer to Drawings.
 3. Nominal Joint Width: As indicated.
 4. Movement Capabilities: Class II; refer to Drawings.
 - C. Floor-to-Wall, Fire-Resistive Joint System (FRJS-2):
 1. Acceptable UL-Classified Products:
 - a. FWD1011, FWD1012, FWD1013, FWD1021 by Hilti.
 - b. FWD1020 & FWD1024 – Grace Flamesafe
 2. Assembly Rating: Refer to Drawings.
 3. Nominal Joint Width: As indicated.
 4. Movement Capabilities: Class II; refer to Drawings.
 - D. Head-of-Wall, Fire-Resistive Joint System (FRJS-3):
 1. Acceptable UL-Classified Products:
 - a. HWD0042, HWD0045, HWD0046, HWD0097, HWD0098 by Hilti.
 - b. HWD0107, HWD0146, HWD0144, HWD1047, HWD1021, HWD1024, HWD0148, HWD0149, HWD0150, HWD-0267, HWD-0299, HWD-257 & HWD-0300– Grace Flamesafe
 2. Assembly Rating: Refer to Drawings.
 3. Nominal Joint Width: As indicated.
 4. Movement Capabilities: Class II; refer to Drawings.
 - E. Wall-to-Wall, Fire-Resistive Joint System (FRJS-4):
 1. Acceptable UL-Classified Products:
 - a. WWD1011, WWD1012, WWD0017 by Hilti.
 - b. WWD1028 & WWD1029 – Grace Flamesafe

2. Assembly Rating: Refer to Drawings.
3. Nominal Joint Width: As indicated.
4. Movement Capabilities: Class II; refer to Drawings.

3.9 PERIMETER FIRE-CONTAINMENT SYSTEMS

- A. Where fire-rated floor assemblies are required, seal voids at intersection of exterior wall and floor assembly with an approved material per building code requirements.
- B. Perimeter Fire Containment Systems are only valid if the certain wall construction details exactly match those called for in a selected UL/Omega Point-classified system. If the details do not match, submit an engineer judgment drawing from the firestop material manufacturer in accordance with the requirements of Part 1 of this Section.
- C. Perimeter Fire-Containment System:
 1. Acceptable Omega Point-Classified Products:
 - a. CEJ216P, CEJ244P, CEJ245P, CEJ246P, CEJ259P, CEJ260P, CEJ261P, CEJ262P, CEJ263P by Hilti.
 - b. CEJ150P, CEJ151P, CEJ152P, CEJ153P, CEJ154P, CEJ-273P, CEJ-274P, CEJ-275P, CEJ-276P, CEJ-296P & CEJ-297P – Grace Flamesafe.
 2. Assembly Rating: Refer to Drawings.
 3. Nominal Joint Width: As indicated.
 4. Movement Capabilities: Class II; refer to Drawings.

END OF SECTION 07 84 43

SECTION 07 92 00

JOINT SEALANTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Silicone joint sealants.
- B. Urethane joint sealants.
- C. Mildew-resistant joint sealants.
- D. Latex joint sealants.
- E. Acoustical joint sealants.
- F. Preformed sealants.

1.3 RELATED REQUIREMENTS

- A. Section 07 62 00 - Sheet Metal Flashing and Trim
- B. Section 09 29 00 - Gypsum Board
- C. Section 09 22 16 - Non-Structural Metal Framing
- D. Section 10 28 00 - Toilet and Bath Accessories

1.4 REFERENCE STANDARDS

- A. ASTM C834 - Standard Specification for Latex Sealants
- B. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants
- D. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems
- E. ASTM C1193 - Standard Guide for Use of Joint Sealants
- F. ASTM C1247 - Standard Test Method for Durability of Sealants Exposed to Continuous Immersion in Liquids.
- G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants
- H. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
- I. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
- J. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Use ASTM C1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Submit not fewer than four pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
 - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
 - 5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

1.6 SUBMITTALS

- A. Product Data: For each joint-sealant product and accessories indicated, including VOC content.
 - 1. Products and accessories should be reviewed and approved by UTSW PM as applicable.
- B. Samples for Verification: 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.
- D. Qualification Data: For qualified Installer.
- E. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- G. Field-Adhesion Test Reports: For each sealant application tested.
- H. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- 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.

1.8 PROJECT 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.

1.9 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which 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's standard form in which joint-sealant manufacturer agrees to furnish joint sealants 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: 20 years from date of Substantial Completion for silicone sealants.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from natural 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 MATERIALS, 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.
- B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
 - 1. Architectural Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Liquid-Applied Joint Sealants: Comply with ASTM C920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 - 1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C1247. Liquid used for testing sealants is de-ionized water, unless otherwise indicated.
- D. Stain-Test-Response Characteristics: Where sealants are specified to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C1248 and have not stained porous joint substrates indicated for Project.
- E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- F. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant (S:) ASTM C920, Type S, Grade NS, Class 50, for Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Master Builders Solutions; Omniseal 50.
 - b. Dow Corning Corporation; 795.
 - c. GE Advanced Materials - Silicones; SilGlaze II SCS2800.
 - d. Pecora Corporation; 864.
- B. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant(S-S:) ASTM C920, Type S, Grade NS, Class 25, for Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Master Builders Solutions; Omniplus.
 - b. Dow Corning Corporation; 786 Mildew Resistant.
 - c. GE Advanced Materials - Silicones; Sanitary SCS1700.
 - d. Tremco Incorporated; Tremsil 200 Sanitary.

2.3 URETHANE JOINT SEALANTS

- A. Multi-component, Non-sag, Urethane Joint Sealant (U-NS): ASTM C920, Type M, Grade NS, Class 50, for Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pecora Corporation; Dynatrol II.
 - b. Polymeric Systems, Inc.; PSI-270.
 - c. Tremco Incorporated; .
- B. Multi-component, Self-Leveling, Traffic-Grade, Urethane Joint Sealant (U-TB): ASTM C920, Type M, Grade SL, Class 50, for Use T.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Polymeric Systems, Inc.; PSI-270.
 - b. Tremco Incorporated; Dymeric 240 FC.
 - c. Pecora; Dynatread.
- C. Urethane, Immersible, S, NS, 35, T, NT, I: Immersible, single-component, nonsag, plus 35 percent and minus 35 percent movement capability, traffic- and non-traffic use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 35, Uses T, NT, and I.
 - 1. Products:
 - a. Master Builders Solutions; MasterSeal NP1.

- b. Sika Corporation.
 - D. Urethane, Immersible, M, NS, 25, T, NT, I: Immersible, multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and non-traffic use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 25, Uses T, NT, and I.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Master Builders Solutions; MsterSeal NP2.
 - b. Sika Corporation.
- 2.4 MILDEW RESISTANT JOINT SEALANTS
- A. Mildew-Resistant Joint Sealants (S-S): 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, non-traffic use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
 - 1. Products:
 - a. GE Construction Sealants, Momentive Performance Materials, Inc.; SCS1700 Sanitary.
 - b. Pecora Corporation: Pecora 860.
 - c. The Dow Chemical Company: Dow Corning 786 Silicone Sealant; White.
- 2.5 LATEX JOINT SEALANTS
- A. Latex Joint Sealant (L): Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
 - 1. Products:
 - a. Master Builders Solutions; MasterSeal-NP 520.
 - b. Bostik, Inc.; Chem-Calk 600.
 - c. May National Associates, Inc.
 - d. Pecora Corporation; AC-20+.
 - e. Tremco Incorporated; Tremflex 834.
- 2.6 ACOUSTICAL JOINT SEALANTS (AC)
- A. Acoustical Joint Sealant: Manufacturer's standard non-sag, paintable, non-staining latex sealant complying with ASTM C834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.
 - 1. Products:
 - a. Pecora Corporation; AC-20 FTR.
 - b. USG Corporation; SHEETROCK Acoustical Sealant.
- 2.7 PREFORMED JOINT SEALANTS (PF)
- A. Preformed Foam Joint Sealant: Manufacturer's standard preformed, pre-compressed, open-cell foam sealant manufactured from urethane foam with minimum density of 10 lb/cu. ft. (160 kg/cu. m) and impregnated with a nondrying, water-repellent agent. Factory produce in pre-compressed sizes in roll or stick form to fit joint widths indicated; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.
 - 1. Products:
 - a. EMSEAL Joint Systems, Ltd.; Emseal 25V.
 - b. Sandell Manufacturing Co., Inc.; Polyseal.
 - c. Willseal USA, LLC; Willseal 150.
 - d. MM Systems, Color Joint Silicone
 - e. Master Builders Solutions, WABO Weather Seal II
- 2.8 MISCELLANEOUS MATERIALS
- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from pre-construction joint-sealant-substrate tests and field tests.
 - 1. As recommended by manufacturer, provide quick drying solvent-based primer.
 - a. Acceptable product:
 - 1) Master Builders Solutions; MasterSeal P 173

- 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: Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.
- D. Backer Rod:
 - 1. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing
 - 2. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F (minus 32 deg C). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance
 - 3. 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 where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable

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 joint-sealant 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 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.
 - d. 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 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.
 - 1. All urethane joint sealants used in concrete to be primed before installation.
- 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 C1193 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 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.
- E. 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 C1193, unless otherwise indicated.
 - 4. Provide flush joint profile where indicated per Figure 8B in ASTM C1193.
 - 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- F. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, 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 C919 and with manufacturer's written recommendations.

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 joint sealants and of products in which joints occur.

3.5 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 and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

- A. Sealant Schedule:
 - 1. Interior Joints:
 - a. Wall and ceiling joints subject to movement: Designation U-MC.
 - b. Wall and ceiling joints not subject to movement: Designation AL.
 - c. Interior side of exterior openings: U-MC.
 - d. Floor joints: Designation U-TB.
 - e. Wall and ceiling joints between frames and their rough opening: Designation AL.

- f. Wall and ceiling joints between frames and adjoining surfaces: Designation AL.
 - g. Interior Sanitary Joints; Joints Between Plumbing Fixtures and Adjoining Floor, Wall, and Ceiling Surfaces; Joints Between Shower Door Enclosure Components and Adjacent Finish Surfaces; Joints in Dietary and Food Preparation Areas, Kitchens, Food Storage Areas, and Areas Subject to Frequent Wet Cleaning, including joints between walls and floors, Joints Between Back Splashes and Wall Substrates: Designation S-S.
2. Exterior locations:
- a. Wall joints:
 - 1) Bordered on both sides by porous building material (concrete, stone, masonry, exterior insulation and finish systems): Designation S-GP PF
 - 2) Bordered on both sides by non-porous building material (coated and uncoated metals, anodized aluminum, porcelain tile, and glass): Designation S-GP PF
 - 3) Bordered on one side by porous building material (concrete, stone, masonry) and other side by non-porous building material (coated and uncoated metals, anodized aluminum, porcelain tile, and glass): Designation S-GP PF
 - b. Perimeter of penetrations through walls: Designation S-GP
 - c. Control joints (filling of V-grooves) and perimeter of penetrations in Portland cement plaster walls: Designation S-GP.
 - d. Expansion joints in ceilings, soffits, and overhead surfaces: Designation S-GP
 - e. Control joints and perimeter of penetrations in ceilings, soffits, and overhead surfaces: Designation S-GP
 - f. Wall and ceiling joints between frames and their rough opening: Designation S-GP.
 - g. Wall and ceiling joints between frames and adjoining surfaces: Designation S-GP.
 - h. Joints and perimeter of penetrations in horizontal pedestrian and vehicle traffic surfaces: Designation U-TB.
 - i. Joints in Division 07 Section "Sheet Metal Flashing and Trim:" Designation S-GP.

END OF SECTION 07 92 00



DIVISION 08

OPENINGS



SECTION 08 06 71
DOOR HARDWARE SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish labor, materials, tools, equipment, and services for Door Hardware, as indicated, in accordance with provisions of Contract Documents.
- B. Notify Architect of items which will not operate properly, attain the required fire label, or where components are physically or functionally incompatible.
- C. Completely coordinate with work of other trades.

1.2 REFERENCES

- A. Builders Hardware Manufacturers Association, BHMA:
 - 1. ANSI/BHMA 1301 Materials and Finishes.
 - 2. ANSI/BHMA 156 Series Standards.
- B. Door and Hardware Institute: Architectural; Hardware Consultant Certification.
- C. ICC/ANSI 117.1 Accessible and Usable Building and Facilities.
- D. National Fire Protection Association, NFPA:
 - 1. NFPA 70 National Electrical Code.
 - 2. NFPA 80 Standard for Fire Doors and Other Opening Protectives.
 - 3. NFPA 101 Life Safety Code.
 - 4. NFPA252 Standard Methods of Fire Tests of Door Assemblies.
- E. United Laboratories, LLC, UL Solutions:
 - 1. UL 10B Standard for Safety-Fire Tests of Door Assemblies.
 - 2. UL 10C Standard for Positive Pressure Fire Tests of Door Assemblies.
 - 3. UL 1784 Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives.
- F. U.S. Department of Justice: 2010 ADA Standards for Accessible Design.

1.3 SUBMITTALS

- A. Product Data:
 - 1. For each type of material and accessory.
- B. Shop Drawings:
 - 1. Complete Hardware Schedule by door.
 - a. Complete list of products including model numbers and cut sheets.
 - b. Use Heading Numbers logically derived from Architect's Hardware Set numbers.
 - c. Hardware Sets shall follow the guidelines established in Door and Hardware Institute Handbook (DHI) Sequence and Format for the Hardware Schedule.
 - d. Notify Architect of items which will not operate properly, attain the required fire label, and where components are physically or functionally incompatible.
 - 2. Diagrammatic Elevations and Point-to-Point Wiring Diagrams of openings scheduled to receive electrified hardware and electronic access control devices.
 - a. Provide detailed wiring diagrams showing connections for signaling, control and locking functions and notes pertinent to programming, operation, etc.

- b. When door hardware sets include automatic operators and locking or latching hardware on the same doors, provide detailed wiring diagrams.
 - c. Submit with Hardware Schedule.
- C. Project Information:
- 1. Certification that items bear UL label where required.
 - 2. Meeting minutes from Pre-Installation Meeting.
- D. Contract Closeout Information:
- 1. Schedule of components installed as hardware sets for each opening.
 - 2. Operating and maintenance data.
 - a. Parts catalog for each product furnished.
 - b. Keying records.
 - 3. Owner instruction report.
 - 4. Letter stating extra material has been delivered.

1.4 QUALITY ASSURANCE

- A. Hardware Supplier Qualifications:
- 1. Architectural door hardware supplier with warehousing facilities.
 - 2. Operating in the project's vicinity for a period of not less than 2 years.
 - 3. Certified Architectural Hardware Consultant (AHC) available throughout construction.
- B. Electrified Hardware Supplier Qualifications:
- 1. Experienced door hardware supplier who has completed projects with electrified door hardware similar in material, design, and extent to that indicated for this project and acceptable to manufacturer of materials.
 - 2. Prepare data for electrified door hardware based on testing and engineering analysis of manufacturer's assemblies similar to those in this project.
- C. Fire Rated Door Assemblies:
- 1. Provide door hardware rated for use in assemblies complying with NFPA 80.
 - 2. Include listed and labeled hardware from a qualified testing agency, for fire protection ratings indicated,
 - 3. Comply with Positive Pressure Requirements UL-10C, Category A or NFPA 252.
- D. Smoke and Draft Control Assemblies:
- 1. Maximum Leakage: 3 cfm/SF of door face area when tested at pressure of 0.10 inches water per UL 1784.
 - 2. Applicability:
 - a. Doors in Smoke Partitions, Smoke Barriers, and Corridor walls.
 - b. Doors forming part of an Elevator Lobby enclosure.
 - 3. Provide S-Labels where required.
- E. Finish designations and standards: Builders Hardware Manufacturers Association (ANSI/BHMA) Standard 1301.
- F. Regulatory Requirements:
- 1. Barrier free design requirements of the local jurisdiction and Americans with Disabilities Act (ADA).
 - 2. Listing requirements of the local jurisdiction and UL listing where applicable by type.
- G. Preinstallation Conference:

1. Prior to installation of hardware, [Construction Manager] [Contractor] to conduct on-site meeting to instruct hardware installer personnel in the proper installation of hardware and related electronics.
 - a. Manufacturer's Reps for Locksets, Closers, Exit Devices, and other major hardware devices shall be present and direct instruction of installers.
 - b. Require attendance of affected parties, not limited to: [Construction Manager] [Contractor], hardware installer, electrical installer, door and frame installers and security installer, where applicable, and installer working with low voltage wiring of electromechanical hardware.
 - c. Discuss installation sequence of components, point-to-point wiring diagrams, and address questions raised by installers.

1.5 SPECIAL WARRANTY

- A. Written warranty in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within 3 years from date of Substantial Completion, or 25 years from date of Substantial Completion in the case of manual surface closers.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

1.6 MAINTENANCE

- A. Extra Materials:
 1. Provide special tools as supplied by hardware manufacturer, for each different or special hardware component.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed in Related Sections:
 1. 08 71 00 - Door Hardware

2.2 HARDWARE SETS – INTERIOR

HARDWARE GROUP NO. 103WX

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5	652	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50HD RHO	626	SCH
1	EA	SFIC EVEREST CORE	80-037 CKC	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	SEALS	488S PSA H & J	BK	ZER

-HARDWARE SPECIFICATION DESIGNED TO SHOW FUNCTIONALITY, DESIGN AND PERFORMANCE REQUIREMENTS.

-VERIFY EXISTING HINGE HEIGHT AND SIZE. MATCH EXISTING HINGE PREP.

HARDWARE GROUP NO. 501GWX

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	ND70HD RHO	626	SCH
1	EA	SFIC EVEREST CORE	80-037 CKC	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	SET	GASKETING	140A-S	A	ZER

-HARDWARE SPECIFICATION DESIGNED TO SHOW FUNCTIONALITY, DESIGN AND PERFORMANCE REQUIREMENTS.

-VERIFY EXISTING HINGE HEIGHT AND SIZE. MATCH EXISTING HINGE PREP.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Coordinate reinforcement or other preparation of doors and frames.
- C. Installation constitutes responsibility for performance.
- D. Coordinate installation power supply and communication wiring to electrically operated devices.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's installation instructions, supervised or inspected by an AHC.
- B. Furnish items of hardware for proper door swing.
- C. Permanently install hardware after finishing operations are complete.
- D. Protect finishes by temporary coverings as required.
- E. Mounting Heights:

Item	Height ^{1,2} (To Item Centerline)
Mortise Locksets	40-5/16 inches AFF to CL of Strike 3
Cylindrical Locksets	
Patient Latches	
Exit Devices	
Door Pulls	42 inches AFF to CL of Pull
Pushplates	45 inches AFF to CL of Plate
Auxiliary Deadbolts	48 inches AFF to CL of Strike
Butt Hinges (and Pivots)	Top Hinge: Not more than 11-3/4 inches down from frame
	Bottom Hinge: Not more than 13 inches above floor
	Equally spaced between Top and Bottom Hinges. Refer to Part 2 for quantity required.

Item	Height ^{1,2} (To Item Centerline)
Other Items	Comply with SDI and DHI Recommendations
Footnotes/Additional Requirements: <ol style="list-style-type: none"> 1. Mounting Heights shall also comply with ADA and ICC/ANSI 117.1 2. Mounting Heights shall also comply with Building Code and Fire Codes. 3. Deviation from listed height will be allowed up to + 1-1/2 inches provided it does not cause a conflict between the lock and lite cutouts. 	

- F. Install hardware with fasteners concealed where not required by code to be exposed.
- G. Coordinate installation of electric access control hardware.
 1. Hardware installer to be responsible for coordination with electrical installer for low voltage installations.
- H. Door Position Switches (DPS):
 1. Coordinate door and frame preparations with door and frame suppliers, and Security System installer as appropriate.
 2. Locate in frame head approximately 4 inches from latching door edge, unless otherwise instructed.

3.3 ADJUST AND CLEAN

- A. Adjust and check each operating item of hardware to ensure proper operation or function.
 1. Lubricate moving parts with lubricant recommended by manufacturer.
 2. Replace units which cannot be adjusted and lubricated to operate smoothly.
- B. Conversion of Construction Keying to Permanent (by Contractor):
 1. Convert cylinders from Construction to Permanent configuration at time of Substantial Completion.
 2. Demonstrate conversion method to Owner's facility personnel, making certain Owner's team understands methodology.
- C. Approximately six months after substantial completion, check and readjust to assure proper function of doors and hardware.
 1. Clean and lubricate operational items.
 2. Replace items which have deteriorated or failed.
 3. Prepare a written report of current and predictable problems in operation of hardware.
 4. Report visit and furnish copy of report to Owner with copy to Architect.
- D. When hardware is installed more than one month prior to final acceptance or occupancy, during week prior to acceptance or occupancy, make a final check and adjustment of hardware items.
 1. Remove temporary coverings.
 2. Clean and lubricate for proper function and finish.
 3. Adjust door control devices to compensate for operation of heating and ventilating equipment.
- E. Instruct Owner's personnel:
 1. Operating and maintenance procedures.
 2. Key control system.

3. Methodology used to re-key cylinders from Construction to Permanent configuration.
- F. Prior to substantial completion instruct Owner's personnel in systems operation.
1. Standard system operation and maintenance.
 2. Modification of codes.
 3. Acquisition, monitoring, and scheduling of ID cards.
 4. Instruction in software applications.

END OF SECTION

SECTION 08 11 14

INTERIOR HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Requirements for standard hollow metal doors frames for interior applications including the following:
 - 1. Standard hollow metal doors
 - 2. Standard hollow metal frames
 - 3. Frame anchors
 - 4. Stops and moldings
 - 5. Louvers
 - 6. Accessories

1.3 RELATED REQUIREMENTS

- A. Section 08 14 23 - Plastic Laminate Faced Doors for wood doors in hollow metal frames.
- B. Section 08 71 00 - Door Hardware for door hardware for hollow metal doors.
- C. Section 08 56 21 - Between-Glass Integral Blind Windows
- D. Division 09 Painting Sections for field painting hollow metal doors and frames.
- E. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators.
- F. Division 28 sections for coordination with other components of electronic access control system.

1.4 ABBREVIATIONS AND ACRONYMS

- A. ANSI: American National standards Institute
- B. ASCE: American Society of Civil Engineers
- C. HMMA: Hollow Metal Manufacturer's Association
- D. NAAMM: National Association of Architectural Metal Manufacturers
- E. SDI: Steel Door Institute
- F. UL: Underwriters Laboratories

1.5 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design
- B. TAS - Texas Accessibility Standards.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- D. ASTM A879/A879M - Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.
- E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
- F. ASTM A1011/A1011M - 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.
- G. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- H. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C.
- I. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcing.
- J. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
- K. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100).

- L. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
- M. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
- N. SDI 111 - Recommendations for Selection and Usage Guide for Standard Steel Doors and Frames.
- O. SDI 117 - Manufacturing Tolerances Standard Steel Doors and Frames.
- P. UL 9 - Standard for Fire Tests of Window Assemblies.
- Q. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.
- R. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.
- S. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
- T. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives.
- U. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.
- V. NFPA 257 - Standard on Fire Test for Window and Glass Block Assemblies.
- W. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

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1.7 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, UL listing, and finishes.
- B. Shop Drawings: Include the following:
 1. Elevations of each door design.
 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.
 10. 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 door hardware schedule.
- C. Samples:
 1. Submit two samples of metal, 2 inch by 2 inch in size (50 mm by 50 mm in size) showing factory finishes, colors, and surface texture.
 2. Louver blade and frame sections, 6 inches (150 mm) long, for each material and finish specified.
 3. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.
- E. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 and UL 10C.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 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.
- C. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are 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. Label each individual glazed lite.
- D. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.
- 1.9 DELIVERY, STORAGE, AND HANDLING
- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
1. Provide additional protection to prevent damage to finish of factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (102-mm-) high wood blocking. Do not store in a manner that traps excess humidity.
1. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.
- 1.10 PROJECT CONDITIONS
- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.
- 1.11 COORDINATION
- A. Coordinate installation of anchorages 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.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amweld Building Products, LLC.
 2. Ceco Door Products; an Assa Abloy Group company.
 3. Curries Company; an Assa Abloy Group company.
 4. Deansteel Manufacturing Co, Inc.
 5. Mesker, dormakaba Group
 6. Republic Doors, an Allegion brand
 7. Steelcraft; an Allegion brand

2.2 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. Frame Anchors: ASTM A879/A879M, Commercial Steel (CS), 40Z (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 according to ASTM A153/A153M, Class B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.
- E. 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 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 6- to 12-lb/cu. ft. (96- to 192-kg/cu. m) density; with maximum

flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

- G. Glazing: Comply with requirements in Division 08 Section "Glazing."
- H. Lead Lining: FS QQ-L-201.

2.3 STANDARD HOLLOW METAL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
 - 1. Design: Flush panel.
 - 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
 - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
 - 3. Vertical Edges for Single-Acting Doors: Square edge.
 - a. Beveled Edge: 1/8 inch in 2 inches (3 mm in 50 mm).
 - 4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch (54-mm) radius.
 - 5. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- (1.0-mm-) thick, end closures or channels of same material as face sheets.
 - 6. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Interior Doors: Face sheets fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 - 1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).
- C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- D. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Interior Frames: Fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames as full profile welded unless otherwise indicated.
 - 3. Frames for Level 2 Steel Doors: 0.053-inch (14 ga.)(1.3-mm-) thick steel sheet.
 - 4. Frames for Wood Doors: 0.053-inch (14 ga.) thick steel sheet.
 - 5. Frames for Borrowed Lights: 0.053-inch (14 ga.) (1.3-mm-) thick steel sheet.
- C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 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 (50 mm) wide by 10 inches (250 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. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
 - 4. Post installed 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, not less than 0.042 inch (1.0 mm) thick, 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 (50-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.6 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as door face sheet in which they are installed.
- B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as frames in which they are installed.
- D. Terminated Stops: Where indicated on interior door frames, terminate stops 6 inches (152 mm) above finish floor with a 45-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.
 - 1. Provide terminated stops unless otherwise indicated.

2.7 LOUVERS

- A. Provide louvers for interior doors, where indicated, that comply with SDI 111, with blades or baffles formed of 0.020-inch- (0.5-mm) thick, cold-rolled steel sheet set into 0.032-inch (0.8-mm) thick steel frame.
 - 1. Sightproof Louver: Stationary louvers constructed with inverted V-shaped or Y-shaped blades.
 - 2. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same testing and inspecting agency that established fire-resistance rating of door assembly.

2.8 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Vision Lite Hinged Privacy Door: (Typical for ARC doors into animal spaces)
 - 1. Door: 20 gauge metal door panel with magnets to secure door in open and closed positions with finger pull to operate. Completely prevents passage of light into space.
 - 2. Opening Size: Sized to provide full coverage of vision lite.
 - a. Dimensions: As indicated on drawings.
 - 3. Finish: Finish to match door.
 - 4. Location: Corridor side of door.
 - 5. Installation: As indicated by manufacturer.

2.9 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 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.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- C. Hollow Metal Doors:
 - 1. Glazed Lites: Factory cut openings in doors.
 - 2. 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.
- D. 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. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - 2. Sidelight 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.
 - 3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 - 5. 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) 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 1 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 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
 - 5) Two anchors per head for frames above 42 inches (1066 mm) wide and mounted in metal-stud partitions.
- c. Compression Type: Not less than two anchors in each jamb.
- d. Post installed 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 doors, 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.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 2. Reinforce doors and frames to receive non-templated, mortised and surface-mounted door hardware.
 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.
- G. Stops and Moldings: Provide stops and moldings around glazed lites 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 type of glazing and type of installation indicated.
- H. Lead Lined Hollow Metal Frames: Equip frames with lead lining where scheduled or indicated. Match thickness of lead with adjacent lead lined walls.
1. Equip frames with angle reinforcing welded to each jamb extending full height from floor to structure above complete with provisions for securing to floor and structure above.

2.10 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pre-treating.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
- B. Color and Gloss: As indicated by manufacturer's designations.

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. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. 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 welded hollow metal frames for squareness, alignment, twist, and plumbness 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 non-templated, 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 ANSI/SDI A250.11 HMMA 840.
 - 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-protection-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 glazing 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 plumbness, squareness, 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 are filled with grout containing anti-freezing agents.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
 - 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 - 5. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
 - 6. In-Place Concrete or Masonry Construction: Secure frames in place with post installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - 7. In-Place Gypsum Board Partitions: Secure frames in place with post installed expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

8. 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. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 3. Smoke-Control Doors: Install doors according to NFPA 105.
 - D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal 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 (50 mm) o.c. from each corner.
- 3.4 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.
 - D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 08 11 14

SECTION 08 14 16
FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish labor, materials, tools, equipment, and services for Flush Wood Doors, as indicated, in accordance with provisions of Contract Documents.
- B. Completely coordinate with work of other trades.

1.2 QUALITY ASSURANCE

- A. Source Limitations:
 - 1. Obtain flush wood doors through one source from a single manufacturer.
- B. Window and Door Manufacturer's Association (WDMA):
 - 1. I.S. 1A Industry Standard for Architectural Wood Flush Doors
- C. American National Standards Institute (ANSI):
 - 1. ANSI A115. W Series, Wood Door Hardware Standards.
- D. Fire Rated Door Standards:
 - 1. Label and list for ratings indicated by ITS – Warnock Hersey, UL or other testing and inspection agency acceptable to authorities having jurisdiction.
 - 2. Factory-apply physical label or approved marking to fire door or fire door frame.
 - 3. Positive pressure:
 - a. Comply with UL 10C Category A or NFPA 252.
 - b. Use concealed intumescent or other tested method.
 - c. Category B applied intumescent seals are not allowed.
- E. Smoke and Draft Control Assemblies:
 - 1. Maximum air leakage rate of door assembly:
 - a. 3.0 cubic feet per minute per square foot of door opening at 0.10 inches of water in accordance with UL 1784.
 - 2. Applications:
 - a. Doors in smoke barriers with fire ratings and fire rated corridor walls.
 - b. Doors forming part of an elevator lobby or doors placed at elevator hoistway openings.
 - 3. Provide S-Labels on smoke and draft control openings.
- F. Sound Control Assemblies:
 - 1. Tested by a laboratory with accreditation for the specific test procedures from a signatory body to the International Laboratory Accreditation Cooperative Mutual Recognition Arrangement.
 - a. Tested door is hung in frame as indicated and is fully operable with hardware and sound control seals installed.
 - 2. Standards identical to assemblies whose transmission loss, STC, and OITC ratings are determined according to ASTM E90, ASTM E413, and ASTM E1332.
 - 3. STC rating: As indicated on Door and Frame Schedule,
 - 4. STC rating: 40.

1.3 SUBMITTALS

- A. Product Data:

1. Include details of construction for each type of door.
 2. Include factory finishing specifications.
 3. Provide manufacturer's technical data for each type of door including details of core and edge construction, trim for openings and factory finishing specifications.
- B. Shop Drawings:
1. Indicate location, size, and hand of each door; elevation of each kind of door; location and extent of hardware blocking.
 2. Indicate dimensions and locations of cutouts.
 3. Indicate requirements for veneer matching.
 4. Describe factory finish and finish requirements.
 5. Indicate fire ratings for fire doors.
- C. Samples:
1. Factory finishes applied to actual door face materials for each material and finish.
 - a. Provide one piece of specified finished work for each wood species and finish.
 - b. Minimum Size: 8 by 10 inches indicating finish.
- D. Contract Closeout Information:
1. Warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Flush Wood Doors:
1. Base:
 - a. Forte Openings.
 2. Optional:
 - a. Oshkosh Door Company.
 - b. VT Industries.
- B. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 DESIGN CRITERIA

- A. Wood Door Manufacturers Association (WDMA):
1. Performance: WDMA I.S.1A-11- Extra Heavy Duty.
 - a. Meet specified performance level without use of additional hardware blocking and without use of through bolts.
 2. Aesthetic Grade: WDMA I.S.1A-11, - Premium Grade except as modified.
- B. Thickness:
1. 1-3/4 inches unless noted otherwise.

2.3 MATERIALS

- A. Base Product: Aspiro Series Wood Veneer Doors by Forte Openings.
- B. Veneer:
1. Veneer thickness: 1/50-inch at 12 percent moisture content.
 2. Veneer grade: HPVA Grade A.

<p>Relative Cost of Various Veneer Types Based on Plain Sliced White Oak</p>

3. Veneer Species (both faces unless otherwise noted):

- a. Select White Maple.
 - 4. Veneer cut:
 - a. Plain Sliced.
 - 5. Veneer leaf match:
 - a. Book match
 - 6. Face assembly match:
 - a. Running
 - 7. Pair and Set match:
 - a. Running match
 - 8. Door vertical edges: Veneer edge banding, same species as face, no joints.
- C. Core:
- 1. Select core types which comply with label for scheduled ratings, sizes, and hardware devices.
 - 2. Bond cores to stiles and rails; drop-in, unbonded cores are not acceptable.
 - 3. Non-Fire Rated Doors:
 - a. PC-5, Extra Heavy Duty Wood Particleboard Core.
 - 4. Fire-rated doors - 20 minutes:
 - a. Core type indicated above for non-rated doors.
 - 5. Fire-rated doors - 45, 60, and 90 minutes:
 - a. Manufacturer's standard Fire Resistant Mineral Core construction as required by label and hardware schedule.
 - b. Provide manufacturers standard edge to meet required fire rating.
 - c. Include blocking as needed for surface applied hardware.
 - 6. Sound Control Doors:
 - a. High Density Particleboard and Insulation as required to achieve sound rating listed in Door and Frame Schedule.
 - 7. Stiles:
 - a. Provide manufacturers standard edge to meet required fire rating.
 - b. Fire rated doors: Fabricate stiles from fire retardant material as allowed by label.
 - c. Meeting stiles where concealed vertical rod (CVR) exit devices are scheduled.
 - 1) Avoid use of applied metal channels where label allows fire retardant material as an alternative.
- D. Rails:
- 1. Solid hardwood or structural composite lumber (SCL).
- E. Cross-banding:
- 1. Engineered wood or wood-based composite, securely bonded to core.
 - 2. Medium density fiberboard (MDF) not acceptable.
- F. Adhesives:
- 1. Face adhesive per WDMA TM-6.
 - 2. Utilize waterproof adhesives for doors indicated near potentially wet conditions.
- G. Lites:
- 1. General:
 - a. Locate bottom of glazed panel 43 inches maximum above finish floor.
 - b. Locate fixed stop at exterior face integral to door.
 - c. Locate removable stop on interior face.

H. Accessories:

1. Metal stile channels:
 - a. Nominal 5 inches metal edge channels at fire rated pairs equipped scheduled to receive concealed vertical rod (CVR) exit devices.
 - b. Use only where fire retardant wood stiles alone are insufficient to satisfy label.
 - c. Material and Finish: Stainless Steel. No. 4 Satin Brushed.
 - d. Concealed intumescent seals: Include where required by fire label.
 - e. Include overlapping metal astragal lip where opening is part of a smoke barrier.
2. Overlapping astragals:
 - a. Provide approved overlapping astragals where required by label but not provided in Section 08 71 00 - Door Hardware.

2.4 FABRICATION

- A. Factory fit doors to suit frame openings with most stringent criteria for uniform clearances in accordance with:
1. National Fire Protection Association NFPA 80 for fire rated doors.
 2. National Fire Protection Association NFPA 105 for smoke control doors.
 3. American National Standards Institute ANSI A250.8.
 4. Locally adopted Building Code.
 5. Wood Door Manufacturers Association (WDMA) pre-fit clearances for factory fit doors.

Door To Frame Clearances		
Location		Clearance
Door to Frame at top and sides		1/8 inches
Meeting Stiles at Pair Doors		1/8 inches
Face of door to face of Stop		1/8 inches
Door Bottom to Floor / Flooring	Typical; all floor covering types	Up to 1/2 inches
	At non-combustible sills	3/8 inches
	Bare floors- No flooring or sills	Up to 3/4 inches

- B. Factory machine doors for hardware that is not surface applied.
1. Comply with final hardware schedules, shop drawings, and hardware templates.
 2. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 3. Factory pre-drill pilot holes for surface applied items.
- C. Hardware Preparation:
1. Make cutouts accurately and neatly.
 2. Glazed lites:
 - a. Factory cut openings in doors.
 - b. Locate bottom of glazed panel 43 inches maximum above finish floor.
 - c. Do not exceed area allowed by code for rated assemblies.
 3. Provide two sets of glazing stop moldings for openings to completely cover cut edges.
 - a. Neatly miter stops at corners.
 4. Cut and trim openings through doors to comply with applicable requirements of referenced standard for kinds of doors required.
 5. Finish as appropriate for material and type:
 - a. Veneer wrapped stops: Finish to match face veneer on doors.

- b. Solid wood stops: Finish to match face veneer on doors.
- 6. Fill nail holes in wood stops.
- D. Top and Bottom Edges:
 - 1. Render top and bottom edges smooth, non-absorptive and readily cleanable.
 - 2. SCL rail finish: Make smooth with the application of veneer tape, plastic laminate, or clear sealer to finish rough or porous edges.
- E. Fire Labels:
 - 1. Affix permanent labels to fire rated units in accordance with agency requirements.
 - 2. On openings where continuous hinges or other items would conceal label, place label in alternate location allowed by listing agency and authorities having jurisdiction.
- F. Finishes:
 - 1. Comply with WDMA finish requirements.
 - 2. Completely finish doors at factory.
 - 3. Stain (STN):
 - a. Type: Manufacturer's standard type.
 - b. Stain color:
 - 1) To be selected by Architect from manufacturer's standard line.
 - 4. Transparent Finish:
 - 1) System WDMA TR-6 catalyzed polyurethane.
 - 2) Sheen: 30 to 40.
- G. Vertical Door Edges:
 - 1. Lock stile edges: Beveled 1/8 inches per 2 inches.
 - a. Fabricate inactive leaves with a square edge at lock stile edge.
 - 1) Active leaves to be beveled per above.
 - 2. Hinge stiles edge: Beveled 1/8 inches per 2 inches.
 - 3. Double acting doors:
 - a. Provide convex, radiused edges at lock stiles and hinge stiles.
 - b. Kerf for privacy gaskets.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify suitability of openings to accept installation.
- B. Verify frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
- C. Reject doors with defects prior to hanging.
- D. Normalize wood doors to ambient conditions and to temperature and humidity levels recommended by manufacturer.
- E. Do not hang doors in frames set out of plumb, out of square, or out of parallel.
- F. Work with frame installer and wall installer to correct misalignment issues.
- G. Proceed with installation only after unsatisfactory conditions have been corrected.
- H. Installation constitutes acceptance of responsibility for performance.

3.2 INSTALLATION

- A. Comply with door manufacturer's written instructions, referenced quality standard, and as indicated.
- B. Drill pilot holes for screws attaching hinges, closers, lock hardware and other devices to stile or face of door.
 - 1. Diameter of pilot hole shall not exceed 90 percent of the root diameter of the screw.
- C. Fit doors to frames and machine for hardware, to extent not previously worked at factory.
- D. Hardware: For installation, see Section 08 71 00, Door Hardware.

3.3 ADJUSTING

- A. Adjust and check doors for proper fit function and uniform clearance at each edge to swing and operate freely.
- B. Leave work complete and in proper operating condition.
- C. Ensure fire labels are intact, and readily visible.

END OF SECTION

SECTION 08 31 13

ACCESS DOORS AND FRAMES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Access doors and frames for walls and ceilings.

1.3 RELATED REQUIREMENTS

- A.
- B. 08 71 00 - Door Hardware for door hardware for keyed cylinders.
- C. 22 00 10 - Basic Plumbing Requirements.
- D. 23 00 00 - Mechanical Design Requirements.

1.4 REFERENCE STANDARDS

- A. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
- B. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.
- C. UL 10B - Standard for Fire Tests of Door Assemblies.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- F. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- G. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- H. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- I. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 SUBMITTALS

- A. Product Data: For each type of access door and frame indicated. Include construction details, fire ratings, materials, individual components and profiles, and finishes.
- B. 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.
- C. Samples for Verification: For each door face material, at least 3 by 5 inches (75 by 125 mm) in size, in specified finish.
- D. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.
- E. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of access door(s) and frame(s) through one source from a single manufacturer.
- B. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics per the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. NFPA 252 or UL 10B for vertical access doors and frames.

2. ASTM E119 for horizontal access doors and frames.
- C. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.7 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

PART 2 PRODUCTS

2.1 STEEL MATERIALS

- A. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS) with A60 (ZF180) zinc-iron-alloy (galvannealed) coating or G60 (Z180) mill-phosphatized zinc coating; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified thickness according to ASTM A924/A924M.
- B. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 1. Surface Preparation for Metallic-Coated Steel Sheet: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A780/A780M.
 - a. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
 2. 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 (0.05 mm).
- C. Drywall Beads: Edge trim formed from 0.0299-inch (0.76-mm) zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.
- D. Plaster Beads: Casing bead formed from 0.0299-inch (0.76-mm) zinc-coated steel sheet with flange formed out of expanded metal lath and in size to suit thickness of plaster.

2.2 STAINLESS-STEEL MATERIALS

- A. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666, Type 304. Remove tool and die marks and stretch lines or blend into finish.
 1. Finish: Directional Satin Finish, No. 4.

2.3 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Acudor Products, Inc.
 2. Babcock-Davis; A Cierra Products Co.
 3. Jensen Industries.
 4. L. Industries, Inc.
 5. Karp Associates, Inc.
 6. Larsen's Manufacturing Company.
 7. Milcor Inc.
 8. Nystrom, Inc.
- B. Flush Access Doors and Frames with Exposed Trim: Fabricated from metallic-coated steel stainless-steel sheet.
 1. Locations: Wall and ceiling surfaces.
 2. Door: Minimum 0.060-inch thick sheet metal, set flush with exposed face flange of frame.
 3. Frame: Minimum 0.060-inch thick sheet metal with 1-inch wide, surface-mounted trim.
 4. Hinges: Continuous piano.
 5. Latch: Cam latch operated by screwdriver with interior release.
- C. Flush Access Doors and Trimless Frames: Fabricated from metallic-coated steel stainless-steel sheet.
 1. Locations: Wall and ceiling surfaces.
 2. Door: Minimum 0.060-inch thick sheet metal, set flush with surrounding finish surfaces.

3. Frame: Minimum 0.060-inch thick sheet metal with drywall bead flange.
 4. Hinges: Continuous piano.
 5. Latch: Cam latch operated by screwdriver with interior release.
- D. Recessed Access Doors and Trimless Frames: Fabricated from metallic-coated steel stainless-steel sheet.
1. Locations: Ceiling surfaces.
 2. Door: Minimum 0.060-inch thick sheet metal in the form of a pan recessed 5/8 inch for gypsum board infill.
 3. Frame: Minimum 0.060-inch thick sheet metal with drywall bead for gypsum board surfaces.
 4. Hinges: Concealed pivoting rod hinge.
 5. Latch: Cam latch operated by screwdriver with interior release.
- E. Fire-Rated, Insulated, Flush Access Doors and Frames with Exposed Trim: Fabricated from metallic-coated steel stainless-steel sheet.
1. Locations: Wall surfaces.
 2. Fire-Resistance Rating: Not less than that of adjacent construction.
 3. Temperature Rise Rating: 250 deg F at the end of 30 minutes.
 4. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 0.036 inch.
 5. Frame: Minimum 0.060-inch thick sheet metal with 1-inch wide, surface-mounted trim.
 6. Hinges: Continuous piano.
 7. Automatic Closer: Spring type.
 8. Latch: Self-latching device operated by flush key with interior release.
- F. Fire-Rated, Insulated, Flush Access Doors and Trimless Frames: Fabricated from metallic-coated steel stainless-steel sheet.
1. Locations: Wall surfaces.
 2. Fire-Resistance Rating: Not less than that of adjacent construction.
 3. Temperature Rise Rating: 250 deg F at the end of 30 minutes.
 4. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 0.036 inch.
 5. Frame: Minimum 0.060-inch thick sheet metal with drywall bead.
 6. Hinges: Continuous piano.
 7. Automatic Closer: Spring type.
 8. Latch: Self-latching device operated by flush key with interior release.
- G. Fire Rated, Uninsulated, Flush Access Doors and Frames with Exposed Trim: Fabricated from metallic-coated steel stainless-steel sheet.
1. Locations: Wall surfaces.
 2. Fire-Resistance Rating: Not less than that of adjacent construction.
 3. Door: Minimum 0.060-inch thick sheet metal, flush construction.
 4. Frame: Minimum 0.060-inch thick sheet metal with 1-inch wide, surface-mounted trim.
 5. Hinges: Continuous piano.
 6. Automatic Closer: Spring type.
 7. Latch: Self-latching device operated by flush key with interior release.

2.4 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 attachment devices and fasteners of type required to secure access panels to types of supports indicated.
 1. Exposed Flanges: Nominal 1 to 1-1/2 inches (25 to 38 mm) wide around perimeter of frame.
 2. For trimless frames with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
 3. For trimless frames with plaster bead for full-bed plaster applications, provide zinc-coated expanded metal lath and exposed casing bead welded to perimeter of frames.
 4. Provide mounting holes in frames for attachment of units to metal or wood framing.

- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.
 - 1. For recessed doors with plaster infill, provide self-furring expanded metal lath attached to door panel.
- E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

2.5 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. Steel and Metallic-Coated-Steel Finishes:
 - 1. Factory Prime: Apply manufacturer's standard, fast-curing, 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 Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - c. Directional Satin Finish: No. 4.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING AND CLEANING

- A. Adjust doors and hardware after installation for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

3.3 SCHEDULE

- A. Wall and ceiling access doors are required:
 - 1. Where specifically scheduled or noted on Drawings.
 - 2. Where service access is required by Code.
 - 3. Where service access is required for serviceable, operable, adjustable or re-settable fire suppression, plumbing, mechanical, electrical, life safety, security, and communications systems items.
- B. Provide stainless steel access doors in restroom, toilet room, locker room, wet areas, operating rooms and other sterile areas, and food service area walls scheduled to receive ceramic tile finish, epoxy paint, or FRP panels.

END OF SECTION 08 31 13

SECTION 08 71 00

DOOR HARDWARE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Finish hardware and accessories required to adequately trim, hang, and operate all doors, as specified and listed in the Hardware Schedule.
 - 1. Provide hardware for doors and frames of unusual profile or shape or other special conditions.
 - 2. Provide all necessary standard and special fasteners, screws, bolts, expansion shields or anchors to properly secure hardware to its intended door, frame, or other surface.

1.3 RELATED REQUIREMENTS

- A. Section 01 77 00 - Closeout Procedures and Submittals
- B. Section 01 79 00 - Demonstration and Training
- C. Section 08 06 71 – Door Hardware Schedule
- D. Section 08 11 13 - Hollow Metal Doors and Frames
- E. Section 08 14 16 - Flush Wood Doors
- F. Section 08 42 29 - Automatic Entrances
- G. Section 28 13 00 - Access Control System

1.4 REFERENCE STANDARDS

- A. The following reference standards and model code documents shall be used in estimating and detailing door hardware, and shall be considered as a standard of quality, function, and performance, as applicable:
 - 1. ICC (IBC): International Building Code (current year adopted).
 - 2. DHI WDHS.3: Recommended Locations for Architectural Hardware for Flush Wood Doors.
 - 3. NFPA 70: National Electrical Code.
 - 4. NFPA 80: Fire Doors & Windows (current year adopted).
 - 5. NFPA 101: Life Safety Code (current year adopted).
 - 6. NFPA 105: Smoke Control Door Assembly. (current year adopted).
 - 7. NFPA 252: Standard Methods of Fire Tests of Door Assemblies.
 - 8. ANSI A117.1: Accessibility and Usability for Physically Handicapped People.
 - 9. ANSI A250.6: Hardware on Standard Steel Doors (Reinforcement--Application).
 - 10. ADAAG: Americans with Disabilities Act Accessibility Guidelines.
 - 11. TAS: Texas Accessibility Standards.
 - 12. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 SUBMITTALS

- A. Product Data: Provide a catalog cut sheet, clearly marked and identified, illustrating and describing each product included in the Hardware Schedule.
 - 1. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Formulate catalog cut sheets into sets and include a set with each copy of the Hardware Schedule submitted.
- B. Door Hardware Schedule: Prepared by or under the supervision of Architectural Hardware Consultant, 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.
 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Fire rating and UL listing.
 - c. Complete designations of every item required for each door or opening including name and manufacturer.
 - d. Fastenings and other pertinent information.
 - e. Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule. Use same scheduling sequence and format and use same door numbers and hardware set numbers as in the Contract Documents.
 - f. Explanation of abbreviations, symbols, and codes contained in schedule.
 - g. Mounting locations for door hardware.
 - h. Door and frame sizes and materials.
 - i. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
 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.
 - a. Shop drawings shall be reviewed by the UTSW Key Control Shop.
 - C. Wiring Diagrams: For electrified hardware items specified for this Project, Provide complete wiring diagrams along with riser drawings and elevations, showing locations where such material is to be installed. Wiring Diagrams shall be submitted with Hardware Schedule. Verify and coordinate with the electrical systems installer. Integration shall take effect into central system as specified by Owner.
 1. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.
 2. Sequence of Operation: Include description of component functions that occur in the following situations:
 - a. Authorized person wants to enter
 - b. Authorized person wants to exit
 - c. Unauthorized person wants to enter
 - d. Unauthorized person wants to exit
 - D. Samples for Verification: If so requested by the Architect, provide a sample of any product or item requested, properly marked and tagged, for the opening for which it is intended.
 1. Tag samples with full product description to coordinate samples with door hardware schedule.
 - E. Keying: Provide a keying schedule, listing the levels of keying, (GGMK, GKD, MKD or KA) as well as an explanation of the key system's function, the key symbols used and the numbers of the doors controlled. Provide in conjunction with the Door Index/Keying Schedule (which lists the door number, schedule heading, lock type and individual key symbol and remarks or special instructions) mentioned in above. Project shall be Masterkeyed and/or Grand Masterkeyed and provide two (2) keys per lockset or cylinder. LOA (Letter of Authorization) must be obtained from Key control to build or order keys, cores, or key systems. All Master, Control, and blank keys must be shipped to UTSW Key Control to maintain integrity.
 - F. Operation and Maintenance Data: For each type of door hardware to include in maintenance manuals. Provide latest, revised and updated schedule of finish hardware, complete with catalog cuts and keying schedule. In addition, furnish one (1) copy of maintenance and parts manuals for those items for which they are readily available and normally provided.
 - G. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.
- 1.6 COORDINATION
- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings for other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

- B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant and UTSW Access Control.
- C. Electrical System Roughing-
In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- D. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, the supplier shall field verify existing conditions, verify the specified hardware will work as requested, and coordinate installation of door hardware to suit opening conditions and to provide proper door operation. Provide alternate solutions and proposals as needed.
- E. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 - 1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2. Preliminary key system schematic diagram.
 - 3. Requirements for key control system.
 - 4. Address for delivery of keys.
 - 5. Location of Key Cabinet.

1.7 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
- B. Keying Conference: Conduct conference at Project site.
 - 1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's Key Control Shop.
 - 2. Incorporate conference decisions into keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 - a. Flow of traffic and degree of security required.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.
 - d. Address for delivery of keys.

1.8 QUALIFICATIONS

- A. Installer Qualifications: An experienced installer who has completed 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.
- B. Supplier Qualifications: Door hardware supplier with warehousing facilities in Project's vicinity and who is or employs a qualified Architectural Hardware Consultant, available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
 - 1. The hardware supplier shall be engaged regularly in the furnishing, delivery and servicing of contract builder's hardware and must be experienced and knowledgeable in all phases of estimating, detailing, scheduling, master keying, shipping and installation practices.
 - 2. When electro-mechanical or electronic hardware is supplied, a qualified individual with a minimum five- (5) year's experience shall be available for assistance.
- C. Architectural Hardware Consultant Qualifications: A person who is currently certified by the Door and Hardware Institute as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

1.9 QUALITY ASSURANCE

- 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.
- B. Substitutions: Request for substitutions for alternative hardware items will not be accepted on this Project unless specifically indicated. Specification indicates one (1) specified product, listed hereinafter in the

- Hardware Schedule, and two (2) acceptable alternative manufacturers for that product. If any specified product is listed as a "No Substitution" product, only that specified product shall be provided as indicated.
- C. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.
 - D. Provide hardware that complies with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," Texas Accessibility Standards (TAS), and ANSI A117.1.
 - E. 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.
 - F. Fire-Rated Door Assemblies: Provide door hardware for 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 NFPA 252. All components including door, frame, and hardware shall comply.
 - G. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105. All components including door, frame, and hardware shall comply.
 - 1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.
 - 2. Integral smoke gasketing is required for all doors at animal spaces,
 - H. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - I. Doorstops:
 - 1. Floor door stops preferred for non-clinical and non-laboratory spaces.
 - 2. Wall mounted stops preferred at clinical and laboratory spaces. Consider specifying back chck on closers to lessen wall damage.
 - J. Acoustical Control:
 - 1. Provide gasketing at mechanical and equipment rooms to ensure acoustical performance and fire code compliance. Automatic door locations shall be discussed with users.
 - K. Hinges:
 - 1. Provide continuous hinges on wide doors, exterior doors, push/pull doors, aluminum doors, high abuse locations,tall doors, and doors with exit devices.
 - 2. Follow manufacturer's recommendations for hinge quantities per height of door.
 - L. Specialty Locations:
 - 1. Delayed egress shall be discussed per project and confirmed with appropriate AHJ.
 - 2. MRI room doors shall accept small core IC with certified specialty hardware.
 - 3. Exam rooms doors shall have non-locking passage sets. On/off stage conditions shall be confirmed per project.
 - 4. CT and X-ray locations shall be confirmed per project.
 - 5. Single occupancy toilets shall have occupancy indicators.
 - a. Single occupancy patient toilets are preferred to be outswinging. Inswinging installations must provide rescue hardware that do not require special tools to open.
- 1.10 DELIVERY, STORAGE, AND HANDLING
- A. Marking and Packaging: All items of hardware shall be delivered to the site in manufacturer's original cartons or boxes. Each item of hardware shall be marked with the abbreviation set forth on the Shop Drawings to ensure that the product reaches its installation destination without needing specific hardware product number knowledge.
 - 1. Levers, handles, and pulls shall be provided with cloth or cotton covered paper coverings, of sufficient size to completely cover items, secured to remain in place.
 - 2. Keys: Tag and mark to identify lock which they will pass.
 - B. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
 - C. 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.

1.11 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, access control system, security system, and building control system, as applicable.

1.12 MAINTENANCE

- 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. Maintenance Service: If there are any products listed hereinafter that normally require a maintenance or service contract, provide the Owner and Architect with details and costs of standard maintenance or service contract.

1.13 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: Five years from date of Substantial Completion.
 - 3. Exit Devices: Two years from date of Substantial Completion.
 - 4. Manual Closers: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Hardware Schedule" Article. Products are identified by using 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 Part 3 "Hardware Schedule" Article.
- B. Product manufacturers listed with an asterisk (*) denote the specified manufacturers listed in the Hardware Schedule. The remaining two (2) listed manufacturers will be acceptable substitutions. If only one manufacturer is listed this shall be considered a "No Substitution" specification as set forth in "Quality Assurance" Article, for that particular item.

2.2 MATERIALS, GENERAL

- A. Materials shall meet or exceed applicable referenced standards, federal, state, and local requirements, and conform to codes and ordinances of Authorities Having Jurisdiction.
- B. Source Limitations: Obtain each type of door hardware from single manufacturer.
- C. Screws and Fasteners: Provide all screws and fasteners of the proper size and type to properly anchor or attach the item of hardware scheduled. Provide all fasteners with Phillips heads, unless security type screws (spanner-head or torx-head) are hereinafter specified.

2.3 DOOR HARDWARE

- A. Hinges: Provide as follows:
 - 1. On doors to exterior openings and main corridor doors, and other doors of high frequency use, provide a continuous, gear type hinge of appropriate weight.
 - 2. Where regular ball bearing hinges are listed for other doors, provide one hinge for each 30-inch of door height.
 - 3. The width of the hinges shall be sufficient to clear all trim that is mounted to the doorframe.
 - 4. Hinges shall be guaranteed for life of opening if installed per manufacturer's recommendations.

5. Acceptable Manufacturers:
 - a. Ives.
 - b. Bommer.
 - c. Hager.
 - d. McKinney
- B. Continuous Hinges: Continuous hinges shall consist of three (3)-interlocking extrusions in a pinless assembly applied to the full height of the door. All continuous geared hinges shall be manufactured to template screw locations and be non-handed. All mortise hinges and half mortise hinges shall cover and wrap the door edge completely. Door frame heads shall be extended for clearance on full or half mortise hinges versus downsizing doors for ease of repair and replacement. All frames shall be properly reinforced per manufacturer's standards. Provide removable section for doors requiring electronic hardware.
 1. Where noted in the hardware sets, continuous hinge to be provided with The Door Switch System.
 2. Standard warranty shall be for the life of opening.
 3. Acceptable Manufacturers:
 - a. Ives
 - b. Select.
 - c. Pemko.
- C. Locks: All locks shall incorporate a seven pin small format removable core patented tumbler system and be keyed to a GRANDMASTER SYSTEM as not to breach security of system in place. Keying system must be guaranteed of no duplication of existing change keys, master keys or grandmaster keys located in this Project. All keying shall be coordinated with UTSW Key Control. Locks shall be Grade 1 cylindrical as listed in the Hardware Schedule.
 1. Acceptable Manufacturers:
 - a. New Construction: Schlage ND Series, with RHO trim, 26D finish. Small Format Housing.
 - b. Existing projects: Schlage ND Series with RHO trim. Small Format Housing.
 - c. Schlage Everest cylinder as required by project. Small Format IC.
 - d. No substitutions.
- D. Lock Trim: Locks are to be furnished with lever handle trim, with levers having a return to within 1/2 inch of the door face, as is hereinafter listed in the Hardware Schedule.
- E. Electronic Cylindrical Lockset: Heavy-duty lever handled, Grade 1, cylindrical lockset for commercial, industrial and institutional applications. Lockset shall accept small formate interchangeable core with motorized, programmable, stand-alone electronics for high security access control, which require no external wiring. Entry shall be by keypad.
 1. Acceptable Manufacturers:
 - a. Schlage CO (new construction).
 - b. No Substitutions.
- F. Flush Bolts: Manual flush bolts to have 12-inch rods for doors 7'-6". Doors over 7'-6" high shall have bolts with top rods of 18 inch or 24 inch to allow ease of access to bolt lever. Furnish dust proof strikes for all bottom bolts.
 1. Acceptable Manufacturers:
 - a. Ives.
 - b. Trimco.
 - c. Rockwood.
- G. Push/Pull Latch: Push/Pull Latch shall be U.L. listed for use on fire doors and provide secure and silent latching action. Provide with ANSI 115.1 strike.
 1. Acceptable Manufacturers:
 - a. Glynn Johnson.
 - b. Rockwood.
 - c. Sargent.
- H. Power Supply: Power supply shall integrate with selected switching for maintained switching with an emergency interface relay wired into the fire alarm system to insure fail secure application. Battery backup shall be included to produce backup power at full load during power failure.
 1. Acceptable Manufacturers:
 - a. Von Duprin*

- b. No Substitutions.
- I. Exit Devices: Exit Devices shall be rim, mortise or vertical rod type as called for in the Hardware Schedule. Devices shall be of the touch-pad type as is hereinafter specified in the Hardware Schedule. Exit devices shall be constructed to allow cylinder to be removed and rekeyed without removing the device from the door either by small format removable core cylinders or construction of exit device. Exit devices shall be constructed to allow the conversion from one function to another simply within lock stile case and selecting proper outside trim as specified hereinafter in the Hardware Schedule. Devices shall be furnished with outside trim lever handles matching locks.
 - 1. Where center mullions are not applicable on double doors and the doors are equipped with a lock, the inactive leaf shall be equipped with concealed, automatic, or manually operated flush bolts. Where the doors are classified as exit doors and require exit hardware, surface mounted vertical rods shall be used.
 - a. Concealed vertical rods, concealed closers, offset door hinges, and offset door pulls are not acceptable items.
 - 2. Acceptable Manufacturers:
 - a. Von Duprin.
 - b. No substitutions.
 - 3. Acceptable Manufacturers:
 - a. Von Duprin.
 - b. No substitutions.
- J. Exit Device (QEL): Quite Electric latch retraction, exit devices shall provide remote unlocking ability. A control switch or wiring schematic as specified shall allow an "exit" only or latched door to push-pull operation by a continuous duty solenoid retracting the latch bolt.
 - 1. Acceptable Manufacturers:
 - a. Von Duprin.
 - b. No substitutions.
- K. Card Reader/Controller: Access credential reader shall be capable of reading keypad codes to ensure flexibility of control and management.
 - 1. Acceptable Manufacturers:
 - a. Related Section.
 - 2. Requirements:
 - a. Provide Request to Exit (REX) switch.
- L. Electrified handsets shall have REX integrated into handset.
- M. Door Closers: Door closers shall be of cast iron and rectangular design, furnished with a full cover. Provide complete with backcheck, delayed action and hold-open as indicated. Closers shall be mounted out of the line of sight with parallel arm mounting on out-swinging doors. All closers to have through-bolt connections. Mount closers to jamb or on brackets and/or drop plates, where special conditions require.
 - 1. Acceptable Manufacturers:
 - a. LCN.
 - b. No Substitutions.
- N. Push Plates: Push plates are to be .050 brass, bronze or stainless steel with four (4) beveled edges, drilled and countersunk for screws, as is hereinafter specified in the Hardware Schedule.
 - 1. Acceptable Manufacturers:
 - a. Ives.
 - b. Trimco.
 - c. Rockwood.
- O. Door Pulls: Door pulls shall be ADA compliant with a 2 1/2 inch projection from back of pull to face of door. All door pulls shall be thru-bolted or back-to-back mounted.
 - 1. Acceptable Manufacturers:
 - a. Ives.
 - b. Trimco.
 - c. Rockwood.
- P. Protective Plates: Protective plates shall be mop (6"), kick (10") or armor (34") and shall be minimum .050 thick brass, bronze, or stainless steel, with three (3) beveled edges, drilled and countersunk for screws. Plates shall be mounted to avoid louvers and/or glass kits.

1. Acceptable Manufacturers:
 - a. Ives.
 - b. Trimco.
 - c. Rockwood.
- Q. Door Stops and Holders: Where a door strikes a wall at approximately 90 degrees, a wall bumper door stop shall be provided. Where doors are undercut, provide floor stops with adequate height to properly stop the door. If door would not otherwise strike a wall, an overhead stop shall be provided. In-wall blocking for wall bumpers at stud walls shall be provided in accordance with Section 06 10 53. Provide reinforcing in frame and door for overhead stops.
 1. Acceptable Manufacturers:
 - a. Ives.
 - b. Rockwood.
 - c. Trimco.
 - d. Glynn-Johnson.
- R. Thresholds and Weatherstrip: Weatherstripping to have aluminum housing, specified insert, and elongated mounting holes. Door sweeps shall be surface mounted, of aluminum/stainless steel housing with specified insert. Overhead drip caps to be of aluminum, have a 2 1/2-inch projection and be 4 inches wider than the door opening. Thresholds shall be of saddle type with no more than 1/2 inch rise. Weatherstripping and smoke seals shall be surface-mounted on doorstop and have 1/4" adjustment slots.
 1. Acceptable Manufacturers:
 - a. NGP.
 - b. Hager.
 - c. Pemko.
 - d. Zero International.
- S. Wall Magnets: Magnets shall be fail safe and hold until the current is interrupted. Current input shall be factory selected to be 24V AC/DC or 120V AC and be protected against voltage surges up to 600 volts. If voltage less than 120 VAC is indicated, provide transformers as required to accommodate power supply on specified magnets. Maximum holding force shall be forty (40) pounds. Magnet covers shall be of metal composite. Plastic covers will not be accepted.
 1. Acceptable Manufacturers:
 - a. LCN.
 - b. ABH Manufacturing.
 - c. Dorma.
- T. Push Button Switch: Push button switch assembly shall be a momentary action switch used as a redundant means of egress. Mount in single gang electrical box.
 1. Acceptable Manufacturers:
 - a. Schlage Commercial Electronics.
 - b. No Substitutions.
- U. Electromagnetic Locks (Access Control): Electromagnetic lock shall have a 1500 lb. holding force containing a built in passive infrared (PIR) sensor to energize the magnetic lock when a person enters its field of view. Lock shall contain a built-in lighted emergency exit button as a redundant means of de-energizing lock. An access control system shall be integral to the lock with keypads/readers easily wired directly to the lock.
 1. Acceptable Manufacturers:
 - a. Security Contractor.
- V. Smoke Gasket: Smoke gasket shall comply with door and frame manufacturers for positive pressure tests for fire and smoke. (UBC 7-2, Parts 1 & 2/UL10C).
 1. Acceptable Manufacturers:
 - a. NGP.
 - b. Reese.
 - c. Pemko.
 - d. Zero International.
- W. Magnetic Locks
 1. Acceptable Manufacturers:

- a. Schlage.
2. Requirements:
 - a. Provide magnetic locks certified to meet ANSI/BHMA A156.23 classification criteria, UL10C, and UL1034 for burglary-resistant electronic locking mechanisms.
 - b. Provide magnetic locks equipped with SPDT Magnetic Bond Sensing device, where specified, to monitor whether enough magnetic holding force exists to ensure adequate locking and SPDT Door Status Monitor device, where specified, to monitor whether door is open or closed. Provide bond sensors fully concealed within electromagnet to resist tampering or damage.
 - c. Provide fasteners, Z-mounting brackets, and spacer bars required for mounting and details.
 - d. Provide power supply recommended and approved by manufacturer of magnetic locks.
 - e. Where magnetic locks are scheduled, provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of magnetic locks for each individual leaf. Switches control both doors simultaneously at pairs. Locate controls as directed by Architect.

2.4 FINISHES

- A. Hardware finishes shall match and be maintained to BHMA symbols, as indicated in the Hardware Schedule. Strict adherence to base metals and finish is required.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.5 KEYING

- A. Keying of locks and cylinders throughout project shall be scheduled through a key meeting with Architect, UTSW Key Control, and hardware supplier. Key schedule shall be prepared and submitted to the UTSW Key Control for approval. Copies of final key schedule with the bitting instructions shall be submitted as part of the Project Record Documents. LOA (Letter of Authorization) must be obtained from Key Control to build or order any keys, cores, or key systems.
- B. Keying: Keying requirements shall be coordinated and completed at factory to protect integrity of system. Field keying will not be permitted and will be considered as just cause for rejection of supplier. Bitting lists must be approved by UTSW Key Control. No keys will go to the contractor or supplied. This will be cause for rejection of the supplies and re-keying charge.
 1. Construction cores must be keyed to an existing UTSW construction core key.
 2. Newly provided keyways must be restricted.

2.6 KEY CONTROL

- A. Provide key cabinet(s) manufactured by of sufficient capacity to handle all keys, plus 50 percent expansion. Provide key control cross-reference chart and accountability (sign-out) tags.
 1. Acceptable Manufacturers:
 - a. Telkee.
 - b. Lund.
 - c. Key Control Systems (i.e. CQRIT).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, 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. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: Comply with DHI A115 series.
 1. Surface-Applied Door Hardware: Drill and tap doors and frames according to SDI 107 or ANSI A250.6, whichever is more stringent.
- B. Wood Doors: Comply with DHI A115-W series.

3.3 INSTALLATION

- A. Installation shall be by a qualified installer with a minimum five (5) year's experience in the installation of commercial grade hardware. Manufacturer's instructions shall dictate templating and installation.
- 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. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- C. Install each door hardware item to comply with manufacturer's 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 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
 - 3. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 4. Install all anchoring devices for each closure and electromagentic device as indicated by manufacturer's instructions for complete installation.
- D. Key Control System: Place keys on markers and hooks in key control system cabinet, as determined by final keying schedule.
- E. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Architect prior to installation.
- F. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- G. Refer to Division 28 Sections for installation and coordination of access control devices.

3.4 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: Owner reserves the right to engage a qualified independent Architectural Hardware Consultant to perform a separate independent inspection and to prepare an inspection report.

3.5 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.
 - 1. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 - 3. Door Closers: Adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.
- B. At completion of the installation and prior to Substantial Completion, make final adjustments to door closures and other items of hardware. Leave all hardware clean and fully operable. Should any item be found to be defective, it shall be repaired or replaced as directed.
- C. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.7 CLOSEOUT ACTIVITIES

- A. As part of project punch list requirements per Section 01 77 00 - Closeout Procedures and Submittals, include UTSW Key Control Shop, UTSW Building Maintenance, UTSW Access Control, Door Hardware Consultant (if applicable), UTSW PM, and other associated teams.
- B. Provide revised Operation and Maintenance Data including final installed hardware schedule, maintenance manuals, and warranty documentation to UTSW PM and to UTSW Building Maintenance.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Section 01 79 00 - Demonstration and Training.
 - 1. Ensure any specialty functions, processes, or procedures are documented as part of the demonstration and training.

3.9 HARDWARE SCHEDULE

- A. Hardware sets are indicated on Drawings.

END OF SECTION 08 71 00



DIVISION 09

FINISHES



SECTION 09 22 16

NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Non-load-bearing steel framing systems for interior gypsum board assemblies.
- B. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

1.3 RELATED REQUIREMENTS

- A. Section 05 50 00 - Metal Fabrications for steel reinforcing used with partial height partitions.
- B. Section 07 84 43 - Joint Firestopping for head-of-wall joint systems installed with non-load-bearing steel framing.
- C. Section 09 29 00 - Gypsum Board

1.4 REFERENCE STANDARDS

- A. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members.
- D. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- E. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.
- F. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- G. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- H. ASTM E413 - Classification for Rating Sound Insulation.
- I. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements.
- J. ASTM E1190 - Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members.
- K. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 SUBMITTALS

- A. Shop Drawings:
 - 1. Indicated prefabricated work, component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories and items of other related work.
 - 2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.
- B. Product Data: For each type of product.
- C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- D. Evaluation Reports: For firestop tracks, from ICC-ES.
- E. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. CEMCO

- B. ClarkDietrich
- C. Marino
- D. SCAFCO Corporation
- E. The Steel Network, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. 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 E119 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 E90 and classified according to ASTM E413 by an independent testing agency.

2.3 FRAMING SYSTEMS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Framing Members, General: Comply with ASTM C754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM A645/A645M requirements for metal unless otherwise indicated.
 - 2. Protective Coating: ASTM A653/A653M, G40 (Z120), hot-dip galvanized unless otherwise indicated.
- C. Studs and Runners: ASTM C645.
 - 1. Steel Studs and Runners:
 - a. Depth: As indicated on Drawings.
 - b. Minimum Base Metal Thickness: Typical interior partitions shall be constructed with 3-5/8 inch wide, 22-ga. metal studs or at stronger gauges as determined to meet space requirements.
 - 1) Spacing shall be 16 inches on center or as required.
 - 2) Utilize 20-ga. minimum metal studs for walls requiring extra support due to heights, attached equipment, expected future equipment, or casework.
 - c. 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
 - d. 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.
 - e. Interior Metal Stud/Gypsum Board Assemblies at Locations with Ceramic Tile or Other Hard Surface Finishes: Provide minimum 20-ga. metal stud. Withstand typical lateral loading (air pressure) with deflection limit not more than L/360 of partition height
 - f. Where wall mounted equipment, woodwork, and casework items are indicated or elsewhere as shown on Drawings, provide minimum 16 ga. studs
- D. Slip-Type Head Joints: Where indicated, provide one of the following:
 - 1. Deflection Track: Steel sheet top runner 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. Products: Subject to compliance with requirements, provide one of the following:
 - 1) ClarkDietrich; SLP-TRK Slotted Deflection Track.
 - 2) Steel Network Inc. (The); VertiClip SLD Series.
- E. 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, provide one of the following:
 - a. Fire Trak Corp.; Fire Trak System attached to studs with Fire Trak Posi Klip.
 - b. Steel Network Inc. (The); VertiClip SLD Series.
- F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - 1. Minimum Base-Metal Thickness: 0.0625 inch (1.5 mm).
- G. Cold-Rolled Channel Bridging: Steel, 0.053-inch (1.34-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: As indicated on Drawings.
 2. 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.
- H. Hat-Shaped, Rigid Furring Channels: ASTM C645.
1. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
 2. Depth: 7/8 inch (22.2 mm).
- I. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.
1. Configuration: Asymmetrical.
- J. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
1. Depth: 1-1/2 inch (38 mm)
 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch (0.8 mm).
 3. Tie Wire: ASTM A641/A641M, 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.

2.4 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, 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. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E488/E488M by an independent testing agency.
 - a. Type: Post installed, expansion anchor.
 2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E1190 by an independent testing agency.
- C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch (1.34 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
1. Depth: 1-1/2 inches (38 mm).
- E. Furring Channels (Furring Members):
1. Cold-Rolled Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
 2. Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch (22 mm) deep.
 - a. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
 3. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical.
- F. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
 - b. Chicago Metallic Corporation; Drywall Grid System.
 - c. USG Corporation; Drywall Suspension System.

2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Metal 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.

2.6 FABRICATION

- A. Fabricate assemblies to sizes and profiles required.
- B. Fit, reinforce, and brace framing members to suit design requirements.
- C. Fit and assemble in largest practical sections for delivery to site, ready for installation.

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 runners (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 required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. 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.
- 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 (runners) 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 penetrating 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 runner 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.
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. Screw to wood framing.
 2. 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 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 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, counter splaying, 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. Do not attach hangers to steel roof deck.
 5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 7. 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 09 22 16

SECTION 09 29 00

GYPSUM BOARD

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Interior gypsum board.
- B. Tile backing panels.

1.3 RELATED REQUIREMENTS

- A. Section 09 22 16 - Non-Structural Metal Framing for non-structural steel framing and suspension systems that support gypsum board panels.
- B. Section 09 91 23 - Interior Painting for finishing of gypsum wall surfaces.

1.4 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency.
- B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- C. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- E. ASTM C834 - Standard Specification for Latex Sealants.
- F. ASTM C840 Standard Specification for Application and Finishing of Gypsum Board.
- G. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications.
- H. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- I. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- J. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel.
- K. ASTM C1396/C1396M - Standard Specification for Gypsum Board.
- L. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels..
- M. ASTM C1658/C1658M- Standard Specification for Glass Mat Gypsum Panels.
- N. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
- O. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- P. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- Q. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 SUBMITTALS

- A. Product Data: For each type of product, including VOC Content.
- B. Shop Drawings: Show locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.
- C. Samples for Verification: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

2. Submit two samples of predecorated gypsum board, 12 by 12 inches (200 by 300 mm) in size, illustrating finish color and each texture indicated to be approved by Architect.
- D. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.6 QUALITY ASSURANCE

- A. Preinstallation Meeting: Conduct preinstallation meeting at Project Site.
- B. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Install mockups for the following:
 - a. Each level of gypsum board finish indicated for use in exposed locations.
 - b. Each texture finish indicated.
 2. Apply or install final decoration indicated, including painting and wall coverings, 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.

1.7 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.
- B. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written recommendations, 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, those that are moisture damaged, and those that are 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 E119 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 E90 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. American Gypsum.
 2. CertainTeed Corp.
 3. Georgia-Pacific Gypsum LLC.
 4. National Gypsum Company.
 5. USG Corporation.
- B. Gypsum Board, Type X: ASTM C1396/C1396M
 1. Thickness: 5/8 inch (15.9 mm).
 2. Long Edges: Tapered.
- C. Flexible Gypsum Board: ASTM C1396/C1396M; manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.

1. Thickness: 1/4 inch (6.4 mm).
 2. Long Edges: Tapered.
- D. Gypsum Ceiling Board: ASTM C1396/C1396M
1. Thickness: 1/2 inch (12.7 mm).
 2. Long Edges: Tapered.
- E. Abuse-Resistant Gypsum Board: Level 1.
1. Core: 5/8 inch (15.9 mm), Type X.
 2. Long Edges: Tapered.
 3. Mold Resistance: ASTM D3273, score of 10.
 4. Locations: All corridors, dock and service corridors.
- F. Moisture- and Mold-Resistant Gypsum Board: ASTM C1396/C1396M; with moisture- and mold-resistant core and paper surfaces.
1. Core: 5/8 inch (15.9 mm), Type X.
 2. Long Edges: Tapered.
 3. Mold Resistance: ASTM D3273, score of 10.
 4. Locations: Restrooms, janitor closets, other locations where water exposure is probable.
- 2.4 SPECIALTY GYPSUM BOARD
- A. Gypsum Board, Type C: ASTM C1396/C1396M; manufactured to have increased fire-resistive capability.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. American Gypsum; Firebloc Type C.
 - b. CertainTeed Corp.; ProRoc Type C.
 - c. Georgia-Pacific Gypsum LLC; Fireguard C.
 - d. National Gypsum Company; Gold Bond Fire-Shield C.
 - e. USG Corporation; Firecode C Core.
 2. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
 3. Long Edges: Tapered.
- B. Mold Resistant Glass-Mat Interior Gypsum Board: ASTM C1658/C1658M. 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. Georgia-Pacific Gypsum LLC; DensArmour Plus.
 2. Core: 5/8 inch (15.9 mm), Type X.
 3. Long Edges: Tapered.
 4. Mold Resistance: ASTM D3273, score of 10.
- 2.5 TRIM ACCESSORIES
- A. Interior Trim: ASTM C1047
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.
 - g. Curved-Edge Cornerbead: With notched or flexible flanges.
- 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. Aluminum: Alloy and temper with not less than the strength and durability properties of, ASTM B221 Alloy 6063-T5.
 3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.
- 2.6 JOINT TREATMENT MATERIALS
- A. General: Comply with ASTM C475/C475M.

- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Exterior Gypsum Soffit Board: Paper.
 - 3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 - 4. 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. Pre-filling: 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 Exterior Applications:
 - 1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
 - 2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.
 - E. Joint Compound for Tile Backing Panels:
 - 1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
- 2.7 AUXILIARY MATERIALS
- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
 - B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - 1. Laminating adhesive shall have a VOC content of 50 Insert value g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - C. Steel Drill Screws: ASTM C1002, 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.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
 - D. Sound Attenuation Blankets: ASTM C665, 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.
 - 2. Thickness/ STC Rating: As scheduled on Drawings.
 - 3. Acceptable Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed; Sound Control Batts or Fire Batts.
 - b. Johns Manville Sound Control Batts or Fire Batts.
 - c. Knauf Insulation; EcoBatt with ECOSE Technology.
 - d. Owens Corning Company, SAB.
 - e. Roxul Inc.; Acoustical Fire Batts.
 - f. Thermafiber, Inc.; an Owens Corning Company, SAFB.
 - E. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Accumetric LLC; BOSS 824 Acoustical Sound Sealant.
 - b. Pecora Corporation; AC-20 FTR AIS-919.
 - c. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
 - d. USG Corporation; SHEETROCK Acoustical Sealant.
 - 2. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- F. Textured Finish Materials: Latex-based compound, plain.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corporation
 - b. National Gypsum.
 - c. Sherwin-Williamm
 - d. USG Corporation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- 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 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C840.
- 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, except floors. 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. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- J. 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 C919 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.
- K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Wallboard Type: Vertical surfaces unless otherwise indicated.
 - 2. Type X: Vertical surfaces unless otherwise indicated.

3. Flexible Type: Apply in double layer at curved assemblies or as indicated on Drawings.
 4. Ceiling Type: Ceiling surfaces.
 5. Abuse-Resistant Type: As indicated on Drawings.
 6. Moisture- and Mold-Resistant Type: As indicated on Drawings.
 7. Type C: Where required for specific fire-resistance-rated assembly indicated.
 8. Glass-Mat Interior Type: Behind all wall tile.
- 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. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 4. 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. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.
- E. Curved Surfaces:
1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- (300-mm-) long straight sections at ends of curves and tangent to them.
 2. For double-layer construction, fasten base layer to studs with screws 16 inches (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches (300 mm) o.c.

3.4 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 according to ASTM C840 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. LC-Bead: Use at exposed panel edges.
 3. Curved-Edge Cornerbead: Use at curved openings.
- D. Exterior Trim: Install in the following locations:
1. Cornerbead: Use at outside corners.
 2. LC-Bead: Use at exposed panel edges.
- E. Aluminum Trim: Install in locations indicated on Drawings.

3.5 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 C840:
 - 1. Level 0: Temporary partitions, Surfaces to be finished in later phase, and _____ .
 - 2. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 3. Level 2: Panels that are substrate for tile Panels that are substrate for acoustical tile Where indicated on Drawings.
 - 4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated including .at locations where Animal Resource Center walls are to be disinfected
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.
 - 5. Level 5: At locations where Animal Resource Center walls to be disinfected, walls with gloss or semi-gloss finish, walls with critical lighting conditions and where indicated on Drawings.
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.
 - E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
 - F. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.
 - G. Cementitious Backer Units: Finish according to manufacturer's written instructions.
- 3.6 TEXTURE FINISH
- A. Apply finish texture in accordance with manufacturer's instructions as indicated by Architect.
 - B. Finish: Smooth and free of tool marks or ridges.
- 3.7 PARTITION IDENTIFICATION
- A. Wall Identification: Permanently label all fire-rated walls and smoke partition assemblies with the partition identification as defined below 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).
 - 2. Partition Identification Text: Apply the following according to partition ratings on Drawings, and as acceptable to authorities having jurisdiction:
 - a. SMOKE PARTITION.
 - b. SMOKE BARRIER.
 - c. 30 MINUTE FIRE BARRIER.
 - d. 1-HOUR FIRE BARRIER.
 - e. 2-HOUR FIRE BARRIER.
 - f. 3-HOUR FIRE WALL.
 - 3. Refer to Section 09 91 23 - Interior Painting for painting. Use Semi-Gloss, Low-Odor paint.
 - 4. Arrows shall be used to delineate any architectural increase or decrease in wall barrier type.
- 3.8 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 09 29 00

SECTION 09 51 00
ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish labor, materials, tools, equipment, and services for Acoustical Ceiling Systems in accordance with provisions of Contract Documents.
- B. Completely coordinate with work of other trades.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM A641/A641M Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - 2. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 3. ASTM B633 Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
 - 4. ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - 5. ASTM C635/C635M Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panels Ceilings.
 - 6. ASTM C636/C636M Standard Specification for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
 - 7. ASTM D2240 Test Method for Rubber Property - Durometer Hardness
 - 8. ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - 9. ASTM E413 Classification for Rating Sound Insulation.
 - 10. ASTM E488/E488M Standard Test Methods for Strength of Anchors in Concrete Elements.
 - 11. ASTM E580/E580M Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions
 - 12. ASTM E1264 Standard Classification for Acoustical Ceiling Products.
 - 13. ASTM E1414/E1414M Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.
 - 14. ASTM E1190 Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members
- B. Site Classification and Seismic Design Categories as defined in the International Building Code.
- C.

1.3 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's literature indicating products comply with specifications.
- B. Samples:
 - 1. Three samples of each type of tile listed in Drawing I-001 Interior Notes and Finish Legend.
- C. Project Information:
 - 1. Test reports for acoustical performance to include, as applicable:
 - a. NRC test reports from test method ASTM C423.
 - b. CAC test reports from test method ASTM E1414/E1414M and classification ASTM E413.

- c. STC test reports from test method ASTM E90 and classification ASTM E413.
 - d. Laboratory and test method accreditation references.
- D. Contract Closeout Information:
- 1. Maintenance Data: See Section 01 78 23.
 - 2. Interior finish fire performance data: See Section 01 78 26.
 - a. Provide for each finish material and type specified:
 - 1) Manufacturer's printed information including:
 - a) Fire class.
 - b) NFPA test number.
 - c) Photograph.
 - 2) Proof of purchase.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Steel Suspension Systems:
- 1. Base:
 - a. Armstrong World Industries.
 - 2. Optional:
 - a. USG Corporation
 - b. Chicago Metallic
- B. Aluminum Suspension Systems, non-gasketed:
- 1. Base:
 - a. Armstrong World Industries
 - 2. Optional:
 - a. USG Corporation
 - b. Chicago Metallic
- C. Formed Edge Systems:
- 1. Base:
 - a. Armstrong World Industries
 - 2. Optional:
 - a. Chicago Metallic
 - b. Gordon Interior Specialties Division
 - c. Hunter Douglas
- D. Acoustical Ceiling Tile:
- 1. Base:
 - a. As noted for individual types in Interior Finish Legend.
 - b. Armstrong World Industries.
 - 2. Optional:
 - a. USG.
 - b. CertainTeed.
 - c. Rockfon.
- E. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 ACOUSTIC SUSPENSION SYSTEMS

A. General Requirements:

1. Heavy duty systems, ASTM C635/C635M.
2. Intermediate duty systems, ASTM C635/C635M.
3. Main runner jointing by spliced, interlocking ends, tab locks, pin locks, or other suitable connections.
4. Cross runners interlocking with main runners.
5. Include components and accessories necessary resist seismic loads and dead loads of items such as light fixtures and air diffusers.
6. Hanger Wire:
 - a. Pre-stretched, with a yield stress load of at least 5 times design load, but not less than 0.106 inches (12 GA) .
 - b. Utilize continuous lengths, without kinks and splices.
 - c. Galvanized Steel:
 - 1) Galvanized, soft annealed steel wire conforming to ASTM A641/A641M.
 - d. Stainless Steel:
 - 1) Type 304, soft annealed steel wire conforming to ASTM A641/A641M.
 - 2) Use where aluminum ceiling grid is specified.
 - 3) Use in the following wet areas: Laundries, showers, kitchens, and other wet areas.
 - 4) Use in the following magnetic sensitive areas: MRI.
7. Attachment Devices:
 - a. Anchors in Concrete:
 - 1) Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 5 times that imposed by ceiling construction, as determined by testing per ASTM E488/E488M or ASTM E1512.
 - 2) Acceptable types: Cast-in-place, post-installed expansion anchors and post-installed bonded anchors.
 - 3) Material: Carbon-steel components zinc plated to comply with ASTM B633, Class Fe/Zn 5 for Class SC 1 service condition.
 - 4) Material: Stainless-steel components complying with ASTM-F593 and ASTM-F594, Group 1 Alloy 304 or 316.
 - b. Power-Actuated Fasteners in Concrete:
 - 1) 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 capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E1190.
8. Wall Moldings: In accordance with International Building Code.
 - a. Description: 7/8 inch minimum horizontal leg for use with BERC-2 clip.
9. Accessories
 - a. Beam End Retaining Clip
 - 1) 2 inch by 0.034 inch thick.
 - 2) Hot dipped galvanized cold rolled steel per ASTM A568.
 - 3) Use to join main beam or cross tee to wall molding.
 - 4) Product: BERC2 by Armstrong.

B. Suspension System Types:

1. Exposed steel grid, non-rated:
 - a. Description: Galvanized, double web steel, main and cross runners.
 - b. Face width: 15/16 inches .
 - c. Base Product:
 - 1) Refer to Interior Finish Legend.
 - 2) Prelude XL, by Armstrong.
 - 3) Donn DX/DXL by USG.
 - 4) 200 Series by Chicago Metallic.
 - 5) 1200 Series by Chicago Metallic.
 - d. Finish on exposed surfaces: Smooth, flat white.
2. Exposed steel grid, fire rated:
 - a. Description: Galvanized double web steel, main and cross runners.
 - b. Face width: 15/16 inches .
 - c. Base Product:
 - 1) Refer to Interior Finish Legend.
 - 2) Prelude XL Fire Guard by Armstrong.
 - 3) 250 Series by Chicago Metallic.
 - 4) 1250 Series by Chicago Metallic.
 - d. Finish on exposed surfaces: Smooth, flat white.
 - e. Components: UL labeled.
1. Aluminum (non-gasketed), exposed grid, non-rated:
 - a. Description: Aluminum double web, main and cross runners.
 - b. Face width: 15/16 inches .
 - c. AL Prelude Plus XL by Armstrong.
 - d. Base Product:
 - 1) Refer to Interior Finish Legend.
 - 2) Prelude Plus XL by Armstrong.
 - e. Optional Products:
 - 1) Donn AX by USG.
 - 2) 830 Series by Chicago Metallic.
 - f. Finish on exposed surfaces: Smooth, flat white.
2. Galvanized Steel, exposed grid, fire rated:
 - a. Description: Hot dipped galvanized steel double web, main and cross runners with aluminum cover cap.
 - b. Face width: 15/16 inches .
 - c. Base Product:
 - 1) Refer to Interior Finish Legend.
 - 2) Prelude Plus XL Fire Guard by Armstrong.
 - 3) 1830 Series by Chicago Metallic.
 - d. Finish on exposed surfaces: Smooth, flat white.
 - e. Components: UL labeled.
3. Gasketed grid, non-rated:
 - a. Base product:
 - 1) Refer to Interior Finish Legend.
 - 2) Co-Extruded Clean Room Grid System by Armstrong World Industries.

- b. Optional product: BarrierGrid Standard Exposed Gasketed by Chicago Metallic Corporation.
 - c. Structural classification of system: ASTM C635/C635M, Intermediate Duty.
 - d. Face width: 15/16 inches.
 - e. Provide main and cross tees, gasketed perimeter channels or angles, connectors, splice connectors and hold down clips for a complete installation.
 - f. Gasket:
 - 1) Factory-applied.
 - 2) Fungus resistance test method 508.1 mill-std 810C.
 - 3) Flame resistance test FMYSS 302 with burn rate of 4 inches per minute.
 - 4) USDA approval standards.
4. Stainless Steel exposed grid, non-rated, non-gasketed:
- a. Description: Stainless steel double web, main, and cross runners.
 - b. Face width: 15/16 inches .
 - c. Base Product:
 - 1) Refer to Interior Finish Legend.
 - 2) SS Prelude Plus XL by Armstrong.
 - 3) 730 Series by Chicago Metallic.
 - d. Finish on exposed surfaces: Smooth, flat white.
5. Narrow grid, non-rated:
- a. Description: Narrow, articulated face.
 - b. Face width: 9/16 inches
 - c. Base Product:
 - 1) Refer to Interior Finish Legend.
 - 2) Superfine XL by Armstrong.
 - 3) 3500 Series by Chicago Metallic.
 - 4) 3570 Series by Chicago Metallic.
 - d. Finish on exposed surfaces: Smooth, flat white.
6. Formed Edge System:
- a. Base Product:
 - 1) Refer to Interior Finish Legend.
 - 2) Axiom by Armstrong.
 - b. Profile: [_____].
 - c. Dimensions: [_____].
 - d. Finish: [_____].
 - e. Color: [_____].
7. Gasketed Grid, Extruded Aluminum, Non-rated:
- a. Base product:
 - 1) Refer to Interior Finish Legend.
 - 2) CG-10 Series by Gordon Interior Specialties Division.
 - b. Structural Classification: ASTM C635/C635M, Intermediate Duty.
 - c. Material: Extruded Aluminum, ASTM B221, 6063-T Alloy.
 - d. Face width: 15/16 inch.
 - e. Minimum Gasket Width: 3/8 inches
 - f. Provide main and cross tees, perimeter angles, connectors, splice connectors and hold down clips for a complete installation.
 - g. Powder coat finish:

- 1) Factory finish, 5-stage pretreatment with dried-in-place conversion coating followed by AAMA 2604 compliant powder coating.
 - 2) Color: As selected by Architect from manufacturer's full line.
 - 3) Color: Custom color to be selected by Architect.
- h. Gasket:
- 1) Description: Factory-applied, self-adhering, closed-cell polyethylene.
 - 2) Minimum density: 2 lbs/ft³.
 - 3) Shore hardness: 7 on AA scale and 51 on OO scale per ASTM D2240.
 - 4) Minimum thickness: 3/32 inches.
 - 5) Fungus resistance test method 508.1 mill-std 810C.
 - 6) Flame resistance test FMYSS 302 with burn rate of 4 inches per minute.
 - 7) USDA approval standards.
8. Gasketed Grid, Extruded Aluminum, Non-rated:
- a. Base product:
 - 1) Refer to Interior Finish Legend.
 - 2) CG-15 Series by Gordon Interior Specialties Division.
 - b. Structural classification: ASTM-C635/C635M, Intermediate Duty.
 - c. Material: Extruded Aluminum, ASTM B221, 6063-T Alloy.
 - d. Face width: 1-1/2 inch.
 - e. Minimum gasket width: 15/32 inch.
 - f. Provide main and cross tees, perimeter angles, connectors, splice connectors and hold down clips for a complete installation.
 - g. Powder coat finish:
 - 1) Factory finish, 5-stage pretreatment with dried-in-place conversion coating followed by AAMA 2604 compliant powder coating.
 - 2) Color: To be selected by Architect from manufacturer's standard colors.
 - 3) Color: Custom color to be selected by Architect.
 - h. Gasket:
 - 1) Description: Factory-applied, self-adhering, closed-cell polyethylene.
 - 2) Minimum Density: 2 lbs/ft³.
 - 3) Shore Hardness: 7 on AA scale and 51 on OO scale per ASTM D2240.
 - 4) Minimum Thickness: 3/32 inches.
 - 5) Fungus resistance test method 508.1 mill-std 810C.
 - 6) Flame resistance test FMYSS 302 with burn rate of 4 inches per minute.
 - 7) USDA approval standards.
9. Concealed grid, non-rated:
- a. Description: Galvanized, double web steel, main and cross runners.
 - b. Face width: 15/16 inch.
 - c. Base product:
 - 1) Refer to Interior Finish Legend.
 - 2) Prelude Concealed Tee by Armstrong
 - 3) 200 Series by Chicago Metallic.
 - 4) 1200 Series by Chicago Metallic.
10. Concealed grid, fire rated:
- a. Description: Galvanized double web steel, main and cross runners.
 - b. Face width: 15/16 inch.
 - c. Base Product:

- 1) Refer to Interior Finish Legend.
 - 2) Concealed Z by Armstrong.
 - 3) 1250 Series by Chicago Metallic.
 - d. Components: UL labeled.
11. Framing and suspension systems for Gypsum Board Ceilings:
- a. Specified in Section 09 22 16.

2.3 ACOUSTICAL CEILING TILE

A. General Requirements:

1. Scheduled finishes to be factory applied.
2. Class A incombustible units.
 - a. Flame spread: 0.
 - b. Smoke developed: 0.
 - c. Fuel contributed: 0.
3. Fire rated units (when used): UL labeled.
4. Edges uniformly fabricated, true, square.
5. Sizes as required to fit scheduled suspension system.
6. Standard tile/panel size: See Reflected Ceiling Plan.
7. Concealed spline style: Edges kerfed for splines.

B. Ceiling Tile Types:

1. Basic Mineral Fiber Ceiling Tile:
 - a. Description: Wet-formed mineral fiber with acoustically transparent membrane and factory-applied latex paint.
 - b. Base Product: Ultima by Armstrong.
 - c. Classification: ASTM E1264, Type IV, Form 2, Pattern E.
 - d. Surface Texture: Smooth.
 - e. Light reflectance: Not less than 0.88.
 - f. NRC: Not less than 0.75.
 - g. Edge: Square.
 - h. Thickness: Minimum 3/4 inches .
 - a. Air Guard Coating.
2. Basic Fiberglass Ceiling Tile:
 - a. Description: Fiberglass with acoustically transparent membrane and factory-applied latex paint.
 - b. Base Product: Optima by Armstrong.
 - c. Classification: ASTM E1264, Type XII, Form 2, Pattern E.
 - d. Surface Texture: Smooth.
 - e. Light Reflectance: Not less than 0.88.
 - f. NRC: Not less than 0.95.
 - g. Edge: Square.
 - h. Thickness: Minimum 1 inches .
3. Ceramic and Mineral Fiber Composite Ceiling Tile:
 - a. Description: Wet-formed ceramic and mineral fiber composite with factory-applied plastic paint finish.
 - b. Base Product: Ceramaguard by Armstrong.
 - c. Classification: ASTM E1264, Type XX high density ceramic-like composition, Pattern G.
 - d. Surface Texture: Unperforated.

- e. Light reflectance: Not less than 0.86.
 - f. NRC: N/A.
 - g. Edge: Square.
 - h. Thickness: Minimum 5/8 inches .
4. Ceramic and Mineral Fiber Composite Ceiling Tile:
- a. Description: Wet-formed ceramic and mineral fiber composite with factory-applied plastic paint finish.
 - b. Base Product: Ceramaguard by Armstrong.
 - c. Classification: ASTM E1264, Type XX high density ceramic-like composition, Pattern C E.
 - d. Surface Texture: Fine Fissured.
 - e. Light reflectance: Not less than 0.79.
 - f. NRC: Not less than 0.55.
 - g. Edge: Square.
 - h. Thickness: Minimum 5/8 inches .
1. Washable Ceiling Tile:
- a. Description: Wet formed mineral fiber with acoustically transparent water-repellant membrane.
 - b. Base Product: Ultima Health Zone by Armstrong.
 - c. Classification: ASTM E1264, Type IV, Form 2, Pattern E
 - d. Light Reflectance: Not less than 0.86.
 - e. NRC: not less than 0.70
 - f. Edge: Square.
 - g. Thickness: Minimum 3/4 inches .
 - h. Air Guard Coating.
1. Scrubbable Ceiling Tile:
- a. Description: Wet-formed mineral fiber with soil-resistant polyester film
 - b. Base Product: Clean Room FL by Armstrong.
 - c. Classification: ASTM E1264, Type IV, Form 2, Pattern GH.
 - d. Surface Texture: Smooth.
 - e. Light reflectance: Not less than 0.79.
 - f. NRC:
 - 1) Field Panel: Not less than 0.55.
 - 2) Border Panel: N/A.
 - g. Edge: Square.
 - h. Thickness:
 - 1) Field Panel: Minimum 3/4 inches .
 - 2) Border Panel: Minimum 5/8 inch .
2. Scrubbable Ceiling Tile:
- a. Description: Wet-formed mineral fiber with vinyl-faced membrane.
 - b. Base Product: Clean Room VL by Armstrong.
 - c. Classification: ASTM E1264, Type IV, Form 2, Pattern E.
 - d. Surface Texture: Smooth, unperforated.
 - e. Light reflectance: Not less than 0.80.
 - f. NRC: N/A
 - g. Edge: Square
 - h. Thickness: Minimum 5/8 inch .

3. Scrubbable Ceiling Tile:
 - a. Base Product: CleanRoom, ClimaPlus, by USG.
 - b. Classification: ASTM E1264
 - 1) Cleanroom ISO 5 Tiles: Type X, Pattern GI
 - 2) Cleanroom ISO 7 Tiles: Type X, Pattern CGI
 - c. Light reflectance: Not less than 0.79.
 - d. NRC:
 - 1) Cleanroom ISO 5 Tiles: None required.
 - 2) Cleanroom ISO 7 Tiles: Not less than 0.55.
 - e. Lay-in style: Square.
 - f. Thickness: Minimum 5/8 inches .
 4. Moisture Resistant Ceiling Tile:
 - a. Base Product:
 - 1) Rockfon Medical Plus by Rockwool.
 - a) Description: Stone wool tile with factory applied paint and latex lacquer on glass scrim surface, ISO Class 4.
 - b) Edge: [Square] [Square Tegular] [Square Tegular Narrow] [Fully concealed].
 - 2) Rockfon Medical Plus by Rockwool.
 - a) Description: Stone wool tile with factory applied paint and latex lacquer on glass scrim surface, ISO Class 4.
 - b) Edge: [Square] [Square Tegular] [Square Tegular Narrow] [Fully concealed].
 - b. Classification: ASTM E1264, Type XX - Stone wool base with membrane faced overlay, Pattern E.
 - c. Light reflectance: Not less than 0.83.
 - d. NRC: Not less than 0.90.
 - e. Thickness: Minimum 3/4 inches .
- A. Diffusers and Grilles: See Section 23 31 13.
- B. Light Fixtures: See Section 26 51 13.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify suitability of substrate to accept installation.
- B. Examine installation site for irregularities having effect on quality and execution of work.
- C. Consult other trades involved before start of ceiling work, to determine areas of potential interference.
- D. Do not start installation until interferences have been resolved.
- E. Installation constitutes acceptance of responsibility for performance.

3.2 PREPARATION

- A. Coordinate ceiling layout with sprinkler head spacing and work penetrating acoustical ceiling systems.
- B. Tolerances:
 1. Comply with ASTM C635/C635M Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
 2. Deviation from level plane: 1/8 inches in 10 feet with no load applied maximum.
 3. Bow: 1/32 inches in 2 feet maximum.
 4. Camber: 1/32 inches in 2 feet maximum.
 5. Twist: 1 degree in 2 feet maximum.

3.3 INSTALLATION

A. Suspension System:

1. Install suspension system in accordance with manufacturers' instructions.
2. Install suspension system in accordance with manufacturer's instructions, and California Title 24.
3. Grid layout:
 - a. See Reflected Ceiling Plans.
 - b. Install grid based on electrical lighting fixture layout indicated in Electrical Drawings, unless otherwise indicated,
 - c. Acoustical panel dimension at perimeter walls: Not less than 6 inches .
 - d. Acoustical panel dimension at perimeter walls: Not less than 12 inches .
 - e. In case of conflict notify Architect.
4. Install grid square with room and with grid or acoustical panel center lines coinciding with center lines of room, each direction.
5. Intersections between main tees and cross tees:
 - a. Butt cut and notch as required.
6. Wall angles:
 - a. Install wall angles or moldings where ceilings meet walls, partitions, vertical elements, and other types of ceilings or ceiling fixtures.
 - 1) Secure angles to wall construction at stud locations.
 - a) Maximum spacing from terminal ends: 3 inches.
 - b) Draw fasteners tight against vertical surfaces.
 - 2) Level tolerance: not more than 1 in 1000.
 - 3) Miter cut inside and outside corners.
 - 4) Install with leg supporting bottom flange of runners.
 - 5) Install with min 7/8-inch horizontal leg supporting bottom flange of main tees and cross tees for use with BERC-2 Clip.
 - b. BERC-2 clip.
 - 1) Install on walls where runners are not fixed to runner allow terminal runner end to move 3/4 inches in both directions.
7. Hanger wires:
 - a. Provide hangers and inserts necessary to support ceiling suspension systems and ceiling dead loads.
 - b. Coordinate location and alignment with work of other trades.
 - c. Install hanger wires plumb to main tees and cross tees.
 - 1) Do not suspend any part of suspension system from ducts, pipes, conduit, cable tray or equipment.
 - 2) Provide supplementary rough suspension system where necessary to support ceilings beneath pipes, ducts, equipment, cable trays.
 - 3) Splay hangers no greater than 30 degrees from vertical to avoid obstructions or other conditions that prevent plumb, vertical installation.
 - 4) Offset horizontal forces by bracing or counter-splaying.
 - d. Space hangers to prevent eccentric deflection and rotation due to loads from items in or on ceiling.
 - 1) Provide supplemental hangers to support lighting fixtures and within 6 inches from end of main runners and fixtures which exceed manufacturer's published load data.
 - 2) Do not bear runners on walls or partitions.
8. Main runners:
 - a. Utilize wall angles to align and receive terminal ends of main tees without transferring load to wall angle.

- b. Space main tees as indicated to receive lay-in panels and fixtures.
 - c. Support terminal ends of main tees by wires located within 6 inches from boundary walls.
9. Cross runners:
- a. Space cross tees as indicated to receive lay-in panels and fixtures.
 - 1) Install cross runners with positive interlock.
 - b. Utilize wall angles to align and receive terminal ends of cross tees without transferring load to wall angle.
 - c. Support terminal ends of cross tees by wires located within 6 inches from boundary walls.
10. Install access splines in concealed systems as directed or required to provide access to concealed items.
11. Do not provide access splines for tiles in security areas.
12. Leave suspension system ready to accept installation of acoustic materials.
- B. Lay-In Items:
- 1. Install acoustic materials in accordance with manufacturer's instructions.
 - 2. Place lay-in panels, fixtures, diffusers, grilles, and similar items in manner not compromising suspension system performance.
 - 3. Field cut materials to fit grid.
 - 4. Tegular and similar tiles with articulated edges:
 - a. Cut edges to match profile of factory edges and paint to match.
 - 5. Ceiling paint:
 - a. Touch-up minor surface scratches and blemishes.
 - b. Cover field cut edges exposed to view.
 - c. Armstrong SuperCoat Ceiling Panel Touch-up Paint.
- C. Identify access tile with a white headed thumb tack.
- D. Hold Down Clips:
- 1. Provide Hold-down-clips where Clean Room Class 100 or Clean Room Class 5 tiles are scheduled.
 - 2. Provide hold down clips if UL rated ceiling requires.

3.4 CLEANING:

- A. Clean all surfaces following installation per manufacturer's cleaning instructions.
- B. Maintenance per Manufacturer's finish maintenance instructions.

3.5 PROTECTION:

- A. Protect ceilings from damage during the remainder of construction.
- B. Finished ceilings shall be without damage. Replace units having scratches, abrasions, or other defects with new units.

END OF SECTION

SECTION 09 65 13
RESILIENT BASE

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish labor, materials, tools, equipment, and services for Resilient Base, as indicated, in accordance with provisions of Contract Documents.
- B. Completely coordinate with work of other trades.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
 - 2. ASTM E648 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
 - 3. ASTM E662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
 - 4. ASTM F1861 Standard Specification for Resilient Wall Base
- B. National Fire Protection Association (NFPA):
 - 1. NFPA 253 Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source
 - 2. NFPA 258 Recommended Practice for Determining Smoke Generation of Solid Materials

1.3 SUBMITTALS

- A. Product Data:
 - 1. For each type of material and accessory.
 - 2. VOC content.
- B. Samples:
 - 1. Resilient Base:
 - a. Three samples of material and color as specified in Drawing Finish Schedule.
 - 2. Field fabricated corners: Construct sample base inside and outside corner:
 - a. Include minimum 4 feet straight base each direction from corner.
 - b. If not acceptable, construct additional corners.
 - c. Stress whitening and cracking will not be acceptable.
 - d. Color and height variation will not be acceptable.
 - e. Sample corners constitute standard of quality for actual construction.
 - f. Maintain sample corners during construction.
 - g. Remove when directed.
 - h. Sample corners may be built into permanent construction provided sample area is readily identifiable during construction.
 - i. Do not proceed with base installation until sample corners are approved by Architect.
- C. Contract Closeout Information:
 - 1. Maintenance data:
 - a. See Section 01 78 23.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Resilient Base:
 - 1. Base:
 - a. Armstrong World Industries.
 - 2. Optional:
 - a. Mannington.
 - b. Endura.
 - c. Tarkett.
 - d. Roppe.
 - e. VPI Floor Products.
- B. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 MATERIALS

- A. Performance Requirements:
 - 1. Thermoplastic Rubber: Type TP.
 - 2. Critical Radiant Flux:
 - a. Class I, not less than 0.45 W/cm².
 - 3. Flame Spread: Maximum, 75.
 - 4. Smoke Developed: Maximum, 250.
- B. Resilient Base:
 - 1. Rubber top set, coved type.
 - 2. 1/8 by 4 inches, 1/4 inches wide at bottom.
 - 3. Field formed external and internal corners.
 - 4. Provide continuous rolls, minimum 95 feet long.
- C. Leveling compound: As recommended by manufacturer, compatible with adhesives.
- D. Adhesives and primers:
 - 1. As recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces for defects and irregularities.
- B. Verify substrates are free of materials that may affect adhesion.
- C. Do not proceed with installation until unsatisfactory conditions have been corrected.
- D. Installation indicates acceptance of substrates and responsibility for performance.

3.2 PREPARATION

- A. Fill cracks, joints, etc., with water resistant non-crumbling patching compound.
- B. Trowel to smooth and proper level.

3.3 INSTALLATION

- A. Install after wall finishes.
- B. Install prior to carpet and acoustical material.
- A. Prepare substrate in accordance with manufacturer's instructions.

- B. Protect adjacent work from damage.
- C. Schedule installation to minimize accumulation of air contaminants that cannot be removed prior to occupancy.
- D. Install base after wall material has dried out thoroughly.
 - 1. Provide base at intersections of floor and vertical surfaces in areas scheduled to receive base, where intersection is exposed to view.
 - 2. Apply primer and adhesive as recommended by manufacturer.
 - 3. Set base straight and true.
 - 4. Fit base neatly into breaks and recesses.
 - 5. Install corners as recommended by manufacturer.
 - 6. Scribe to trim at door frames.
 - 7. Make joints tight.
 - 8. Install with top and bottom edges in firm contact with wall and floor.

3.4 CLEANING

- A. Remove surplus adhesive immediately after application and rolling.
- B. Clean in accordance with manufacturer's recommendations after materials have sufficiently seated.

END OF SECTION

SECTION 09 65 16
RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish labor, materials, tools, equipment, and services for Resilient Sheet Flooring (RS), as indicated, in accordance with provisions of Contract Documents.
- B. Completely coordinate with work of other trades.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM D2047 Standard Test Method for Static Coefficient of Friction of Polish Coated Flooring Surfaces as Measured by the James Machine.
 - 2. ASTM E648 Standard Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
 - 3. ASTM E662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
 - 4. ASTM F970 Standard Test Method for Static Load Limit.
- B. National Fire Protection Association (NFPA):
 - 1. NFPA 253 Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
 - 2. NFPA 258 Recommended Practice for Determining Smoke Generation of Solid Materials.

1.3 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's product data indicating adhesives comply with applicable VOC regulations.
- B. Shop Drawings:
 - 1. Seaming Diagram.
- C. Samples:
 - 1. Submit samples for the following items as specified in Finish Schedule on Drawings:
 - a. Three samples of each sheet goods selected.
 - b. Three samples of each welding rod.
- D. Contract Closeout Information:
 - 1. Maintenance data:
 - a. See Section 01 78 23.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Experienced in installation of sheet flooring using heat welded seams.
- B. Fire and Smoke Rating:
 - 1. Critical Radiant Flux, per ASTM E648 / NFPA 253:
 - a. Class I, not less than 0.45 W/cm².
 - 2. Smoke Developed: 450 or less per ASTM E662 / NFPA 258.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Resilient Sheet Flooring:
 - 1. Base:
 - a. Armstrong Flooring: an AHF Products Company.
 - 2. Optional:
 - a. Gerflor.
 - b. Johnsonite: A Tarkett Company.
 - c. Mohawk Group
- B. Cap Strip:
 - 1. Base:
 - a. Roppe.
 - 2. Optional:
 - a. Johnsonite: A Tarkett Company.
- C. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 MATERIALS

- A. Resilient Sheet Flooring:
 - 1. Homogenous sheet vinyl floor covering, minimum 0.080 inches overall thickness.
 - 2. ASTM Standard:
 - a. ASTM F1913.
 - 3. Static coefficient of friction: 0.6.
 - 4. Static Load Limit:
 - a. 1000 psi.
- B. Slip Resistant Resilient Sheet Flooring:
 - 1. PVC flooring with aluminum oxide grit embedded for slip resistance.
- C. Integral Coved Base:
 - 1. Height: 6 inches.
 - 2. Extend the flooring material up the wall supported by a cove filler strip having a minimum height of 7/8 inches and adhering to the wall.
- D. Plastic cove cap strip:
 - 1. 1/8 inches, vinyl extrusion in minimum 12 feet lengths.
 - 2. Color: Match or compatible with flooring color.
- E. Sealers:
 - 1. Provide sealers as recommended by flooring manufacturer.
- F. Adhesive:
 - 1. Provide adhesives as recommended by flooring manufacturer.
- G. Leveling Compound:
 - 1. Cementitious type as recommended by flooring manufacturer.
 - 2. Verify compatibility with moisture content of concrete.
- H. Transition Strips:
 - 1. 1 inches wide, tapered to meet abutting materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces for defects, irregularities and conditions under which flooring is to be installed.
- B. Verify substrates are free of materials that may affect adhesion.
- C. Identify cracks and other surface defects which need repair prior to application of floor system.
- D. Inspect substrate for markers, paint and similar materials used for layout by others and take remedial action as necessary to remove layout line work to prevent bleed-through.
- E. Verify floors are level or meet indicated slope.
- F. Do not proceed with installation until unsatisfactory conditions have been corrected.
- G. Installation indicates acceptance of substrates and responsibility for performance.

3.2 PREPARATION

- A. Coordinate installation with requirements of Section 07 16 04 Concrete Floor Moisture Testing, and Section 07 16 05 Water Vapor Emission Control System.
- B. Prepare substrate in accordance with manufacturer's instructions.
- C. Fill construction joints and other non-moving joints with product approved by manufacturer of flooring system.
- D. Where necessary for smooth substrate, fill or level floors with leveling compound and feather minimum 4 feet from transition.
- E. Coordinate leveling with vapor emission control system provider.

3.3 INSTALLATION

- A. Apply flooring in accordance with manufacturer's printed instruction.
- B. Minimize accumulation of air contaminants that cannot be removed prior to occupancy.
- C. Install after wall finishes.
- D. Provide sheets in one room or area from one production run.
- E. Install in maximum possible sizes.
- F. Install in adhesive with accurate, tight seams.
- G. Utilize hard set adhesive in the following rooms:
 - 1. Patient Rooms.
 - 2. Other areas indicated.
 - 3. Utilize conventional adhesive in remaining locations.
- H. Install flooring and base as indicated for rooms:
 - 1. Include areas under and behind equipment.
- I. Install integral coved base at walls, columns, pilasters, casework, and similar features.
 - 1. Seam inside and outside corners with welded butterfly corners.
 - 2. Cap coves with vinyl cap strip and caulk joint between cap strip and wall surface.
- J. Weld to adjacent vinyl sheet flooring and weld joints between sheets.
- K. Remove excess rod with sharp knife and buff to match adjacent surfaces.
- L. Locate transition strip directly under door when in closed position where seam occurs in door openings.

- M. Utilize transition strip specified in respective section where abutting materials are carpet, ceramic tile, quarry tile, stone tile, and similar.
- N. Where resilient sheet flooring abuts thicker finish flooring materials, feather leveling compound for approximately 12 inches for each 1/8 inches of rise so finished surfaces align.

3.4 PROTECTION

- A. Restrict heavy traffic for 48 hours.
- B. Do not expose to water for 30 days.
- C. Protect floors from rolling loads by covering with hardboard or plywood.
- D. Protect the floor with un-dyed, untreated building paper until final inspection.

3.5 CLEANING

- A. When final building cleanup is being accomplished clean flooring and base in accordance with manufacturer's instructions.

END OF SECTION

SECTION 09 67 23
RESINOUS FLOORING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Resinous flooring systems and base.

1.3 RELATED REQUIREMENTS

- A. Section 03 54 16 - Hydraulic Cement Underlayment for self-leveling underlayment.
- B. Section 07 92 00 - Joint Sealants for sealants installed at joints in resinous flooring systems.
- C. Section 09 05 63 - Water Vapor Emission Control System for substrate moisture and alkalinity tests to be performed on concrete substrates
- D. Section 26 05 39 - Underfloor Raceways for Electrical Systems: Recessed electrical access cover frames.

1.4 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency.
- B. ASTM C307 - Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing.
- C. ASTM C579- Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
- D. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
- E. ASTM D905 - Standard Test Method for Strength Properties of Adhesive Bonds in Shear by Compression Loading; 2008 (Reapproved 2021).
- F. ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
- G. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
- H. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- I. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- J. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- K. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.
- L. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated, including VOC content. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- B. Samples for Verification: For each type of exposed finish required.
- C. Manufacturer's Installation Instructions: Indicate special procedures.
- D. Product Schedule: For resinous flooring.
- E. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- F. Material Certificates: For each resinous flooring component, from manufacturer.
- G. Material Test Reports: For each resinous flooring system.
- H. Maintenance Data: For resinous flooring to include in maintenance manuals.

- I. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of flooring systems required for this Project.
 - 1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated with 5 years experience installing specified flooring system.
- B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.
- C. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Apply full-thickness mockups on 48-inch- (1200-mm-) square floor area selected by Architect.
 - 2. Simulate finished lighting conditions for Architect's review of mockups.
 - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 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 storage and mixing with other components.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application unless manufacturer recommends a longer period.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Dur-A-Flex, Inc.
- B. Stonhard, Inc.

2.2 MATERIALS

- A. VOC Content of Resinous Flooring: Provide resinous flooring systems, for use inside the weatherproofing system, that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Resinous Flooring: 100 g/L.

2.3 RESINOUS FLOORING - LABORATORY SPACES (FLAKE SYSTEMS)

- A. Resinous Flooring: Abrasion-, impact-, and chemical-resistant, aggregate-filled, resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.
- B. Basis of Design:
 - 1. Dur-A-Flex: Durachip: Primer: Dura-A-Glaze #4 WB resin and hardener, Broadcast Coat: Dur-A-Gard OPF resin and hardener, Broadcast: Micro Decorative Colored Chips, Body Coat: Dur-A-Glaze #4 and Water Clear hardener, Broadcast: Micro Decorative Colored Chips, Grout Coat: Dur-A-Glaze #4 resin and Water Clear Hardener, Topcoat: Armor Top resin, hardener, and grit.
 - 2. Stonhard: Stontec ERF: Primer: Stonhard Standard Primer, Body Coat: Stonshield Undercoat, Broadcast: Stontec Flakes, Topcoat: Stonkote CE4.
- C. System Characteristics:
 - 1. Color and Pattern: As selected by Architect from manufacturer's full range.
 - 2. Wearing Surface: Textured for slip resistance.
 - 3. Overall System Thickness: 5/64 inch (2.0 mm).
 - 4. Integral Cove Base: 6 inches high.

5. Application: As recommended by manufacturer.
 - D. Primer:
 1. Resin: Epoxy, 2 component.
 2. Coats: One.
 - E. Broadcast Coat and Broadcast: Per manufacturer's requirements.
 - F. Body Coats:
 1. Resin: Epoxy, 3 component, solvent free
 2. Coats:
 - a. Number of Coats: One.
 - b. Thickness of Coat: 25 - 30 mil.
 - G. Broadcast Media:
 1. Pattern: Decorative Flake as selected by Architect from manufacturer's full range.
 2. Size: 1/16 inch.
 - H. Grout Coat: Per manufacturer's requirements.
 - I. Topcoat: Sealing or finish coats.
 1. Resin: Epoxy.
 2. Formulation Description: 2 component, UV stable, solvent free.
 3. Type: Clear.
 4. Finish: Gloss.
 5. Number of Coats: Two.
 - J. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
 1. Tensile Strength: 3,700 psi per ASTM D638.
 2. Flexural Strength: 4,000 psi per ASTM D790
 3. Abrasion Resistance: 0.03 gm maximum weight loss per ASTM D4060, CS-17.
 4. Flammability: Class 1 per ASTM E648
- 2.4 RESINOUS FLOORING - LABORATORY SPACES (CHEMICAL RESISTANCE NEEDED)
- A. Resinous Flooring: Abrasion-, impact-, and chemical-resistant, aggregate-filled, resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.
 - B. Basis of Design:
 1. Dur-A-Flex: PolyCrete SLB: Primer: Pigmented Poly-Crete TF Plus (if required), Body Coat: Poly-Crete SL, Broadcast: Flintshot or Q-Rok Quartz into Body Coat, Topcoat: Pigmented Topcoat.
 2. Stonhard: Stonclad GS: Primer: Stonhard Standard Primer, Mortar Base: Stonclad GS, Top Coat: Stonkote GS4.
 - C. System Characteristics:
 1. Color and Pattern: As selected by Architect from manufacturer's full range.
 2. Wearing Surface: Textured for slip resistance.
 3. Overall System Thickness: 1/4 inch (6.4 mm).
 4. Application: As recommended by manufacturer.
 - D. Primer:
 1. Resin: Manufacturers standard.
 2. Application: As recommended by manufacturer.
 3. Coats: One
 - E. Body Coat / Mortar Base:
 1. Resin: Manufacturers standard..
 2. Aggregates: Manufacturer's standard.
 3. Broadcast: Manufacturer's standard.
 - F. Topcoat:
 1. Resin: Manufacturers standard.
 2. Type: Pigmented.
 3. Finish: _____.
 4. Number of Coats: One.
 - G. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

1. Compressive Strength: 9,000 psi per ASTM C579.
2. Tensile Strength: _____ per ASTM C307.
3. Flexural Modulus of Elasticity: _____ per ASTM C580.
4. Water Absorption: 0.2% per ASTM C413.
5. Impact Resistance: >160 inches/pounds per ASTM D2794.
6. Abrasion Resistance: _____ maximum weight loss per ASTM D4060.
7. Hardness: 85 to 90, Shore D per ASTM D2240.

2.5 RESINOUS FLOORING - MAINTENANCE SPACES

- A. Basis of Design:
 1. Dur-A-Flex, Inc.: Dur-A-Gard MR: Primer: Elast-O-Coat, Body Coat: Dur-A-Gard, Topcoat: Armor Top.
 2. Stonhard, Inc.: Stongard MR: Primer: Stonhard Standard Primer, Primer (two): Stonhard SL Primer, Body: Stonproof ME7, Topcoat: Stonkote GS4. Cove Base: Stonclad GS.
- B. System Characteristics:
 1. Color and Pattern: As selected by Architect from manufacturer's full range.
 2. Wearing Surface: Textured for slip resistance as selected by Architect.
 3. Overall System Thickness: 40 mil.
 4. Flooring and cove base.
- C. Primer Coat (one):
 1. Resin: Epoxy, 2 component.
 2. Formulation Description: 100 percent solids.
 3. Application Method: Squeegee back roll.
 - a. Thickness of Coat: 1/16 inch (1.6 mm).
 - b. Number of Coats: One.
- D. Primer Coat (two):
 1. Resin: Epoxy, 3 component with 90 grit silica.
 2. Formulation Description: 100 percent solids.
 3. Application Method: Squeegee back roll onto first wet primer.
 - a. Number of Coats: One.
- E. Body Coat:
 1. Resin: Urethane Epoxy Membrane.
 2. Formulation Description: 100 percent solids elastomeric.
 3. Type: Clear or Pigmented.
 4. Finish: Gloss.
 5. Application Method: Notched trowel screed.
 - a. Thickness of Coat: 20 mils.
 - b. Number of Coats: One.
- F. Topcoat: Sealing or finish coats.
 1. Resin: Epoxy.
 2. Formulation Description: 100 percent solids epoxy.
 3. Type: Pigmented.
 4. Finish: Gloss.
 5. Number of Coats: One.
- G. Cove Base:
 1. Color and Pattern: As selected by Architect from manufacturer's full range.
 2. Height: As indicated on drawings.
 3. Application Method: Troweled.
 - a. Thickness : 1/16 inch (1.6 mm)
 - b. Number of Coats: One.
 4. Accessories: Cove strip.
- H. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
 1. Tensile Strength: 1,200 psi per ASTM C307.
 2. Water Absorption: 0.1% per ASTM C413.
 3. Elongation: 150 Percent Percent per ASTM D412.

4. Impact Resistance: No chipping, cracking, or delamination and not more than 1/16-inch (1.6-mm) permanent indentation per MIL-D-3134.
5. Resistance to Elevated Temperature: No slip or flow of more than 1/16 inch (1.6 mm) per MIL-D-3134.
6. Abrasion Resistance: 0.06 gm per ASTM D4060.
7. Flammability: Self-extinguishing per ASTM D635.
8. Hardness: 70, Shore D per ASTM D2240 or greater than 4H per ASTM D3363.

2.6 RESINOUS FLOORING: EQUIPMENT PADS

- A. Basis of Design:
 1. Dur-A-Flex: Accelera S.
 2. Stonhard: Stonseal PA7.
- B. System Characteristics:
 1. Formulation: 2 Component, pigmented aspartic polyurethane coating.
 2. Color: Safety Yellow.
- C. Location: Use on equipment pads in mechanical, electrical, and other housekeeping spaces including on cove edges and entire surface of pads.

2.7 ACCESSORIES

- A. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.
- B. Precast, Integral Cove Base: Impact-resistant, polymer-resin, cove base moldings with a grit profile to promote adhesion of resinous flooring and recommended in writing by resinous flooring manufacturer.
 1. Radius Cove Base: 4-inch-(102-mm-) high base molding that provides approximately 1-inch (25-mm) radius cove at floor-to-wall joint and wall to wall joint; for adhesive installation as substrate for resinous flooring system to form an integral cove base.
 - a. Preformed Inside and Outside Corners: Provide manufacturer's standard square inside and square outside corners.
 2. Cap Strip: Square stainless steel cap provided or approved by resilient sheet flooring manufacturer.

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 resinous flooring systems.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
 1. Roughen concrete substrates as follows:
 - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - b. Comply with requirements in SSPC-SP 13/NACE No. 6, with a Concrete Surface Profile of 3 or greater in accordance with ICRI Technical Guideline No. 310.2R, unless manufacturer's written instructions are more stringent.
 2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
 3. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. (304.8 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

- a. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- 4. Alkalinity and Adhesion Testing: Perform tests recommended in writing by resinous flooring manufacturer. Proceed with installation only after substrate alkalinity is not less than 6 or more than 8 pH unless otherwise recommended in writing by flooring manufacturer.
- C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
 - 1. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

3.3 APPLICATION

- A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
 - 1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 - 2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 - 3. At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Apply self-leveling slurry body coats in thickness indicated for flooring system.
 - 1. Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.
- C. Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, remove trowel marks and roughness using method recommended by manufacturer.
- D. Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat and to produce wearing surface indicated.
- E. Integral Cove Base Accessories: Adhesively install precast accessories before applying flooring coats and in accordance with manufacturer's written instructions.
- F. Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer.
- G. Finish of flooring and base shall provide surfaces free of pinholes, fish eyes, cracks or other conditions that can prevent thorough cleaning.

3.4 FIELD QUALITY CONTROL

- A. Material Sampling: Owner may at any time and any number of times during resinous flooring application require material samples for testing for compliance with requirements.
 - 1. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
 - 2. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

3.5 PROTECTION

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 09 67 23

SECTION 09 91 23

INTERIOR PAINTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Materials for backpriming woodwork.
- D. Scope: Finish interior surfaces exposed to view, unless fully factory-finished
 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 2. Elevator pit ladders.
 3. Surfaces inside cabinets.
 4. Prime surfaces to receive wall coverings.
 5. Mechanical and Electrical:
 - a. In finished areas, paint conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
 - b. In finished areas, paint shop-primed items.
 - c. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
 - d. Paint dampers exposed behind louvers, grilles, to match face panels.
- E. Do Not Paint or Finish the Following Items:
 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 2. Items indicated to receive other finishes.
 3. Items indicated to remain unfinished.
 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, copper, chrome-plated items, monel metal, and lead items.
 6. Marble, granite, slate, and other natural stones.
 7. Floors, unless specifically indicated.
 8. Ceramic and other tiles.
 9. Brick, architectural concrete, cast stone, integrally colored plaster, and stucco.
 10. Glass.
 11. Acoustical materials, unless specifically indicated.
 12. Concealed pipes, ducts, and conduits.

1.3 RELATED REQUIREMENTS

- A. Section 01 81 13 - Sustainable Design Requirements
- B. Section 05 50 00 - Metal Fabrications: Shop-primed items.
- C. Section 05 51 00 - Metal Stairs: Shop-primed items.
- D. Section 09 91 13 - Exterior Painting.
- E. Section 09 96 00 - High-Performance Coatings.
- F. Section 22 05 53 - Plumbing Identification: Color coding scheme for items to be painted under this section.
- G. Section 23 05 53 - Mechanical Identification: Color coding scheme for items to be painted under this section.

- H. Section 26 05 53 - Electrical Identification: Color coding scheme for items to be painted under this section.
 - I. Section 32 17 23 - Pavement Markings: Painted pavement markings.
- 1.4 DEFINITIONS
- A. Comply with ASTM D16 for interpretation of terms used in this section.
- 1.5 REFERENCE STANDARDS
- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency.
 - B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.
 - C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials.
 - D. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.
 - E. SCAQMD 1113 - Architectural Coatings.
 - F. SSPC V1 (PM1) - Good Painting Practice: Painting Manual Volume 1.
 - G. SSPC V2 (PM2) - Systems and Specifications: Steel Structures Painting Manual Volume 2.
 - H. SSPC-SP 1 - Solvent Cleaning.
 - I. SSPC-SP 3 - Power Tool Cleaning.
 - J. SSPC-SP 6 - Commercial Blast Cleaning.
 - K. SSPC-SP 13 - Surface Preparation of Concrete.
 - L. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005.
- 1.6 SUBMITTALS
- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
 - B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
 - 2. Cross-reference to specified paint system products to be used in project; include description of each system.
 - 3. Manufacturer's installation instructions.
 - C. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.
 - 1. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.
 - D. Samples: Submit two paper chip samples 3 inch by 3 inch minimum in size, illustrating selected colors and textures for each color and system selected with specified coats and labeled per finish schedule.
 - E. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
 - F. Manufacturer's Instructions: Indicate special surface preparation procedures; substrate conditions requiring special attention.
 - G. Maintenance Data: Submit data and coating maintenance manual; including finish schedule showing where each product/color/finish was used; product technical data sheets; material safety data sheets (MSDS); care and cleaning instructions; touch-up procedures; repair of painted and finished surfaces; and color samples of installed products.
- 1.7 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum 10 years documented in similar project types experience.
- 1.8 MOCK-UP
- A. See Section 01 40 00 - Quality Requirements, for general requirements for mock-up.
 - B. Provide panel, ____ feet (____ m) long by ____ feet (____ m) wide, illustrating paint color, texture, and finish.
 - C. Locate where directed by Architect.
 - D. Mock-up may remain as part of the work upon direction from Architect.
- 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.10 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Provide lighting level of 80 fc (860 lux); measured mid-height at substrate surface.

1.11 ATTIC STOCK

- A. Furnish an additional 2 percent of any specialty paint products or colors as confirmed with Building Maintenance.
- B. Label each container with color, color number, texture, and locations, in addition to the manufacturer's label.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
- B. Paints:
 - 1. Sherwin Williams
 - 2. PPG
 - 3. Benjamin Moore
- C. Primer Sealers: Same manufacturer as top coats.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
 - 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
 - 3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
 - 4. Supply each paint material in quantity required to complete entire project's work from a single production run.
 - 5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content:
 - 1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - b. SCAQMD 1113.
 - c. CARB (SCM).
 - d. Ozone Transport Commission (OTC) Model Rule, Architectural, Industrial, and Maintenance Coatings; www.otcair.org; specifically:
 - 1) Opaque, Flat: 50 g/L, maximum.
 - 2) Opaque, Nonflat: 150 g/L, maximum.
 - 3) Opaque, High Gloss: 250 g/L, maximum.
 - e. Architectural coatings VOC limits of the State in which the Project is located.

- f. Architectural coatings VOC limits of Authority having jurisdiction.
- 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- C. Flammability: Comply with applicable code for surface burning characteristics.
- D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- E. Colors: As indicated on drawings.
 - 1. Extend colors to surface edges; colors may change at any edge as directed by Architect.
 - 2. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.
 - 3. In utility areas, finish equipment, piping, conduit, and exposed duct work in colors according to the color coding scheme indicated.

2.3 PAINT SYSTEMS – INTERIOR

- A. Gypsum Board, Latex Flat Finish, 3 Coat (Dark Room, Reading Room, Gypsum Board Ceilings):
 - 1. SW:
 - a. One coat of B28W2600, ProMar 200 Zero VOC Interior Latex Primer.
 - b. Flat: Two coats of B30-2600 Series, ProMar 200 Zero VOC Interior Latex Flat.
 - 2. PPG:
 - a. One coat of 6-4900XI, Speedhide ZERO Interior Sealer.
 - b. Flat: Two Coats of 6-5100, Speedhide ZERO Interior Flat
 - 3. BM:
 - a. One coat of N534, UltraSpec 500 Zero VOC Interior Latex Primer.
 - b. Flat: Two Coats of 295, SuperHide Interior Latex Flat
- B. Gypsum Board Walls, Latex Egg-Shell Finish, 3 Coat (Public Spaces, Office Spaces, Majority of spaces):
 - 1. SW:
 - a. One coat of B28W2600, ProMar 200 Zero VOC Interior Latex Primer.
 - b. Eggshell: Two coats of B20-2600 Series, ProMar 200 Zero VOC Interior Latex Egg-Shel.
 - 2. PPG:
 - a. One coat of 6-4900XI, Speedhide ZERO Interior Sealer.
 - b. Eggshell: Two Coats of 6-5310, Speedhide ZERO Interior Eggshell.
 - 3. BM:
 - a. One coat of N534, UltraSpec 500 Zero VOC Interior Latex Primer.
 - b. Eggshell: Two coats of 296, SuperHide Interior Latex Low Sheen/Eggshell
- C. Gypsum Board Walls, Latex Satin Finish, 3 Coat (Accent Walls):
 - 1. SW:
 - 2. PPG:
 - a. One coat of 6-4900XI, Speedhide ZERO Interior Sealer
 - b. Two Coats of 13-410 Ultralast Interior Satin
 - 3. BM:
 - a. One coat of N534, UltraSpec 500 Zero VOC Interior Latex Primer.
 - b. Satin: Two coats of T545, UltraSpec 500 Zero VOC Interior Latex Satin/Pearl
- D. Gypsum Board, Epoxy Eggshell, 3 Coat (High traffic public spaces with direction from UTSW Interiors, restrooms, laundry rooms):
 - 1. SW:
 - a. One coat of B28W2600, ProMar 200 Zero VOC Interior Latex Primer.
 - b. Two coats of SW K45-1150 Series, Pre-Catalyzed Waterbased Epoxy Eg-Shel.
 - 2. PPG:
 - a. One coat of 17-921XI, SealGrip Universal Primer
 - b. Eggshell: Two Coats of 16-1310, Pitt Glaze WB1 Eggshell Pre-Catalyzed Water-Borne
 - 3. BM:
 - a. One coat of N534, UltraSpec 500 Zero VOC Interior Latex Primer.
 - b. Eggshell: Two coats of 485, Scuff-X Interior Latex Eggshell Scuff Resistant Coating
- E. Gypsum Board, Epoxy Semi-Gloss, 3 Coat (ARC animal spaces):
 - 1. SW:

- a. One coat of S-W B28W2600 ProMar 200 Zero VOC Interior Latex Primer.
 - b. Two coats of SW S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy, K46- Series.
 - 2. PPG:
 - a. One coat of 17-921XI, SealGrip Universal Primer
 - b. Eggshell: Two Coats of 16-1510, Pitt Glaze WB1 Semi-Gloss Pre-Catalyzed Water-Borne Epoxy.
 - 3. BM:
 - a. One coat of N534, UltraSpec 500 Zero VOC Interior Latex Primer.
 - b. Two coats of Corotech V341, Corotech Pre-Catalyzed Waterborne Epoxy Semi-Gloss.
- F. CMU, Pre-Catalyzed Epoxy Finish Eggshell, Latex, 3 Coat (Wet Spaces, Back of House):
 - 1. SW:
 - a. One coat CF1W50, ConFlex Block Filler.
 - b. Two coats of K45-1150 Series, Pre-Catalyzed Waterbased Epoxy Eg-Shel.
 - 2. PPG:
 - a. One Coat of 6-15XI, Speedhide Hi-Fill Masonry Block Filler
 - b. Two Coats of 16-1310, Pitt Glaze WB1 Eggshell Pre-Catalyzed Water-Borne
 - 3. BM:
 - a. One Coat of 571, UltraSpec Hi-Build Masonry Block Filler.
 - b. Two coats of Corotech V342, Corotech Pre-Catalyzed Waterborne Epoxy Eggshell
- G. CMU, Pre-Catalyzed Epoxy Finish Semi-Gloss, Latex, 3 Coat (ARC animal spaces):
 - 1. SW:
 - a. One coat CF1W50, ConFlex Block Filler.
 - b. Two coats of K46 Series, Pre-Catalyzed Waterbased Epoxy.
 - 2. PPG:
 - a. One Coat of 6-15XI, Speedhide Hi-Fill Masonry Block Filler
 - b. Eggshell: Two Coats of 16-1510, Pitt Glaze WB1 Semi-Gloss Pre-Catalyzed Water-Borne Epoxy.
 - 3. BM:
 - a. One Coat of 571, UltraSpec Hi-Build Masonry Block Filler.
 - b. Two coats of Corotech V341, Corotech Pre-Catalyzed Waterborne Epoxy Semi-Gloss.
- H. Ferrous Metals Unprimed, WB Alkyd Urethane, Semi-Gloss, 3 Coat (doors, door frames, vision/lite frames, and handrails):
 - 1. SW:
 - a. One coat of B66W01310 Series, Pro Industrial Pro-Cryl Universal Acrylic Primer.
 - b. Two coats of B53W01151 Series, Pro Industrial WB Alkyd Urethane Enamel Semi-Gloss.
 - 2. PPG:
 - a. One coat of Pitt-Tech Plus 4020PF
 - b. Two coats Pitt-Tech Plus EP S/G, 90-1610
 - 3. BM:
 - a. One coat of Corotech V110, Acrylic Metal Primer.
 - b. Two coats of HP29, UltraSpec HP DTM Acrylic Enamel Semi-Gloss
- I. Galvanized Metals, Latex, 3 Coat:
 - 1. SW:
 - a. One coat of B66-1300 Series, Pro-Cryl Universal Water Based Primer.
 - b. Two coats of B66-650 Series, Pro Industrial Acrylic Semi-Gloss
 - 2. PPG:
 - a. One Coat of 4020PF, Pitt-Tech Plus 4020
 - b. Two Coats of 90-1610, Pitt-Tech PLUS EP Semi-Gloss
 - 3. BM:
 - a. One coat of Corotech V110, Acrylic Metal Primer.
 - b. Two coats of HP29, UltraSpec HP DTM Acrylic Enamel Semi-Gloss
- J. Aluminum, Unprimed, Latex, semi-gloss, 3 Coat:
 - 1. SW:
 - a. One coat etching primer: SW B71Y1, DTM Wash Primer.
 - b. Two coats of B66-650 Series, Pro Industrial Acrylic Semi-Gloss
 - 2. PPG:

- a. One Coat of 4020PF, Pitt-Tech Plus 4020
 - b. Two Coats of 90-1610, Pitt-Tech PLUS EP Semi-Gloss
- 3. BM:
 - a. One Coat of Corotech V110, Acrylic Metal Primer.
 - b. Two coats of HP29, UltraSpec HP DTM Acrylic Enamel Semi-Gloss.
- K. Metal Decking DryFall Finish, Latex Flat, 2 Coat:
 - 1. SW:
 - a. Possible primer if rusting is present.
 - b. Two coats of B42W1181, Pro Industrial Waterborne Acrylic DryFall Flat.
 - 2. PPG:
 - a. Possible primer if rusting is present.
 - b. Two Coats of 6-725XI, PPG Speedhide Super Tech WB Interior Dry Fog Flat
 - 3. BM:
 - a. If rust present, Corotech V132, Prep All Universal Metal Primer Alkyd.
 - b. Two Coats of 395, Latex Dryfall Flat.
- L. Metal Decking DryFall Finish, Latex Eggshell, 2 Coat:
 - 1. SW:
 - a. Possible primer if rusting is present.
 - b. Two coats of B42W82, Pro Industrial Waterborne Acrylic DryFall Eg-Shel.
 - 2. PPG:
 - a. Possible primer if rusting is present.
 - b. Two Coats of 6-724XI, Speedhide Super Tech WB Interior Dry Fog Eggshell
 - 3. BM:
 - a. If rust present, Corotech V132, Prep All Universal Metal Primer Alkyd.
 - b. Two coats of 395, Latex Dryfall Eggshell.

2.4 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: filler.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
 - 1. Gypsum Wallboard: 12 percent.
 - 2. Plaster and Stucco: 12 percent.
 - 3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
 - 4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
 - 5. Concrete Floors and Traffic Surfaces: 8 percent.

3.2 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or repair existing paints or finishes that exhibit surface defects.
- D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- E. Seal surfaces that might cause bleed through or staining of topcoat.
- F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate; tri-sodium phosphate; or _____ and bleach. Rinse with clean water and allow surface to dry.

- G. Concrete:
 - 1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
 - 2. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
- H. Masonry:
 - 1. Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
 - 2. Prepare surface as recommended by top coat manufacturer.
- I. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
- J. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- K. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high-alkali surfaces.
- L. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- M. Galvanized Surfaces:
 - 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
 - 2. Prepare surface according to SSPC-SP 2.
- N. Ferrous Metal:
 - 1. Solvent clean according to SSPC-SP 1.
 - 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
 - 3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 Commercial Blast Cleaning. Protect from corrosion until coated.
- O. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
- P. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.
- Q. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's written instructions.
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- E. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
- F. Sand wood surfaces lightly between coats to achieve required finish.
- G. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection; and testing.
- B. Owner will provide field inspection; and testing.

3.5 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.6 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 09 91 23

**SECTION 09 96 00
HIGH-PERFORMANCE COATINGS**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation and application of high-performance coating systems.

1.2 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.
- C. ASTM D523 - Standard Test Method for Specular Gloss.
- D. GreenSeal GS-11 - Standard for Paints, Coatings, Stains, and Sealers.
- E. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual.
- F. SSPC-PA 1 - Shop, Field, and Maintenance Coating of Metals.
- G. SSPC-SP 11 - Power-Tool Cleaning to Bare Metal.
- H. SSPC-SP 7 - Brush-Off Blast Cleaning.

1.3 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D16 apply to this Section.
- B. Sheen: As defined by MPI (APSM).
 - 1. Wherever reference is made to sheen finish or gloss, provide reflectivity, when measured with a gloss meter per ASTM D523, as follows for each designation:
 - a. Gloss Level 5: Semi-Gloss: Not less than 35 units, nor more than 70 units, at a 60 degree meter.
 - b. Gloss Level 6: Full Gloss: Not less than 70 units, nor more than 85 units, at a 60 degree meter.
 - c. Gloss Level 7: High Gloss: More than 85 units at a 60 degree meter.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.
- B. Certification: By manufacturer that all paints and coatings do not contain any of the prohibited chemicals specified; GreenSeal GS-11 certification is not required but if provided shall constitute acceptable certification.
- C. Samples for Initial Selection: For each type of topcoat product indicated.
- D. Samples for Verification: For each type of coating system and in each color and gloss of topcoat indicated.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- E. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. VOC content.

1.5 MOCKUPS

- 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 specified in Part 3.
 - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft.
 - 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.
 - 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 surrounding air temperatures are between 50 and 95 deg F.
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F 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. Base:
 - 1. Stonglaze by Stonhard (SP-1, SP-2); www.stonhard.com (Stonhard)
- B. Carboline; www.carboline.com. (Carboline)
- C. PPG Architectural Coatings; www.ppgac.com. (PPG)
- D. Tnemec Company, Inc.; www.tnemec.com. (Tnemec)

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each coating system that are 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 coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.
 - 3. Provide products of same manufacturer for each coat in a coating system.
- B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior coatings applied at project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Primers, Sealers, and Undercoaters: 200 g/L.
4. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: 250 g/L.
5. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
6. Pre-Treatment Wash Primers: 420 g/L.

C. Colors: As selected by Architect from manufacturer's full range.

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 paints 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.
1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Masonry: 12 percent.
 - c. Gypsum Board: 12 percent.
- B. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates 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 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. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
1. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi at 6 to 12 inches.
 2. Abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
- E. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions.
1. Clean surfaces with pressurized water. Use pressure range of 100 to 600 psi at 6 to 12 inches.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following.
1. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions.
1. Use applicators and techniques suited for coating and substrate indicated.
 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Apply prime and finish coats prior to final installation of permanently fixed equipment or furniture.
 3. Coat back sides 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.
1. Application of Primer/Block Filler to CMU: Apply block filler to CMU to provide a smooth, uniform surface free of trowel marks, laps, ridges, and other surface imperfections.
 2. Voids and Pin Holes: Following application of primer/block filler, examine surface of CMU for evidence of voids or pin holes. If pin holes or voids are found, apply additional primer/block filler.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner will 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.
- B. Inspection for Pin Holes and Other Surface Defects: On-site supervisor of personnel applying high performance coating shall perform a visual inspection for voids and pin holes in finished coatings.
1. In order to guarantee a 100 percent pinhole-free surface, visually inspect for voids and pin holes following application of primer/filler and again after application of finished coating. Visually inspect for pin holes at a distance not greater than 5 feet from the coated surface. Inspect each surface in every room and space where coatings have been applied. Perform inspection under finished lighting conditions or use temporary lighting that simulates finished lighting.
 - a. Maintain log of inspection in tabular form; include the following:
 - 1) Date of inspection.
 - 2) Room or area inspected.
 - 3) Note whether inspection is for primer/filler or finished coating.
 - 4) Amount of time spent inspecting each room or area.
 - 5) Location of each pin hole or other surface defect in coating that requires correction.
 - 6) Mark location of each pin hole or other surface defect using temporary marker that can be easily removed without staining surface.
 - 7) Written recommendations for repair of each type of surface defect including required materials and methods of application.
 - 8) Name and signature of manufacturer's technical representative.
 - b. Submit log to Owner and Architect when inspection is complete. Architect will review log and visit Site to verify that inspection is complete. Architect's review and inspection is not an approval of the materials and methods used to repair surface defects.

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 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 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Steel Substrates:
 1. HPC-5; Gloss, Urethane Finish: Gloss aliphatic acrylic urethane over polyamide epoxy primer.
 - a. Primer: Polyamide epoxy undercoat, as recommended by manufacturer for this substrate, applied at rate to achieve a total dry film thickness of not less than 4.0 mils.
 - 1) Carboline: Carboguard 893 SG.
 - 2) PPG: Pitt-Guard 97-948 All Weather DTR Epoxy.
 - 3) Tnemec: Hi-Build Epoxoline Series 66.
 - b. Intermediate Coat: Full-gloss, Aliphatic acrylic urethane enamel applied at rate recommended by manufacturer to achieve a total dry film thickness of not less than 4.0 mils.

- 1) Carboline: Carbothane 134 SG.
 - 2) PPG: Pittthane Ultra 95-812 Gloss Urethane Enamel.
 - 3) Tnemec: Endura-Shield Series 1074.
- c. Finish Coat: Full-gloss, Aliphatic acrylic urethane enamel applied at rate recommended by manufacturer to achieve a total dry film thickness of not less than 4.0 mils.
- 1) Carboline: Carbothane 134 SG.
 - 2) PPG: Pittthane Ultra 95-812 Gloss Urethane Enamel.
 - 3) Tnemec: Endura-Shield Series 1074U.

B. CMU Substrates:

1. HPC-1; Gloss, Modified Polyamine Epoxy Finish: Epoxy finish coat over an epoxy filler/primer
 - a. Prime/Filler Coat: 100 percent solids epoxy filler, applied at rate to achieve a total dry film thickness of not less than 15 mils.
 - 1) Tnemec: Series 215 Surfacing Epoxy.
 - b. Base Coat: 100 percent solids polyamide epoxy basecoat, applied at rate to achieve a total dry film thickness of not less than 5 mils.
 - 1) Tnemec: Series 201 Epoxoprime.
 - c. Finish Coat: 100 percent solids gloss polyamide epoxy, applied at rate to achieve a total dry film thickness of not less than 12 mils.
 - 1) Tnemec: Series 280 Tneme Glaze; 2 coats required.
2. HPC-2; Fiberglass mat reinforced polyamine epoxy wall coating system with gloss aliphatic urethane topcoat.
 - a. Primer: Modified polyamine epoxy filler and surface, applied at rate recommended by manufacturer (1/32 inch to 1/8 inch).
 - 1) Tnemec: Series 215 Surfacing Epoxy .
 - b. Base Coat: Polyamine epoxy with fiberglass mat reinforcing, applied at rate to achieve a total dry film thickness of not less than 25 mils.
 - 1) Tnemec: Series 273 Stranlok ML; 2 coats required.
 - a) Fiberglass mat reinforcing.
 - c. Topcoat: Low VOC gloss aliphatic urethane, applied at rate to achieve a total dry film thickness of not less than 2.5 mils.
 - 1) Tnemec: Series 297 Enviro-Glaze.

C. Gypsum Board Substrates:

1. HPC-3; Gloss, Modified Polyamine Epoxy Finish
 - a. Primer: 100 percent solids epoxy filler, applied at rate to achieve a total dry film thickness of not less than 3 mils.
 - 1) Tnemec: Series 201 Epoxoprime; 2 coats required.
 - b. Topcoat: Gloss modified polyamine epoxy applied at rate recommended by manufacturer to achieve a total dry film thickness of not less than 6.0 mils per coat.
 - 1) Tnemec: Series 280 Tneme-Glaze ; 2 coats required.
 - c. Total dry film thickness (DFT): Not less than 18 mils.
2. HPC-4; Fiberglass mat reinforced polyamine epoxy wall coating system with gloss aliphatic urethane topcoat.
 - a. Primer: Waterborne acrylic primer applied at rate recommended by manufacturer to achieve a total dry film thickness of not less than 3.0 mils per coat.
 - 1) Tnemec: Series 201 Epoxoprime; 2 coats required
 - b. Base Coat: Polyamine epoxy with fiberglass mat reinforcing, applied at rate to achieve a total dry film thickness of not less than 25 mils.

- 1) Tnemec: Series 273 Stranlok ML; 2 coats required.
 - a) Fiberglass mat reinforcing.
- c. Topcoat: Low VOC gloss aliphatic urethane, applied at rate to achieve a total dry film thickness of not less than 2.5 mils.
 - 1) Tnemec: Series 297 Enviro-Glaze.

END OF SECTION



DIVISION 10

SPECIALTIES



SECTION 10 26 00

WALL AND DOOR PROTECTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Wall guards.
- B. Corner guards.
- C. End wall guards.
- D. Impact-resistant wall coverings.

1.3 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry for wall and corner guard anchors.
- B. Section 09 29 00 - Gypsum Board for placement of supports in stud wall construction.
- C. Section 09 22 16 - Non-Structural Metal Framing for placement of supports in stud wall construction.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design.
- C. Texas Accessibility Standards (TAS).
- D. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency.
- E. ANSI A208.1 - American National Standard for Particleboard.
- F. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- G. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
- H. ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents.
- I. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
- J. ASTM D1784 - Standard Specification for Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds.
- K. ASTM D6098 - Standard Classification System and Basis for Specification for Extruded and Compression Molded Shapes Made from Polycarbonate (PC).
- L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- M. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- N. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- O. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.5 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes for each impact-resistant wall protection unit.
- B. Shop Drawings: For each impact-resistant wall protection unit showing locations and extent. Include sections, details, and attachments to other work.
 - 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Samples for Verification: For each type of product indicated.
- D. Material Certificates: For each impact-resistant plastic material, from manufacturer.
- E. Warranty: Sample of special warranty.

- F. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer with a minimum of 5 years experience.
- B. Source Limitations: Obtain impact-resistant wall protection units from single source from single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated. Refer to Division 01 Section "Quality Requirements."
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- D. Surface-Burning Characteristics: Provide impact-resistant, plastic wall protection units with surface-burning characteristics as determined by testing identical products per ASTM E84, NFPA 255, or UL 723 by UL or another qualified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store impact-resistant wall protection units 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 sheet material out of direct sunlight.
 - 3. Store plastic wall 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.
 - b. Store wall-guard bed-locator handrail covers in a horizontal position.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install impact-resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F (21 deg C) for not less than 72 hours before beginning installation and for the remainder of the construction period.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall 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.
 - b. Deterioration of plastic and other materials beyond normal use.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide handrails capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
 - 2. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - 3. Uniform and concentrated loads need not be assumed to act concurrently.

2.2 MATERIALS

- A. PVC Plastic: ASTM D1784, Class 1, textured, chemical- and stain-resistant, high-impact-resistant PVC or acrylic-modified vinyl plastic with integral color throughout; extruded and sheet material, thickness as indicated.
 - 1. Impact Resistance: Minimum 25.4 ft-lbf/in. (1356 J/m) of notch when tested according to ASTM D256, Test Method A.

2. Chemical and Stain Resistance: Tested according to ASTM D543.
 3. Self-extinguishing when tested according to ASTM D635.
 4. Flame-Spread Index: 25 or less.
 5. Smoke-Developed Index: 450 or less.
- B. Polycarbonate Plastic Sheet: ASTM D6098, S-PC01, Class 1 or 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft-lbf/in. (800 J/m) of notch when tested according to ASTM D256, Test Method A.
- C. Stainless-Steel Sheet: ASTM A240/A240M.
- D. Aluminum Extrusions: Alloy and temper recommended by manufacturer for type of use and finish indicated, but with not less than strength and durability properties specified in ASTM B221 for Alloy 6063-T5.
- E. Solid Wood: Clear hardwood lumber of species indicated, free of appearance defects, and selected for compatible grain and color.
- F. Particleboard: ANSI A208.1, Grade M-2; made with binder containing no urea formaldehyde.
- G. Fasteners: Aluminum, nonmagnetic stainless-steel, or other non-corrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- H. Adhesive: As recommended by impact-resistant plastic wall protection manufacturer and with a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 WALL GUARDS

- A. Bumper Rail: Extended mounted crash rail with PBT free cover, aluminum retainer, and continuous resilient bumper cushion and mounting brackets with color coordinated end caps and returns..
1. Basis of Design Manufacturer:
 - a. Construction Specialties, Inc.
 2. Alternate Manufacturers:
 - a. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 3. Vinyl Thickness; 0.110 inches minimum.
 4. Height: Refer to Drawings.
 5. Provide UL classified materials tested in accordance with UL 723 achieving Class 1 flame and smoke rating.
 6. Color: Refer to Drawings.
 7. Accessories: Concealed splices and mounting hardware.
 8. Mounting: Extended mounting on injection-molded plastic mounting brackets.
- B. Rubber Bumper Rail: Extruded rubber, continuous wall-mounted bumper with retainer mounting bar and color-matched plugs (Animal Holding Spaces).
1. Acceptable Manufacturers:
 - a. American Floor Products Company, Maya Wall Guard WG-2176.
 - b. Pro Tek Systems Inc., EB-4 Extruded Bumper.
 2. Size: 1-1/2 inches by 4 inches.
 3. Accessories: Prefabricated matching end caps and exterior corners.
 4. Color: Black.

2.4 CORNER GUARDS

- A. Surface-Mounted, Resilient, Plastic Corner Guards: Assembly consisting of snap-on plastic cover installed over continuous retainer; including mounting hardware; fabricated with 90 or 135 degree turn to match wall condition.
1. Basis of Design Manufacturer:
 - a. Construction Specialties, Inc.
 2. Alternate Manufacturers:
 - a. Arden Architectural Specialties, Inc.
 - b. Balco, Inc.
 - c. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - d. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - e. Pawling Corporation.
 3. Cover: Extruded rigid plastic, minimum 0.100-inch (2.5-mm) wall thickness; as follows:
 - a. Profile: Nominal 2-inch- (50-mm-) long leg and 1/4-inch (6-mm) corner radius.

- b. Height: refer to interior finish legend.
 - 1) Corner guard to begin 1/2 to 1 inch above the top of the base and extend up to 6 feet above finish floor minimum.
 - c. Color and Texture: As indicated by manufacturer's designations.
 - 4. Retainer: Minimum 0.060-inch- (1.5-mm-) thick, one-piece, extruded aluminum.
 - 5. Retainer Clips: Manufacturer's standard impact-absorbing clips.
 - 6. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
- B. Flush-Mounted, Resilient, Plastic Corner Guards: Assembly consisting of snap-on plastic cover that is flush with adjacent wall surface, installed over continuous retainer; including mounting hardware; fabricated with 90 or 135 degree turn to match wall condition; full wall height.
 - 1. Basis of Design Manufacturer:
 - a. Construction Specialties, Inc.
 - 2. Alternate Manufacturers:
 - a. Arden Architectural Specialties, Inc.
 - b. Balco, Inc.
 - c. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - d. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - e. Pawling Corporation.
 - 3. Cover: Extruded rigid plastic, minimum 0.100-inch (2.5-mm) wall thickness; as follows:
 - a. Profile: Nominal 2-inch- (50-mm-) long leg and 1/4-inch (6-mm) corner radius.
 - b. Height: refer to interior finish legend
 - 1) Corner guard to begin 1/2 to 1 inch above the top of the base and extend up to 6 feet above finish floor minimum.
 - c. Color and Texture: As indicated by manufacturer's designations.
 - 4. Retainer: Minimum 0.060-inch- (1.5-mm-) thick, one-piece, extruded aluminum.
 - 5. Retainer Clips: Manufacturer's standard impact-absorbing clips.
- C. Surface-Mounted, Metal Corner Guards: Fabricated from one-piece, formed or extruded metal with formed edges; with 90 or 135 degree turn to match wall condition.
 - 1. Basis of Design Manufacturer:
 - a. Construction Specialties, Inc.
 - 2. Alternate Manufacturers:
 - a. Arden Architectural Specialties, Inc.
 - b. Balco, Inc.
 - c. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - d. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - e. Pawling Corporation.
 - 3. Material: Stainless steel, Type 304 .
 - a. Thickness: Minimum 0.0500 inch (1.3 mm).
 - b. Finish: Directional satin, No. 4.
 - 4. Wing Size: Nominal 1-1/2 by 1-1/2 inches (38 by 38 mm).
 - 5. Height: 6 feet (1.8 m).
 - a. Corner guard to be installed at floor level, extending 6 feet above finish floor minimum.
 - 6. Corner Radius: 1/8 inch (3 mm).
 - 7. Mounting: Countersunk screws through factory-drilled mounting holes.

2.5 END-WALL GUARDS

- A. Surface-Mounted, Resilient, Plastic End-Wall Guard: Assembly consisting of snap-on plastic cover installed over continuous retainer; including mounting hardware.
 - 1. Basis of Design Manufacturer:
 - a. Construction Specialties, Inc.
 - 2. Alternate Manufacturers:
 - a. Arden Architectural Specialties, Inc.
 - b. Balco, Inc.
 - c. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - d. Korogard Wall Protection Systems; a division of RJF International Corporation.

- e. Pawling Corporation.
- 3. Cover: Extruded rigid plastic, minimum 0.078-inch (2.0-mm) wall thickness; as follows:
 - a. Profile: Nominal 2-inch- (50-mm-) long leg and 1/4-inch (6-mm) corner radius.
 - b. Height: 4 feet (1.2 m).
 - c. Color and Texture: As indicated by manufacturer's designations.
- 4. Retainer: Minimum 0.060-inch- (1.5-mm-) thick, one-piece, extruded aluminum.
- 5. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
- B. Flush-Mounted, Resilient, Plastic End-Wall Guard: Assembly consisting of snap-on plastic cover that is flush with adjacent wall surface and that covers entire end of wall, installed over continuous retainer; including mounting hardware.
 - 1. Basis of Design Manufacturer:
 - a. Construction Specialties, Inc.
 - 2. Alternate Manufacturers:
 - a. Arden Architectural Specialties, Inc.
 - b. Balco, Inc.
 - c. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - d. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - e. Pawling Corporation.
 - 3. Cover: Extruded rigid plastic, minimum 0.078-inch (2.0-mm) wall thickness; as follows:
 - a. Profile: Nominal 2-inch- (50-mm-) long leg and 1/4-inch (6-mm) corner radius.
 - b. Height: 4 feet (1.2 m).
 - c. Color and Texture: As indicated by manufacturer's designations.
 - 4. Retainer: Minimum 0.060-inch- (1.5-mm-) thick, one-piece, extruded aluminum.

2.6 IMPACT-RESISTANT WALL COVERINGS

- A. Impact-Resistant Sheet Wall Covering: Fabricated from plastic sheet wall-covering material.
 - 1. Basis of Design Manufacturer:
 - a. Construction Specialties, Inc.
 - 2. Alternate Manufacturers:
 - a. Arden Architectural Specialties, Inc.
 - b. Balco, Inc.
 - c. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - d. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - e. Pawling Corporation.
 - 3. Size: 48 by 96 inches (1219 by 2438 mm) for sheet.
 - 4. Sheet Thickness: 0.022 inch (0.56 mm).
 - 5. Color and Texture: As indicated by manufacturer's designations.
 - 6. Height: Full wall.
 - 7. Trim and Joint Moldings: Extruded rigid plastic that matches sheet wall covering color.
 - 8. Mounting: Adhesive.

2.7 FABRICATION

- A. Fabricate impact-resistant wall protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.
- B. Preform curved semirigid, impact-resistant sheet wall covering in factory for radius and sheet thickness as follows:
 - 1. Sheet Thickness of 0.040 Inch (1.0 mm): 24-inch (610-mm) radius.
- C. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- D. Fabricate components with tight seams and joints 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.
- E. Miter corners and ends of wood handrails for returns.

2.8 METAL FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Remove tool and die marks and stretch lines, or blend into finish.
 - 2. Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 3. Run grain of directional finishes with long dimension of each piece.
 - 4. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- B. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Examine walls to which impact-resistant wall 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 impact-resistant wall protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. General: Install impact-resistant wall protection units 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.
 - 1. Install impact-resistant wall protection units in locations and at mounting heights indicated on Drawings.
 - 2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
 - a. Provide anchoring devices to withstand imposed loads.
 - b. Where splices occur in horizontal runs of more than 20 feet (6.1 m), splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches (305 mm).
 - c. Adjust end and top caps as required to ensure tight seams.
- B. Impact-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.

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 10 26 00

SECTION 10 28 00

TOILET AND BATH ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Public-use washroom accessories.
- B. Public-use shower accessories.
- C. Private use bathroom accessories.
- D. Under lavatory guards.
- E. Custodial accessories.
- F. Baby changing stations.
- G. Healthcare accessories.

1.3 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry for in-wall blocking for wall mounted equipment and accessories.
- B. Section 07 92 00 - Joint Sealants for requirements for joint sealants in sanitary or wet areas.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design.
- C. TAS - Texas Accessibility Standards.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- F. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
- H. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
- I. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror.
- J. ASTM F446 - Standard Consumer Safety Specification for Grab Bars and Accessories Installed in the Bathing Area.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
 - 5. Manufacturer's warranty.
- B. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.
- C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify products using designations indicated.

3. Identify mounting height as dimension above finish floor.
- 1.6 QUALITY ASSURANCE
- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.
- 1.7 COORDINATION
- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
 - B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.
- 1.8 WARRANTY
- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Sealants: Coordinate joint sealant requirements with Section 07 92 00 - Joint Sealants.
- B. Stainless Steel: ASTM A666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
- C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 (Z180) hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C1053, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Manufacturers:
 1. American Specialties, Inc.
 2. Bobrick Washroom Equipment, Inc.
 3. Bradley Corporation.
 4. Cintas Corporation.
 5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
 6. Georgia-Pacific.
 7. Koala Kare Products.
 8. Kimberly-Clark Corporation.
 9. Purell (Gojo Industries, Inc.).
 10. Safe-Strap Company, Inc.
 11. Tork.
- B. Toilet Tissue (Roll) Dispenser:
 1. Basis-of-Design Product: Tork 56TR, Twin Jumbo Dispenser.
 2. Description: Double-roll dispenser.
 3. Mounting: Surface mounted.
 4. Operation: Non-control delivery with standard spindles.
 5. Capacity: Designed for 9-inch diameter tissue rolls.
 6. Material and Finish: Plastic, Color: Smoke.
- C. Automatic Paper Towel (Roll) Dispenser (Surface Mounted) - 7:
 1. Basis-of-Design Product: Scott Pro Electronic Hard Roll Towel Dispenser, No. 34348.
 2. Description: Automatic controlled delivery of paper rolls in preset lengths.
 - a. Modes: Hidden and Hanging.

- b. Sensor Sensitivity: 2 settings.
- c. Battery powered.
- d. Paper: Blue arm with blue plug paper, 25702.
- 3. Mounting: Surface Mounted
- 4. Minimum Capacity: 7.5-inch wide towel, 8-inch diameter roll.
- 5. Material and Finish: Plastic, Colors: Black and grey.
- 6. Lockset: Key-activated spring lock or push-button.
- D. Liquid-Soap Dispenser – 9V:
 - 1. Basis-of-Design Product: Purell ES8, Touch-free soap.
 - 2. Description: Designed for dispensing soap in liquid or lotion form automatically with coin cell battery power.
 - 3. Mounting: Surface mounted.
 - 4. Capacity: 1,200 ml.
 - 5. Materials and Finish: Plastic in graphite color.
 - 6. Lockset: Manufacturer's standard.

2.3 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and re-supplying. Provide minimum of six keys to Owner's representative.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars:
 - 1. Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F446.
 - 2. For hospital and clinical areas, seal fastener holes at showers with sanitary silicone sealant prior to mounting accessories and grab bars.
 - 3. Set entire plate and perimeter trim in sealant to ensure watertight installation at penetrations.
 - 4. Gypsum Board Partitions: Extend grab bars through wall surface. Anchor to concealed 16 ga. steel anchor plates secured to steel studs supporting partitions.
 - 5. CMU partitions: Fasten with expansion anchors to grouted CMU cells.
 - 6. Lead Shielded Areas: Install accessories to ensure continuous X-ray shielding. Refer to Section 13 49 00 - Radiation Protection.
 - 7. Install to support minimum 500 pound hanging load placed at any point along bar length.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10 28 00

SECTION 10 43 00
EMERGENCY AID SPECIALTIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Automated external defibrillators (AED).
- B. Bleeding control kits.

1.3 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. UL 60601-1 - UL Standard for Safety Medical Electrical Equipment, Part 1: General Requirements for Safety.

1.4 SUBMITTALS

- A. Product Data: Including all pertinent performance characteristics and criteria.
- B. Shop Drawings: Indicate materials, construction, sizes, quantities, finishes, and installation details.
- C. Manufacturer's Instructions: For installation, maintenance, and repair.
- D. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with Section 01 60 00 "Product Requirements".

1.6 WARRANTY

- A. Provide warranties in accordance with Section 01 60 00 "Product Requirements".

PART 2 PRODUCTS

2.1 AED

- A. Manufacturer:
 - 1. Zoll Medical Corporation.
- B. Product: Zoll Medical Corporation, AED Plus.
- C. Configuration:
 - 1. Size: 5.25 inches height by 9.5 inches wide by 11.50 inches deep.
 - 2. Weight: 6.7pounds (3.1 kg).
 - 3. Power: User-Replaceable Batteries. 10 Type 123A Photo Flash lithium manganese dioxide batteries.
 - 4. Device Classification: Class II and internally powered per EN60601-1.
 - 5. Design Standards: Meets applicable requirements of UL 2601, AAMI DF-39, IEC 601-2-4, EN60601-1, IEC 60601-1-2
- D. Zoll Semi-Recessed Wall Cabinet – Meets American with Disability Act (ADA) of not protruding into more than 4 inches into corridor.
 - 1. Part #8000-0814.
 - 2. Size: 17.5 x 17.5 x 2.5 inches (44.45 x 44.45 x 6.38 centimeters)
- E. Zoll Fully Recessed Wall Cabinet
 - 1. Part #8000-0811
 - 2. Size: 17.5 x 17.5 x 1 inches (44.45 x 44.45 x 2.54 centimeters)
- F. CPR D Padz:
 - 1. Shelf Life: 5 years.
 - 2. Conductive Gel: Polymer Hydrogel.
 - 3. Conductive Element: Tin.

2.2 BLEEDING CONTROL KITS

- A. Manufacturer:
 - 1. American College of Surgeons - Stop the Bleed Kit.
 - 2. North American Rescue - Public Access Bleeding Control.
- B. Small Kit: Premium Personal Bleeding Control Part Number Kit-02.
 - 1. Kit includes:
 - a. Instructional booklet on bleeding control.
 - b. C-A-T tourniquet.
 - c. QuikClot Bleeding Control Dressing.
 - d. Mini Sharpie marker.
 - e. 1 pair of protective gloves.
 - f. Compression bandage.
- C. Large Kit - Wall-Mounted Bleeding Control Part number Kit 04:
 - 1. Kit Size:
 - a. Stop the Bleed: 14 1/2 inches length by 10 inches height by 5 inches depth.
 - b. Public Access Bleeding Control Stations (8 pack): 15 1/2 inches length by 18 inches height by 10 inches depth.
 - 2. Kit includes:
 - a. Instructional booklet on bleeding control.
 - b. C-A-T tourniquet.
 - c. QuikClot Bleeding Control Dressing.
 - d. Mini Sharpie Marker.
 - e. 1 pair of protective gloves.
 - f. Compression bandage.
- D. Cabinet Required for Each Large Kit
 - 1. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance and UL rating of walls where being installed.
 - 2. Cabinet Type: Suitable for Large Bleeding Control Kits.
 - 3. Manufacturers:
 - a. Activar Construction Products Group - JL Industries.
 - b. Kidde, a unit of United Technologies Corp.
 - c. Larsen's Manufacturing Company.
 - d. Nystrom, Inc.
 - e. Potter-Roemer.
 - 4. Cabinet Construction:
 - a. Fire-Rated Cabinets: 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. Provide factory-drilled mounting holes.
 - b. Non-Fire Rated Cabinets: Steel sheet. Provide factory-drilled mounting holes.
 - 5. Cabinet Material: Steel sheet.
 - 6. Cabinet Type:
 - a. Recessed Cabinet:
 - 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).
 - b. Semi-recessed Cabinet:
 - 1) Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
 - 2) Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semi-recessed cabinet installation.
 - 3) Rolled-Edge Trim: 2-1/2-inch backbend depth.
 - 7. Cabinet Trim Material: Steel sheet.
 - 8. Door Material: Steel sheet.
 - 9. Door Style: Full panel glass.

10. Door Glazing: Clear float glass.
11. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - a. Provide projecting door pull and friction latch.
 - b. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
12. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
 - a. Identification is necessary on all flush mount bleeding control stations.
 - b. Identify cabinet with the words "Bleeding Control."
 - 1) Location: Applied to cabinet door.
 - 2) Application Process: Silk-screened.
 - 3) Lettering Color: Black or as indicated by AHJ.
13. Finishes:
 - a. Manufacturer's standard baked-enamel paint for the following:
 - 1) Exterior of cabinet, door, and trim except for those surfaces indicated to receive another finish.
 - 2) Interior of cabinet and door.
 - b. Aluminum: Clear anodic.
 - c. Stainless Steel: Polished standard finish.

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. Location: Place as indicated on the drawings.
- B. 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 10 43 00

SECTION 10 44 13

FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Fire extinguisher cabinets.

1.3 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry for wood blocking products and execution requirements.
- B. Section 10 44 16 - Fire Extinguishers for requirements portable fire extinguishers.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, strip, Plate, and Flat Bar.
- C. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with improved Formability, Solution Hardened, and Bake Hardenable.
- D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- E. ASTM C1036 - Standard Specification for Flat Glass.
- F. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.
- G. NFPA 70 - National Electrical Code; current edition adopted by Authority Having Jurisdiction.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
 - 1. Fire Protection Cabinets: 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.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Size: 6 by 6 inches square.

1.6 QUALITY ASSURANCE

- A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.
- B. 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.

1.7 COORDINATION

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate size of fire protection cabinets to ensure that type and capacity of fire hoses, hose valves, and hose racks indicated are accommodated.
- C. Coordinate sizes and locations of fire protection cabinets with wall depths.
- D. Where cabinets are flush mounted, conspicuous notification of the fire extinguisher shall be provided.

- E. Coordinate with Architect the signage for the fire extinguisher and Stop the Bleed Kit (SBK) where necessary.

1.8 SEQUENCING

- A. Apply vinyl lettering on field-painted, fire protection cabinets after painting is complete.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
- B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
 - 1. Sheet: ASTM B209.
- C. Stainless-Steel Sheet: ASTM A666, Type 304.
- D. Clear Float Glass: ASTM C1036, Type I, Class 1, Quality q3, 3 mm thick.

2.2 FIRE PROTECTION CABINET

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance and UL rating of walls where being installed.
- B. Cabinet Type: Suitable for fire extinguisher.
- C. Manufacturers:
 - 1. Activar Construction Products Group - JL Industries.
 - 2. Kidde, a unit of United Technologies Corp.
 - 3. Larsen's Manufacturing Company.
 - 4. Nystrom, Inc.
 - 5. Potter-Roemer.
- D. Cabinet Construction:
 - 1. Fire-Rated Cabinets: 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. Provide factory-drilled mounting holes.
 - 2. Non-Fire Rated Cabinets: 304 stainless steel with 1/2 inch thick door. Provide factory-drilled mounting holes.
- E. Cabinet Material: Stainless steel
 - 1. Shelf: Same metal and finish as cabinet.
- F. Recessed Cabinet:
 - 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).
- G. Semi-recessed Cabinet:
 - 1. Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
 - 2. Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semi-recessed cabinet installation.
 - 3. Rolled-Edge Trim: 2-1/2-inch backbend depth.
- H. Cabinet Trim Material: Steel sheet.
- I. Door Material: Steel sheet.
- J. Door Style: Vertical duo panel with frame.
- K. Door Glazing: Clear float glass.
- L. 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.
- M. 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.

- N. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
 - 1. Identification is necessary on all flush mount fire extinguisher boxes
 - 2. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
 - a. Location: Applied to cabinet door.
 - b. Application Process: Silk-screened.
 - c. Lettering Color: Black.
 - d. Orientation: Vertical.
- O. Finishes:
 - 1. Manufacturer's standard baked-enamel paint for the following:
 - a. Exterior of cabinet, door, and trim except for those surfaces indicated to receive another finish.
 - b. Interior of cabinet and door.
 - 2. Aluminum: Clear anodic.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.
- C. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets will be installed.

3.2 PREPARATION

- A. Prepare recesses for recessed and semi recessed 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.
 - 1. Shelf of Fire Protection Cabinets: Between 30 - 36 inches from finish flooring.
- B. Install in accordance with manufacturer's instructions.
- C. Install cabinets plumb and level in wall openings, while maintaining NFPA requirements.
 - 1. NFPA 6.1.3.8.1 - Fire extinguishers having a gross weight not exceeding 40 pounds (18.14 kg) shall be installed so that the top of the fire extinguisher is not more than 5 feet (1.53 m) above the finished floor.
 - 2. NFPA 6.1.3.8.2 - Fire extinguishers having a gross weight exceeding 40 pounds (18.14 kg) (except wheeled types) shall be installed so that the top of the fire extinguisher is not more than 3-1/2 feet (1.07 m) above the finished floor.

END OF SECTION 10 44 13

SECTION 10 44 16
FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Portable, hand-carried fire extinguishers, and mounting brackets for fire extinguishers.

1.3 RELATED REQUIREMENTS

- A. Section 10 44 13 - Fire Extinguisher Cabinets for fire extinguisher cabinets.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NFPA 10 - Standard for Portable Fire Extinguishers.
- C. UL (DIR) - Online Certifications Directory; current edition.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Warranty: Sample of special warranty.
- C. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.
- D. Product Location: The location of the fire extinguishers shall be in compliance with NFPA 10: Installation of Portable Fire Extinguishers for the hazard that they are intended to protect. This information will be provided by the architect; reflected on the architectural or life safety plans.
- E. Contractor shall maintain a valid State of Texas Extinguisher Certificate of Registration (ECR). Installing employees must maintain a valid Type B portable License.

1.6 QUALITY ASSURANCE

- 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 UL.

1.7 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.8 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 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
- B. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.

- C. Fire Extinguishers: Type, size, and capacity for each mounting bracket indicated.
 - 1. There shall be no plastic hardware on fire extinguishers.
 - 2. All extinguishers, regardless of size, shall have gauges.
 - 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.
- D. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A: 60-B:C, 10-lb nominal capacity, with mono ammonium phosphate-based dry chemical in enameled-steel container.
- E. Purple-K Dry-Chemical Type in Aluminum Container (Areas where cooking producing grease laden vapors): UL-rated 10-B:C, 2.5-lb nominal capacity, with potassium bicarbonate-based dry chemical in enameled-aluminum container.
- F. Carbon Dioxide Type (at OR's, Cath Labs, EP, and Interventional Radiology, Mechanical Rooms): UL-rated 10-B:C, 10-lb nominal capacity, with carbon dioxide in manufacturer's standard enameled-metal container. Extinguishers located in MRI areas must be constructed completely of nonferrous metal and have an "MRI SAFE" extinguisher logo.
- G. Water Extinguisher – UL rated 2- A: 2.5 gallon pressurized steel water based extinguisher.
- H. Combustible Metal Extinguisher (storage locations or laboratories using combustible metals) – UL rated, sodium chloride based dry powder extinguishing agent.

2.2 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. Mounting brackets shall be installed in accordance with NFPA 10 as related to the proper height of fire extinguishers.
- B. Identification: Lettering complying with UTSW Fire Safety 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.

2.3 FIRE EXTINGUISHER CABINETS

- A. In accordance with UTSW Master Specification requirements, Section 10 44 13 "Fire Extinguisher Cabinets"
 - 1. Cabinets shall be sized appropriately to hold the type and size of extinguisher(s) proposed.
 - 2. Fire extinguisher signs shall be mounted above all semi-recessed fire extinguisher boxes. Height to be verified on architectural drawings.
 - 3. Signage for the fire extinguisher shall be coordinated with the Architect. Signage shall detail a Stop the Bleed (STB) kit and fire extinguisher, where necessary.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
- B. Remove and replace damaged, defective, or undercharged fire extinguishers.
- C. 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 UTSW Fire Safety.
- B. Mounting Brackets:
 - 1. As required by NFPA 10.
 - 2. Fasten mounting brackets to surfaces, square and plumb per manufacturers instructions, at locations indicated.

END OF SECTION 10 44 16



DIVISION 11

EQUIPMENT



SECTION 11 53 13

LABORATORY FUME HOODS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Bench-top laboratory fume hoods.
- B. Floor-mounted laboratory fume hoods.
- C. Fume hood base cabinets.
- D. Fume hood base stands.
- E. Work tops within fume hoods.
- F. Laboratory sinks and cup sinks in fume hoods.
- G. Water, laboratory gas, and electrical service fittings in fume hoods.
- H. Piping and wiring within fume hoods for service fittings, light fixtures, fan switches, and other electrical devices included with fume hoods.

1.3 RELATED REQUIREMENTS

- A. Division 22 Plumbing Sections.
- B. Division 23 Sections.
- C. Division 26 Electrical Sections.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ASHRAE Std 110 - Methods of Testing Performance of Laboratory Fume Hoods; 2016.
- C. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2018.
- F. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.
- G. ASTM C1186 - Standard Specification for Flat Fiber-Cement Sheets; 2016.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2019b.
- I. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- J. SEFA 1 - Laboratory Fume Hoods; 2010
- K. SEFA 2.3 - Installations; 2010
- L. SEFA 7 - Laboratory Fixtures; 2010
- M. SEFA 8M - Laboratory Grade Metal Casework; 2016
- N. NFPA 45 - Standard on Fire Protection for Laboratories Using Chemicals

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For laboratory fume hoods. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Indicate details for anchoring fume hoods to permanent building construction including locations of blocking and other supports. Include calculations demonstrating that anchorages comply with seismic performance requirements.

2. Indicate locations and types of service fittings together with associated service supply connection required.
 3. Indicate duct connections, electrical connections, and locations of access panels.
 4. Include roughing-in information for mechanical, plumbing, and electrical connections.
 5. Show adjacent walls, doors, windows, other building components, laboratory casework, and other laboratory equipment. Indicate clearances from above items.
 6. Include layout of fume hoods in relation to lighting fixtures and air-conditioning registers and grilles.
 7. Include coordinated dimensions for laboratory equipment specified in other Sections.
- C. Samples: For fume hood exterior finishes, interior lighting, and work top material in manufacturer's standard sizes.
- D. Delegated-Design Submittal: For fume hoods indicated to comply with seismic performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer, licensed in the state in which the Project is located, responsible for their preparation.
- E. Product Test Reports: Showing compliance with specified performance requirements for as-manufactured containment and static pressure loss based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency.
- F. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.
- G. Maintenance Data: Identify system maintenance requirements, servicing cycles, lubrication types required and local spare part sources.
- H. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Source Limitations for Laboratory Fume Hoods: Obtain fume hoods from single manufacturer.
1. Obtain from same source from same manufacturer as laboratory casework specified in Division 12 Section "Laboratory Casework."
- B. Product Designations: Drawings indicate sizes, types, and configurations of fume hoods by referencing designated manufacturer's catalog numbers. Other manufacturers' hoods of similar sizes, types, and configurations, and complying with the Specifications, may be considered. See Division 01 Section "Product Requirements."
- C. Product Standards: Comply with SEFA 1, "Laboratory Fume Hoods - Recommended Practices." Provide fume hoods UL listed and labeled for compliance with UL 1805.
- D. Safety Glass: Products complying with testing requirements in 16 CFR 1201 for Category II materials.
1. Permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.
- E. 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.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install fume hoods until building is enclosed, wet work and utility roughing-in are complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.9 COORDINATION

- A. Coordinate layout and installation of framing and reinforcements for lateral support of fume hoods.
- B. Coordinate installation of fume hoods with laboratory casework, fume hood exhaust ducts, and plumbing and electrical work.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Containment: Provide fume hoods that comply with the following when tested according to ASHRAE 110 at a release rate of 4.0 L/min.:
1. Average Face Velocity: 100 fpm (0.51 m/s) plus or minus 10 percent with sashes fully open.

2. Face-Velocity Variation: Not more than 10 percent of average face velocity.
 3. Sash Position: Fully open.
 - a. Test hoods with horizontal sashes with maximum opening on one side, with maximum opening in the center, and with one opening at each side equal to half of maximum opening.
 - b. Test hoods with combination sashes fully raised, with maximum opening on one side, with maximum opening in the center, and with one opening at each side equal to half of maximum opening.
 4. As-Manufactured (AM) Rating: AM 0.05 (0.05 ppm)
 5. As-Installed (AI) Rating: AI 0.10 (0.10 ppm)
 6. Test Setup Modifications: Conduct tests with a minimum of three and a maximum of five people in the test room and with two 1-gal. (3.8-L) round paint cans, one 12-by-12-by-12-inch (300-by-300-by-300-mm) cardboard box, and three 6-by-6-by-12-inch (150-by-150-by-300-mm) cardboard boxes in the fume hood during the test. Position items from 6 to 10 inches (150 to 250 mm) behind the sash, randomly distributed, and supported off the work surface by 2-by-2-inch (50-by-50-mm) blocks.
 7. Walk-by Test: At the conclusion of containment test, execute three rapid walk-bys at 30-second intervals, 12 inches (300 mm) behind the mannequin. Test-gas concentration during each walk-by shall not exceed 0.1 ppm and shall return to specified containment value within 15 seconds.
- B. Static-Pressure Loss: Not more than 1/4 inch wg (62 Pa) at 100 fpm (0.51 m/s) face velocity when measured at four locations 90 degrees apart around the exhaust duct and at least three duct diameters downstream from duct collar.
 - C. Structural Performance: Provide fume hood components capable of withstanding the following loads without permanent deformation, excessive deflection, or binding of cabinet drawers and doors:
 1. Radioisotope Fume Hood Work Tops: 200 lb/ft. (297 kg/m).
 2. Base Cabinets of Radioisotope Fume Hoods: 75 lb/ft. within cabinets, 50-lb/ft. work top, 200 lb/ft. on work top, plus weight of hood.
 3. Fume Hood Base Stands for Radioisotope Hoods: 50-lb/ft. work top, 200 lb/ft. on work top, plus weight of hood.
 4. Fume Hood Base Stands for Fume Hoods other Than Radioisotope Hoods: 50-lb/ft. work top, 75 lb/ft. on work top, plus weight of hood.
 - D. Delegated Design: Design fume hoods, including comprehensive engineering analysis by a qualified professional engineer, using seismic performance requirements and design criteria indicated.
 - E. All fume hoods to be balanced and certified after installation
- 2.2 MANUFACTURERS
- A. AT Villa.
 - B. Kewaunee Scientific Corporation; Laboratory Products Group.
 - C. Labconco Corporation.
 - D. Mott Manufacturing.
- 2.3 MATERIALS
- A. Steel Sheet: Cold-rolled, commercial steel (CS) sheet, complying with ASTM A1008/A1008M; matte finish; suitable for exposed applications.
 - B. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
 - C. Glass-Fiber-Reinforced Polyester: Polyester laminate with a chemical-resistant gel coat on the exposed face, and having a flame-spread index of 25 or less per ASTM E84.
 - D. Epoxy: Factory molded, modified epoxy-resin formulation with smooth, non-specular finish.
 1. Manufacturers:
 - a. Kemresin.
 - b. American Epoxy Scientific.
 - c. Durcon Company (The).
 - d. Prime industries, Inc.
 2. Physical Properties:
 - a. Flexural Strength: Not less than 10,000 psi (70 MPa).
 - b. Modulus of Elasticity: Not less than 2,000,000 psi.
 - c. Hardness (Rockwell M): Not less than 100.

- d. Water Absorption (24 Hours): Not more than 0.02 percent.
 - e. Heat Distortion Point: Not less than 260 deg F.
 - f. Flame-Spread Index: 25 or less per ASTM E84.
3. Chemical Resistance: Epoxy-resin material has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:
 - a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), benzene, carbon tetrachloride, dimethyl formamide, ethyl acetate, ethyl alcohol, ethyl ether, methyl alcohol, nitric acid (70 percent), phenol, sulfuric acid (60 percent), and toluene.
 - b. Slight Effect: Chromic acid (60 percent) and sodium hydroxide (50 percent).
 4. Color: Black.
- E. Glass-Fiber Cement Board: ASTM C1186.
 - F. Glass: Clear, laminated tempered glass complying with ASTM C1172, Kind LT, Condition A, Type I, Class I, Quality-Q3; with two lites not less than 3.0 mm thick and with clear, polyvinyl butyral interlayer.
 - G. Fasteners: Provide stainless-steel fasteners where exposed to fumes.
- ## 2.4 FUME HOOD VENTILATION
- A. Constant-Volume Fume Hoods: Provide constant-volume fume hoods without bypass[where indicated].
 - B. Variable-Air-Volume Control: Where indicated, equip fume hoods with an electronic control unit with a sensing device that monitors face velocity, and a motorized damper on the exhaust connection that maintains a constant face velocity by controlling air volume in response to control unit. Equip units with manual override switch that opens motorized damper to provide maximum exhaust capacity regardless of sash position.
 1. Provide output transmitter on electronic control unit that produces 0- to 10-V dc signal proportional to fume hood exhaust volume for interface with building's HVAC control system.
 2. Provide electronic control unit that also monitors sash position and anticipates changes in face velocity caused by abrupt changes in sash position.
- ## 2.5 FABRICATION
- A. General: Assemble fume hoods in factory to greatest extent possible. Disassemble fume hoods only as necessary for shipping and handling limitations. Fume hoods shall be capable of being partly disassembled as necessary to permit movement through a 35-by-79-inch (889-by-2007-mm) door opening.
 - B. Steel Exterior: Fabricate from steel sheet, not less than 0.0478 inch thick, with component parts screwed together to allow removal of end panels, front fascia, and airfoil and to allow access to plumbing lines and service fittings. Apply chemical-resistant finish to interior and exterior surfaces of component parts before assembly.
 - C. Fiberglass Exterior: Fabricate from glass-fiber-reinforced polyester components not less than 1/4 inch (6.35 mm) thick, bonded together to maximum extent practical. Trim edges of panels with PVC extrusion. Limit removable parts to access panels, front fascia, and airfoil.
 - D. Product Option: Provide either steel or fiberglass exterior as specified above.
 - E. Ends: Fabricate with double-wall end panels without projecting corner posts or other obstructions to interfere with smooth, even airflow. Close area between double walls at front of fume hood and as needed to house sash counterbalance weights, utility lines, and remote-control valves.
 - F. Splay top and sides of face opening to provide an aerodynamic shape to ensure smooth, even flow of air into fume hood.
 1. Glass-fiber cement board, not less than 1/4 inch (6.35 mm) thick, with white acid-resistant finish.
 2. Glass-fiber-reinforced polyester, not less than 1/4 inch (6.35 mm) thick.
 - G. Molded Glass-Fiber-Reinforced Polyester Lining: Molded unit consisting of end panels, back panel, preset rear baffle, and top bonded together into a single piece; reinforced to form a rigid assembly to which exterior is attached.
 1. Punch fume hood lining side panels to receive service fittings and remote controls. Provide removable plug buttons for holes not used for indicated fittings.
 - H. Rear Baffle: Unless otherwise indicated, provide baffle, of same material as fume hood lining, at rear of hood with openings at top and bottom for airflow through hood. Secure baffle to cleats at rear of hood with stainless-steel screws. Fabricate baffle for easy removal for cleaning behind baffle.
 1. Provide preset baffles, unless otherwise indicated].

2. Provide adjustable baffles with control adjustment strips at top and bottom with plastic or stainless-steel knobs unless otherwise indicated.
 3. Provide adjustable baffles with remote-control adjustment from outside front of fume hood[where indicated].
 4. Provide epoxy-coated, stainless-steel screen at bottom baffle opening to prevent paper from being drawn into the exhaust plenum behind baffles.
- I. Exhaust Plenum: Full width of fume hood and with adequate volume to provide uniform airflow from hood, of same material as hood lining, and with duct stub for exhaust connection.
1. Duct-Stub Material: Epoxy-coated steel or glass-fiber-reinforce polyester .
- J. Bypass Grilles: Provide grilles at bypass openings of bypass and restricted bypass fume hoods.
- K. Sashes: Provide operable sashes of type indicated.
1. Fabricate from 0.050 inch (1.27 mm) nominal thickness stainless steel or PVC extrusions. Form into four-sided frame with bottom corners welded and finished smooth. Make top member removable for glazing replacement. Set glazing in chemical-resistant, U-shaped gaskets.
 2. Glaze with laminated safety glass.
 3. Counterbalance vertical-sliding sash with sash weight and stainless-steel cable system to hold sash in place regardless of position. Provide ball-bearing sheaves, plastic glides in stainless-steel guides, and stainless-steel lift handles. Provide rubber bumpers at top and bottom of each sash unit.
- L. Airfoil: Unless otherwise indicated, provide airfoil at bottom of fume hood face opening with 1-inch (25-mm) space between airfoil and work top. Sash closes on top of airfoil, leaving 1-inch (25-mm) opening for air intake. Airfoil directs airflow across work top to remove heavier-than-air gases and to prevent reverse airflow.
1. Fabricate airfoil from stainless steel coated with PTFE or PVDF.
- M. Light Fixtures: Provide vaporproof, two-tube, rapid-start, LED light fixtures, of longest practicable length; complete with tubes at each fume hood. Shield tubes from hood interior with 1/4-inch- (6.35-mm-) thick laminated glass or 3-mm-thick tempered glass, sealed into hood with chemical-resistant rubber gaskets. Provide units with fluorescent tubes easily replaceable from outside of fume hood.
- N. Base Cabinets: Comply with Division 12 Section "Laboratory Casework." Provide metal base cabinets in finish matching fume hood exterior finish.
- O. Fume Hood Base Stands: Fabricated from not less than 2-inch- (square, electrically welded steel tubing. Provide leg stretchers where necessary to comply with structural performance requirements. Weld leg stretchers, cross stretchers, and work top support rails to legs, and finish entire assembly with chemical-resistant finish. Provide leveling device at each corner of base stand at floor.
1. Provide clear floor space not less than 30 inches (760 mm) wide by 25 inches (635 mm) deep by 27 inches (685 mm) high within fume hood base stands, unless otherwise indicated.
- P. Work Top Troughs and Sinks
1. Work Tops, General: Provide units with smooth surfaces free of defects. Make exposed edges and corners straight and uniformly beveled. Where acid storage cabinets are indicated beneath fume hoods, provide holes in work tops as need to accommodate cabinet vents.
 2. Resin Work Tops: Provide front overhang of 1 inch, with continuous drip groove on underside 1/2 inch from edge.
 - a. Work Top Material: Solid epoxy composition or phenolic composite.
 - b. Work Top Configuration: Raised (marine) edge, 1 inch thick at raised edge, with beveled or rounded edge and corners.
 3. Sinks, General: Provide sizes indicated or laboratory casework manufacturer's closest standard size of equal or greater volume, as approved by Architect.
 - a. Outlets: Provide with strainers and tailpieces, NPS 1-1/2 (DN 40), unless otherwise indicated.
 - b. Overflows: For each sink except cup sinks, provide overflow of standard beehive or open-top design with separate strainer.
 - 1) Height: 2 inches less than sink depth.
 - 2) Provide in same material as strainer.
 4. Epoxy Sinks: Molded in one piece with smooth surfaces, coved corners, and bottom sloped to outlet; 1/2-inch (13-mm) minimum thickness.

- a. Provide with polypropylene strainers and tailpieces.
 - b. Provide sinks for drop-in installation with 1/4-inch thick lip around perimeter of sink.
 - c. Provide integral sinks in epoxy work tops, bonded to tops with invisible joint line.
 - Q. Work Surface of Floor-Mounted Fume Hoods: Provide integral floor as follows:
 - 1. Solid epoxy floor 1 inch (25 mm) thick with 1/2-inch-(13-mm-) high, raised (marine) edge.
 - R. Filler Strips: Provide as needed to close spaces between fume hoods or fume hood base cabinets and adjacent building construction. Fabricate from same material and with same finish as fume hoods or fume hood base cabinets, as applicable.
 - S. Ceiling Extensions: Provide filler panels matching fume hood exterior to enclose space above fume hoods at front and sides of fume hoods and extending from tops of fume hoods to ceiling.
 - T. Finished Back Panels: Where rear surfaces of fume hoods are exposed to view, provide finished back panels matching rest of fume hood enclosure.
 - U. Comply with requirements in Divisions 23 and 26 Sections for installing water and laboratory gas service fittings, piping, electrical devices, and wiring. Install according to Shop Drawings. Securely anchor fittings, piping, and conduit to fume hoods unless otherwise indicated.
- 2.6 CHEMICAL-RESISTANT FINISH
- A. General: Prepare, treat, and finish welded assemblies after welding. Prepare, treat, and finish components that are to be assembled with mechanical fasteners before assembling. Prepare, treat, and finish concealed surfaces same as exposed surfaces.
 - B. Preparation: Clean steel surfaces, other than stainless steel, of mill scale, rust, oil, and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
 - C. Chemical-Resistant Finish: Immediately after cleaning and pretreating, apply fume hood manufacturer's standard two-coat, chemical-resistant, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).
 - 1. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8. Acceptance level for chemical spot test shall be no more than four Level 3 conditions.
 - 2. Colors for Fume Hood Finish: As indicated by manufacturer's designations
- 2.7 ACCESSORIES
- A. Service Fittings: Comply with requirements in Division 12 Section "Laboratory Casework." and Division 11 Section "Laboratory Service Fittings".
 - 1. Provide service fittings with exposed surfaces, including fittings, escutcheons, and trim, finished with acid- and solvent-resistant powder coating complying with requirements in SEFA 7 for corrosion-resistant finishes or made from PVD.
 - 2. Provide service fittings with exposed surfaces in laboratory casework manufacturer's standard metallic brown, aluminum, white, or other color as approved by Architect.
 - B. Airflow Indicator: Provide each fume hood with airflow indicator of[one of] the following type(s):
 - 1. Indicator Type: Direct-reading aneroid (Magnehelic-type) gage that measures fume hood exhaust duct static pressure as an indication of airflow.
 - 2. Indicator Type: Thermal anemometer that measures fume hood face velocity and indicates whether it is below normal, normal, or above normal.
 - 3. Indicator Type: Thermal anemometer that measures fume hood face velocity and displays data as digital readout.
 - C. Airflow Alarm: Provide fume hoods with audible and visual alarm that activates when airflow sensor reading is outside of preset range.
 - 1. Provide with thermal-anemometer or aneroid (Magnehelic-type) gage airflow sensor.
 - 2. Provide with reset and test switches.
 - 3. Provide with switch that silences audible alarm and automatically resets when airflow returns to within preset range.
 - D. Sash Alarm: Provide fume hoods with audible and visual alarm that activates when sash is opened beyond preset position.
 - 1. Provide with silence and test switches.

- E. Sash Stops: Provide fume hoods with sash stops to limit hood opening to 50 percent of sash height. Sash stops can be manually released to open sash fully for cleaning fume hood and for placing large apparatus within fume hood.
- F. Bypass Grille Blank-off Panel: Provide fume hoods with blank-off panel on bypass grille designed for use with sash stops to reduce exhaust air volume and provide design face velocity with sash at 50 percent open position.

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 fume hoods.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:
 - 1. Install fume hoods according to Shop Drawings and manufacturer's written instructions.
 - 2. Install level, plumb, and true; shim as required, using concealed shims, and securely anchor to building and adjacent laboratory casework.
 - 3. Securely attach access panels, but provide for easy removal and secure reattachment.
 - 4. Where fume hoods abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- B. Comply with requirements in Division 12 Section "Laboratory Casework" for installing fume hood base cabinets, work tops, and sinks.
- C. Comply with requirements in Divisions 22 and 26 Sections for installing water and laboratory gas service fittings and electrical devices.
 - 1. Install fittings according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions. Set bases and flanges of sink and work top-mounted fittings in sealant recommended by manufacturer of sink or work top material. Securely anchor fittings to fume hoods unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

- A. Field test installed fume hoods according to "Flow Visualization and Velocity Procedure" requirements in ASHRAE 110.
 - 1. Test one installed fume hood, selected by Architect, for each type of hood installed, according to ASHRAE 110.
 - 2. If tested hood fails to meet performance requirements, field test additional hoods as directed by Architect.
- B. Field test installed fume hoods according to ASHRAE 110 to verify compliance with performance requirements.
 - 1. Adjust fume hoods, hood exhaust fans, and building's HVAC system, or replace hoods and make other corrections until tested hoods perform as specified.
 - 2. After making corrections, retest fume hoods that failed to perform as specified.

3.4 ADJUSTING AND CLEANING

- A. Adjust moving parts for smooth, near silent, accurate sash operation with one hand. Adjust sashes for uniform contact of rubber bumpers. Verify that counterbalances operate without interference.
- B. Clean finished surfaces, including both sides of glass; touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

3.5 FUME HOOD SCHEDULE

- A. Bench Top Fume Hood Type:
 - 1. Ventilation Type: Constant volume Constant volume, with variable-air-volume control .
 - 2. ASHRAE 110 As-Manufactured (AM) Rating: AM 0.05 (0.05 ppm).
 - 3. ASHRAE 110 As-Installed (AI) Rating: AI 0.10 (0.10 ppm).
 - 4. Sash Configuration:
 - a. Operation: Vertical-sliding, single-hung sash.

- b. Operation: Combination sash consisting of two horizontal-sliding, bypassing sashes retained in a vertical-sliding, single-hung frame.
 - c. Opening Height: 27 to 30 inches (685 to 762 mm).
 - 5. Work Top: Epoxy Phenolic composite Epoxy or phenolic composite.
 - 6. Service Fittings:
 - a. Water: One remote-control, rigid, gooseneck, single-service faucet(s) with vacuum breaker and removable serrated outlet.
 - b. Laboratory Gas for Air and Gas (Fuel Gas): One flange-type fitting(s) with straight outlet and remote-control ground -key cock.
 - c. Electrical: One duplex receptacle at one end(s) of hood, mounted on exterior front face of end pilaster.
 - 1) Provide GFCI receptacles.
- B. Floor-Mounted Fume Hood Type:
 - 1. Ventilation Type: Constant volume Constant volume, with variable-air-volume control.
 - 2. ASHRAE 110 As-Manufactured (AM) Rating: AM 0.05 (o.05 ppm).
 - 3. ASHRAE 110 As-Installed (AI) Rating: AI 0.10 (0.10 ppm).
 - 4. Sash Configuration:
 - a. Operation: Vertical-sliding, independently operable, double-hung sashes.
 - b. Opening Height: 58 inches (1473 mm).
 - 5. Floor: Epoxy Epoxy or phenolic composite.
 - 6. Service Fittings:
 - a. Water: One remote-control, rigid, gooseneck, single-service faucet(s) with vacuum breaker and removable serrated outlet.
 - b. Laboratory Gas for Air and Gas (Fuel Gas): One flange-type fitting(s) with straight outlet and remote-control ground -key cock.
 - c. Electrical: One duplex receptacle at one end(s) of hood, mounted on exterior front face of end pilaster.
 - 1) Provide GFCI receptacles.

END OF SECTION 11 53 13

SECTION 11 53 19

LABORATORY SPECIALTY EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Requirements for Owner Furnished, Contractor Installed (OFCI) and Contractor Furnished, Contractor Installed (CFCI) specialty laboratory equipment
- B. Refer to Equipment List on Drawings for complete listing of CFCI/OFCI equipment whether included in this section or in other Sections of the Project Manual.

1.3 RELATED REQUIREMENTS

- A. Section 11 53 13 - Laboratory Fume Hoods
- B. Section 11 53 43 - Laboratory Service Fittings
- C. Section 11 53 53 - Biological Safety Cabinets
- D. Section 12 35 53 - Laboratory Casework

1.4 RELATED WORK (BY OTHER SECTIONS OF THE PROJECT)

- A. Provisions for related work by other sections of the specifications:
 - 1. Refer to Equipment List on Drawings.
 - 2. Installation an connection of drains, tail pieces, and other items furnished by Equipment Supplier.
 - 3. Furnishing, installing, setting, and connecting special electrical and plumbing fixtures and piping to meet local codes, even though not specifically called for in Specifications and shown on Drawings.
 - 4. Providing hoist or elevator with operator to enable Equipment Supplier to locate equipment in proper areas.

1.5 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.6 SYSTEM DESCRIPTION

- A. Drawings and Specifications outline the design intent and the general requirements of laboratory equipment. Construction details and component specifications for each product may not be complete. Equipment furnished shall be complete for the intended function and operation.
- B. The equipment described and included in this Section will be selected during the bidding process in a competitive manner. Several manufacturers may be shown for each category of equipment. Each of these different models may have slightly different utility connections, flow rates, pressure requirements and pipe sizes, number of connections, physical configurations (including pits) and clearance requirements. It shall be the responsibility of the Contractor to coordinate the actual final equipment selected by the Owner, then furnished and installed with the supporting utility and systems connections, and final hook up and equipment start up and testing to ensure that all equipment is fully functional and operating properly.

1.7 SUBMITTALS

- A. Product Data. Submit manufacturer's specifications and installation instructions for each item of laboratory equipment furnished. Indicate on product data which optional devices and operations are proposed for inclusion with equipment.
- B. Shop Drawings:
 - 1. Shop Drawing are to be reviewed and approved by UTSW Project Manager and Lab Representative.
 - 2. For equipment listed include plans, elevations, sections, details, and attachments to other Work.
 - a. Indicate details for anchoring to permanent building construction including locations of blocking and other supports.

- b. Indicate locations and types of service fittings together with associated service supply connection required.
 - c. Indicate duct connections, electrical connections, and locations of access panels.
 - d. Include roughing-in information for mechanical, plumbing, and electrical connections.
 - e. Show adjacent walls, doors, windows, other building components, laboratory casework, and other laboratory equipment. Indicate clearances from above items.
 - f. Include coordinated dimensions for laboratory equipment specified in other Sections.
 - g. Where substitutions for specified items of laboratory equipment are proposed, submit data substantiating the proposed equipment is equal to that specified. Manufacturer's specifications shall contain a full, detailed explanation of variations in operating and/or performance requirements.
- C. Provide Operations and Maintenance Manuals per Section 01 77 00 - Closeout Procedures and Submittals for each equipment type/model that describe operating procedures, maintenance (including teardown), replacement schedules, components parts list, and nearest local factory representative (include phone number) for components and emergency repairs. Provide a digital version of each manual and one complete set of each, bound and indexed.
 - D. Delegated Design Submittals: Provide design calculations by a qualified engineer showing conformance with specified pressure loading or structural requirements as required, or provide certified test reports from an accredited independent testing laboratory.
 - E. Product Test Reports: For Pass-thru Box showing compliance with specified performance requirements as-manufactured for containment. Tests performed by Commissioning Agent.
 - F. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.8 QUALITY ASSURANCE

- A. Requirements may differ from manufacturer's standard product.
 - 1. Make modifications necessary to comply with specified requirements.
 - 2. Each piece of equipment listed includes the manufacturer's name and catalog number, establishing levels of quality, specific construction features, operating conditions and desired features and accessories.
 - 3. Indicating other manufacturer's names does not relieve perspective bidders of their obligation to prove that their submissions are equal to specified equipment in size, construction, performance, basic features, options and accessories prior to award.
- B. Manufacturer Qualifications:
 - 1. Manufacturer shall be a firm having an established organization and factory, with production facilities specializing in the type of equipment specified, having an experienced engineering department and an established history of similar installations of equal scope and complexity.
 - 2. Manufacturer shall have the demonstrated ability to produce the specified equipment of the required quality and a proven capacity to complete an installation of this size and type within the required time limits.
 - 3. Service response time to a telephone inquiry shall be same day (or within 4 hours, whichever is less) followed up by a factory trained technician at the site within 24 hours of the telephone inquiry; serviceable components warehoused or readily available to service personnel; and fast access to shop drawings of equipment in field.
- C. Installer Qualifications: Manufacturer or personnel approved in writing by manufacturer.
 - 1. For fabrication and installation of Work, use personnel who are trained and experienced with the specified equipment.

1.9 PROJECT CONDITIONS

- A. Review surfaces and conditions under which equipment is to be installed. Verify measurement of space for equipment and means of access for installation. Verify that service rough-ins and backing plates are in place. Report to Owner in writing, items that may be detrimental to equipment or equipment operation.
- B. Drawings show arrangement and location of items of equipment. If it is necessary to vary from arrangement shown, because of structural, mechanical, electrical or other considerations, make such variations only after approval of Architect and at no additional cost to the Owner.

- C. Verify dimensions at building. Confirm that equipment will be able to be moved through the building in order to reach its designated location. Measure recesses and openings at building and provide trim pieces, fillers and closures in sizes required.

1.10 WARRANTY

- A. Except where more stringent warranty requirements are noted in the individual equipment descriptions, equipment furnished under this section to be guaranteed for a minimum of one (1) year, parts and labor, from date of Substantial Completion against defective materials, design and workmanship. Defects shall be promptly rectified at vendor's expense after notification by Architect.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Provide equipment complete with necessary supports, anchorage, stands, gages, valves, parts, and accessories required for a complete operating installation.
- B. Provide each item of equipment with internal electrical services necessary for proper operation including wiring, conduit, boxes, raceways, fittings, lamps, switches, device plates, etc., sized for single point connection to building services, complying with requirements of NEC and bearing UL labeling as required.
- C. Provide each item of equipment with mechanical and plumbing services necessary for proper operation including piping, fittings, ductwork, troughs, accessories, and materials, installed for easy access and connection to respective building service.
- D. Provide each item of equipment fully finished by manufacturer with no additional finish or painting required after installation.

2.2 MANUFACTURERS

- A. Provide products indicated or comparable products approved by Owner.
- B. Accepted Substitutions in accordance with Section 01 25 00 - Substitution Procedures.

2.3 PRODUCTS

- A. Sterilizers: Typically Owner furnished.
- B. Glass Washers: Typically Owner furnished.
- C. Dryers: Typically Owner furnished
- D. Flammable storage cabinets: Typically Owner furnished.
- E. Tank restraints:
 - 1. Pre-manufactured Wall Mount Gas Cylinder Brackets:
 - a. Basis of Design: USA Safety
 - 1) Steel foundation with steel reinforced vinyl edge guard and polypropylene straps with steel cinch buckles: 2 units installed at 3'-0" AFF and 1'-0" AFF.
 - 2) Capacity: 1 cylinder, 2 cylinders, 3 cylinders, 4 cylinders.
 - 3) Cylinder Dimension: 4-12".
 - 2. Custom Unistrut Gas Cylinder Restraints:
 - a. Unistrut vertical and horizontal members with removable 3/8-inch stainless steel rods.
 - 1) Capacity: 1 cylinder, 2 cylinders, 3 cylinders, 4 cylinders.
 - 2) Cylinder Dimension: 4-12".
- F. DI water Units: Typically Owner furnished.
- G. Water Purifiers: Typically Owner furnished.
- H. Auto-Water, Environmental Monitoring, Lighting, Room Access Controls:
 - 1. Basis of Design Manufacturer: Avidity Science (formerly Edstrom):
 - 2. System shall consist of five key components:
 - a. Data Management – WatchDog System:
 - 1) Server
 - 2) Panels and network sensors
 - 3) Local processors
 - 4) Light relays
 - b. Reverse Osmosis Auto Water:
 - 1) Indigo System or RO100 contingent on the needed size/use.
 - c. Stainless Steel (SS) Room Distribution System:

- 1) SS welded tubing, coupling, elbows, and tee fittings.
- 2) Interconnect stations.
- 3) Detachable kynar recoil hose.
- 4) Solenoid flush valves.
- 5) Rack flush.
- 6) Header piping.
- d. Pressure Reducing Stations:
 - 1) SS enclosure cabinet.
 - 2) Piping, fittings, valves, etc.
 - 3) Water filter.
 - 4) Pressure regulator.
 - 5) Pressure transducer.
 - 6) Flow switch.
 - 7) Solenoid valves.
- e. Pin Code Room Access:
 - 1) Electric Strike Lock Mechanism:
 - (a) Controlled at Local Processor.
 - (b) Powered by local power supply.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Prior to start of Work examine surfaces and areas to receive equipment to ensure that rough-ins and substrates are correct, that equipment will fit as indicated on Drawings, that surfaces are clean, dry and that preparatory Work is complete.
- B. Proceed with Work when conditions will permit installation in accordance with the original design, accepted submittals, and the manufacturer's printed instruction and defects or oversights are corrected.

3.2 PREPARATION

- A. Check for shipping damage. Reject units with scratches, dents or other defects that cannot be readily corrected.
- B. Confirm access to proper utilities and clearances before beginning installation.

3.3 INSTALLATION

- A. Deliver equipment to the job site freight paid.
- B. Uncrate equipment and place in locations shown on Drawings. Remove crating materials and packing debris.
- C. Install items in accordance with Manufacturer's standards. Provide accessories necessary for a complete installation.
- D. Coordinate connections with Work of Divisions 23 and 26.

3.4 ADJUST AND CLEAN

- A. Check operation and installation of equipment. Make adjustments as necessary to meet equipment manufacturer's specifications and the requirements of this Section.
- B. Installer shall replace items, which do not operate properly, have defacing marks or damage, which cannot be satisfactorily repaired as determined by the Owner's Representative. Replace parts at no cost to Owner or Architect.
- C. Clean and polish equipment in accordance with Manufacturer's recommendations before and after demonstration for Owner. Leave ready for use with copy of instruction manual attached to equipment in a manner to be specified by Owner's Representative.

3.5 PROTECTION

- A. Units shall be protected after installation during remainder of construction.

END OF SECTION 11 53 19

SECTION 11 53 43

LABORATORY SERVICE FITTINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Laboratory water, gas service, and electrical fittings, valves, and related components.
- B. Laboratory fixtures.
- C. Ceiling service panels.

1.3 RELATED REQUIREMENTS

- A. Section 11 53 13 - Laboratory Fume Hoods
- B. Section 11 53 19 - Laboratory Specialty Equipment
- C. Section 11 53 53 - Biological Safety Cabinets
- D. Section 12 35 53 - Laboratory Casework

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements
- B. SEFA 7 - Laboratory Fixtures.

1.5 DESCRIPTION

- A. Work includes but not necessarily limited to furnishing to the project site for installation in accordance with applicable provisions of Division 23, all laboratory fixtures, fittings, and emergency plumbing fixtures described herein and shown on the Drawings.
- B. Work in this Section requires close coordination with Work in electrical and mechanical Sections. Coordinate all Work to ensure an orderly progress in the Project, without removal of previously installed Work, and so as to prevent damage to finishes and products

1.6 SUBMITTALS

- A. Product Data: Submit complete materials list, including catalogue data, of all materials, equipment and products for Work in this Section.
- B. Shop Drawings: Submit complete shop fabrication and installation drawings, including plans, elevations. Sections, details and schedules. Show relationship to adjoining materials and construction. Shop drawings shall be in the form of reproducible or photocopies, not to exceed 11"x17" in size. Blue line prints are not acceptable.
- C. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.
- D. Samples: Submit two (2) samples of each type of specified finish and color range available.
- E. Operation and Maintenance Manuals: Submit under provisions of Section 01 78 23 complete operation and maintenance manuals that describe proper operating procedures, maintenance and replacement schedules, components parts lists, and nearest local factory representative for components and repairs.

1.7 QUALITY ASSURANCE

- A. Installer shall have an established organization and production facility with five years documented experience specializing in the manufacture of the type of equipment specified, with an experienced Engineering Department. Each shall have demonstrate ability to produce the specified equipment of the required quality and quantity for complete installation in a project of this type an size within the required time limits.
- B. Source Limitations for Laboratory Service Fittings: Obtain lab service fittings from one source from a single manufacturer, with resources to provide products of consistent quality in appearance and physical properties for the entire Project.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all fittings and fixtures to job site in recommended packaging with each fitting individually packaged, marked, and scheduled for point use. Items shall be identified by same room number and assembly as indicated on Drawings.
- B. Inventory fittings, at job site, verify that type and quantity are correct, and re-package until time of installation.
- C. Store in a clean, dry location.
- D. Replacements: In the event of damage, immediately make all repairs and replacement necessary for the approval of the Architect and at no additional cost to the Owner.

PART 2 PRODUCTS

2.1 GENERAL

- A. Service fittings and emergency plumbing fixtures shall be specifically designed for laboratory use.
- B. Service fittings be furnished and delivered to point of use for installation as specified in other sections of the Specifications.
- C. All service fittings shall be factory pre-assembled including the assembly of valves to turrets, mounting shanks to turrets, etc., and individually factory used.
- D. All laboratory service fittings shall be the product of one service-fitting manufacturer to assure ease of replacement and maintenance.
- E. All service valves, fittings, and accessories shall be of cast brass with a minimum copper content of 85%, except for items which are to be brass forging or bar stock.
- F. Provide fittings as shown in schedule for all laboratory equipment and casework indicated on Drawings. Refer to Laboratory Fixture Outlet Schedule on Drawings.
- G. Assembly components and operating parts such as valve stems, renewable units, pacing nuts, outlet nozzles and straight serrated hose ends shall be made from solid brass stock.
- H. Replaceable seats, needle cones, valve disc screws and other accessories shall be monel or stainless steel alloys especially selected for use intended.
- I. Fittings shall be factory tested and shall be supplied with nipples, lock nuts, shanks, etc.
- J. Serrated tip fittings shall have 3/8-inch IPS thread with the hose end being tapered. Diameter of orifice in serrated tip shall be 1/8 inch, except where otherwise specified.
- K. Turrets shall be brass drip forging of design indicated in details shown elsewhere in the Section and shall be one or two-way, as required, with 3/8 inch IPS female inlet thread for connections. Units shall be furnished with brass shanks, brass locknuts, and washers.
- L. Fittings located on the same plane shall have their handles project the same distance from the plane of reference to present a uniform related appearance, regardless of valve type construction.
- M. Flanges shall be brass forging of approved design with 3/8 inch IPS female inlet and outlet.
- N. All goosenecks shall provide full thread for attachment of anti-splash outlet fittings, serrated tips, and filter pumps.
- O. Hot water/cold water gooseneck mixers and wall-mounted cold-water goosenecks shall swivel. Swivel point shall be at turret or at valve packings; "O" rings will not be permitted. Provide cold-water fittings including hand held drench hoses and water fittings at fume hoods.

2.2 WATER AND GAS SERVICE FITTINGS

- A. Manufacturers:
 - 1. Water Saver Faucet Co.
 - 2. Chicago Faucet Company.
 - 3. Substitutions: Under provisions of Section 01 25 00.
- B. Pattern: All service fittings shall have tapered body profiles.
- C. Handles:
 - 1. ADA faucets shall be fitted with "wrist-blade" handles.
 - 2. Laboratory gas, air and vacuum valves at ADA accessible workstations shall be ball valves fitted with lever-type handles.
 - 3. Other fittings shall be fitted with four arm handles.
- D. Water Valves:

1. Water valves shall include a renewable unit containing all the working parts which are subject to wear, including stainless steel or monel screw and heavy duty seat disk and Teflon packing, and an integral or external adjustable volume control.
 2. Unit shall be capable of being readily converted from compression to self-closing, and vice versa, without disturbing faucet body proper and shall also be capable of being readily converted from water construction to needle valve or steam valve construction having outside packing gland without disturbing faucet body.
 3. Unit shall be sealed in valve body with special composition gasket. Metal-to-metal or ground joint type of sealing is not acceptable.
 4. Water fixtures shall be fully assembled and factory tested at 80 psi water pressure.
- E. Needle Valves: All needle valve assemblies shall be fully assembled and factory tested at 150 psi air pressure. Gas, air, vacuum and steam needle valve fittings shall have stainless steel replaceable floating cone that is precision ground and self-centering which shall seat against a stainless steel or monel renewable valve seat. Action of valve shall be slow compression for fine control under pressure up to 125 psi and shall have subject-to-wear parts easily replaceable.
- F. Laboratory Ball Valves: All ball valves shall be suitable for laboratory gas, air, and vacuum and be supplied fully assembled and factory tested at 125 psi air pressure. Ball valves shall be of quarter-turn (closed to fully open) design, be fitted with lever handle requiring less than 5lbs pressure to operate, and shall have subject-to-wear parts easily replaceable. Ball valves shall be AGA/CGA certified for gas service.
- G. High Purity Water Valves: High purity water valves shall be chromium plated cast brass with polypropylene liner. Valve stem and bonnet shall be brass. See fitting schedule on Drawings.
- H. Service Fitting Color Index:

Service Name	Disc Color	Letters	Letter Color
Lab Air	Orange	AIR	Black
GAS	Dark Blue	GAS	White
Vacuum	Yellow	VAC	Black
Cold Water	Dark Green	CW	White
Hot Water	Red	HW	White
High Purity	White	DI	Black
Nitrogen	Brown	N2	Black
Carbon Dioxide	Pink	CO2	Black
Special Gas	Light Blue	Chemical Symbol	Black

2.3 ELECTRICAL SERVICE FITTINGS

- A. Service Fittings, General: Provide units complete with metal housings, receptacles, switches, pilot lights, cover plates, accessories, and gaskets required for mounting on laboratory casework
- B. Electrical Wiring Devices: Comply with requirements in Section 26 27 26 "Wiring Devices" for receptacles, switches, pilot lights, cover plates, and accessories.
- C. Receptacles:
1. Duplex Convenience Receptacles: 125 V, 20 A; NEMA WD 6, Configuration 5-20R
 - a. Standards: Comply with NEMA WD 1, UL 498, and FS W-C-596
 2. Hospital-Grade, Duplex Convenience Receptacles: 125 V, 20 A; NEMA WD 6, Configuration 5-20R
 - a. Standards: Comply with NEMA WD 1, UL 498 Supplement sd, and FS W-C-596
 3. Isolated-Ground, Duplex Convenience Receptacles: 125 V, 20 A; NEMA WD 6, Configuration 5-20R.
 - a. Standards: Comply with NEMA WD 1, UL 498, and FS W-C-596.
 4. Tamper-Resistant, USB Charger Receptacles: 12 V dc, 2.0 A, USB Type A.
 - a. Standards: Comply with NEMA WD 1, UL 498, UL 1310, and FS W-C-596.
 5. Hospital-Grade, USB Charger Receptacles: 12 V dc, 2.0 A, USB Type A.
 - a. Standards: Comply with NEMA WD 1, UL 498 Supplement sd, UL 1310, and FS W-C-596
 - b. Marking: Labeled and complying with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.
 6. Duplex GFCI Convenience Receptacles: 125 V, 20 A; NEMA WD 6, Configuration 5-20R; feed-through type with integral LED indicator light.
 - a. Standards: Comply with NEMA WD 1, UL 498, UL 943 Class A, and FS W-C-596

7. Hospital-Grade, Duplex GFCI Convenience Receptacles: 125 V, 20 A; NEMA WD 6, Configuration 5-20R; feed-through type with integral LED indicator light.
 - a. Standards: Comply with NEMA WD 1, UL 498 Supplement sd, UL 943 Class A, and FS W-C-596.
 8. Duplex SPD Convenience Receptacles: 125 V, 20 A; NEMA WD 6, Configuration 5-20R; with LED indicator light and integral SPD in line to ground, line to neutral, and neutral to ground
 - a. Standards: Comply with NEMA WD 1, UL 498, UL 1449, and FS W-C-596.
 9. Isolated-Ground, Duplex SPD Convenience Receptacles: 125 V, 20 A; NEMA WD 6, Configuration 5-20R; with LED indicator light and integral SPD in line to ground, line to neutral, and neutral to ground.
 - a. Standards: Comply with NEMA WD 1, UL 498, UL 1449, and FS W-C-596.
 10. Hospital-Grade, Duplex SPD Convenience Receptacles: 125 V, 20 A; NEMA WD 6, Configuration 5-20R; with integral SPD in line to ground, line to neutral, and neutral to ground.
 - a. Standards: Comply with NEMA WD 1, UL 498 Supplement sd, UL 1449, and FS W-C-596.
 11. Isolated-Ground, Hospital-Grade, Duplex SPD Convenience Receptacles: 125 V, 20 A; NEMA WD 6, Configuration 5-20R; with integral SPD in line to ground, line to neutral, and neutral to ground.
 - a. Standards: Comply with NEMA WD 1, UL 498 Supplement sd, UL 1449, and FS W-C-596.
 12. Color of Receptacles: Brown unless otherwise indicated or required by NFPA 70.
- D. Switches:
1. Single-Pole Switches: 120/277 V, 20 A.
 - a. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.
 2. Two-Pole Switches: 120/277 V, 20 A.
 - a. Comply with NEMA WD 1, UL 20, and FS W-S-896.
 3. Pilot-Light Switches, Single Pole: 120/277 V, 20 A, with LED-lighted handle, illuminated when switch is off.
 - a. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.
 4. Key-Operated Switches: 120/277 V, 20 A; single pole, with factory-supplied key in lieu of switch handle.
 - a. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.
 5. Color of Switches: Brown unless otherwise indicated or required by NFPA 70..
- E. Data Communication Outlets: Two RJ-45 jacks for terminating 100-ohm, balanced, four-pair twisted-pair cabling complying with TIA-568-C.1; complying with Category 6. Comply with UL 1863.
- F. Cover Plates: Provide satin-finish, Type 304, stainless steel cover plates with formed, beveled edges.
- G. Cover-Plate Identification: Use 1/4-inch- (6-mm-) high letters unless otherwise indicated. For stainless steel or chrome-plated metal, stamp or etch plate and fill in letters with black enamel.
1. Provide at the following locations:
 - a. Receptacles other than standard 125-V duplex, grounding type.
 - b. Switches and thermal-overload switches.
 - c. Pilot lights when located remotely from associated equipment or switch, where function is not obvious.
 - d. Receptacles, switches, and other locations indicated.
 2. Provide the following information:
 - a. Voltage and phase for receptacles other than standard 125-V duplex, grounding type.
 - b. Indicate equipment being controlled by switches and thermal-overload switches.
 - c. Indicate equipment being controlled for pilot lights when located remotely from associated equipment or switch, where function is not obvious.
 - d. Number of the breaker in panelboard that controls device.
- H. Pedestal-Type Fittings: Cast-aluminum housings with sloped single face or two faces, as indicated, with neoprene gasket under base and with concealed mounting holes in base for attaching to laboratory casework. Provide holes tapped for conduits.
- I. Line-Type Fittings: Provide with cast-metal boxes with threaded holes for mounting on rigid steel conduit. Provide cover plates same size as boxes.
- J. Recessed-Type Fittings: Provide with galvanized-steel boxes.

- K. Finishes for Service-Fitting Components: Provide housings or boxes for pedestal- and line-type fittings with manufacturer's standard baked-on, chemical-resistant enamel in color as selected by Architect from manufacturer's full range.

2.4 FINISHES

- A. All laboratory service fittings (except fittings inside fume hoods) and emergency plumbing fixtures shall be finished as follows:
 - 1. White epoxy, with clear, acid-resistant coating.
 - 2. Epoxy Finish: Coating material shall be free-flowing epoxy powder with particle size of 35-7 microns. Surfaces to be coated shall be polished or sandblasted to produce a uniform fine-grained surface and immersed in a phosphoric acid cleaning solution to remove thoroughly all oil grease and other foreign substances. Following cleaning, coating material shall be electrostatic ally applied to all exposed surfaces. After applications, coating shall be fully baked to permit curing. Surfaces shall have a minimum coating thickness of 2 mils.
- B. Fume hood service fittings shall be finished as follows:
 - 1. Colored epoxy, with clear, acid-resistant coating.
 - 2. Epoxy Finish: Coating material shall be free-flowing epoxy powder with particle size of 35-7 microns. Surfaces to be coated shall be polished or sandblasted to produce a uniform fine-grained surface and immersed in a phosphoric acid cleaning solution to remove thoroughly all oil grease and other foreign substances. Following cleaning, coating material shall be electrostatic ally applied to all exposed surfaces. After applications, coating shall be fully baked to permit curing. Surfaces shall have a minimum coating thickness of 2 mils.
 - 3. Color: Fittings inside fume hoods shall have a colored finish color-coded to match the fitting service index color.
- C. Performance Requirements for Coated Finishes:
 - 1. Chemical Resistance:
 - a. Fume Test: Suspend coated samples in a container at least 6 cu. Ft. capacity, approximately 12 inches above open breakers, each containing 100 cc of 70% nitric acid, 94% sulfuric acid and 35% hydrochloric acid, respectively.
 - b. After exposure to these fumes for 150 hours, the finish on the samples shall show no discoloration, disintegration or other effects.
 - 2. Mar and Abrasion Resistance:
 - a. Coating material shall have a pencil hardness of 2H-4H with adhesion substantial enough to withstand both direct and reverse impacts of 160 inch pounds.
 - b. Coating shall have excellent mar resistance and be capable of withstanding scuffing, marring and other ordinary wear.
 - 3. Reparability: Scratches and other localized surfaced damage shall be field-repairable.

2.5 LABORATORY FIXTURES

- A. Cup Sink: Provide cup sinks for fume hoods as specified in Section 11 53 13.
- B. Provide strainer, outlet and tailpiece for all cup sinks.
- C. Epoxy Resin Laboratory Sinks: Refer to Section 12 35 53 for additional requirements.
 - 1. Epoxy, for ender-mount installation in epoxy bench tops, color-matched,
 - 2. Acceptable Manufacturers: Laboratory Tops, Inc., Prime Industries, Epoxyn, Durcon or acceptable substitution.
 - 3. Provide epoxy resin sink outlet with strainer, stopper and one end overflow, and install in sink with silicone bead.
 - 4. All exposed edges shall be radiused not less than 1/4-inch.
 - 5. At main edge in top: sink shall be set at or up to 1/8-inch below the lowest level.
- D. Provide all necessary mounting hardware required for wall-mounted sinks.
- E. Provide Stainless steel strainer, outlet, standpipe overflow and stopper for all sinks unless otherwise specified. Provide tailpieces compatible with waste piping system. See Division 23 for piping requirements.

2.6 CEILING SERVICE PANELS

- A. Ceiling utility panel shall integrate with most standard-duty T-grid acoustical suspended ceiling systems.

- B. Utility panel shall provide a means to mount and connect electrical outlets, and quick connect service fixtures.
- C. Utility panels shall be shipped with junction boxes factory attached. Electrical outlets, data outlets, and cover plates shall be provided by electrical contractor.
- D. Utility panels shall be a minimum of 0.067-inch cold rolled steel with a urethane powder coat finish.
 - 1. Color: As selected by Architect from manufacturer's standard range of colors.
- E. Size: 1 foot by 2 foot.
- F. Layout: As indicated on Drawings.

2.7 SERVICE FIXTURES SCHEDULE

- A. HCW1: Bench-mounted hot and cold water faucet.
 - 1. Base Product: Water Saver LA412-855.
 - 2. Four-arm handles .
 - 3. Renewable water valves and deck-mounted valve body.
 - 4. Swing gooseneck with 200mm 8 inches spread.
 - 5. Removable aerator.
 - 6. Aerator should terminate approximately 76mm 3 inches above deck.
 - 7. Threaded mounting with locknut, washer, and coupling nuts.
 - 8. Adjustable volume control.
- B. CW-5: Cold Water Faucet, Panel Mounted at Fume Hood CS-3.
 - 1. Feature: Remote control cold water faucet, 6 inch rigid/swing gooseneck, removable serrated hose end and in-line vacuum breaker.
 - 2. Model: WaterSaver L740W-L074-WSA.
 - 3. Fume hood fitting finish to be powder coated finish color-coded per service index color. Handle to be 4-arm style handle, clear epoxy over satin chrome finish.
- C. EW1: Barrier-free eye/face wash, wall mounted with stainless steel skirt.
 - 1. Basis for design: Water Saver Model No. FEBF721.
 - 2. Exposed piping shall be chrome-plated brass.
 - 3. Flag/paddle shall be epoxy-coated cast aluminum or stainless steel.
 - 4. Eyewash heads shall be ABS plastic with float-off dust covers.
 - 5. Stay-open brass ball valve.
 - 6. Stainless steel skirt shall have No. 4 finish.
 - 7. Fixture shall be furnished with green plastic sign with graphic symbol for eyewash.
- D. PW1: Bench-mounted purified water fixture:
 - 1. Base Product: Water Saver L7833MSC.
 - 2. Forged brass valve body and 200mm 8 inches spread riser with polypropylene interior and lining.
 - 3. Self-closing lever that can also be turned to operate in a stay-open mode.
 - 4. Polypropylene serrated hose end.
 - 5. Deck mounting flange.
 - 6. Mounting shank.
 - 7. End of serrated hose end shall be 200mm 7-7/8 inches, nominal, above bench top.
- E. B5: Wall/panel-mounted, single, laboratory ball valve fitting.
 - 1. Base Product: Water Saver L4200-158WSA.
 - 2. Lever handle with colored plastic index button.
 - 3. Provide mounting flange, all applications:
 - 4. At wall-mounted applications: Flange shall be threaded in a manner to be installed tight to wall surface and allow fitting to be installed plumb.
 - 5. Serrated hose end.
 - 6. Outlets shall be 125mm 4-7/8 inches, nominal, from wall.
 - 7. Mounting shank assembly for panel installations, only.
- F. B6: Bench-mounted, single, laboratory ball valve fitting.
 - 1. Base Product: Water Saver CT4200-331WSA.
 - 2. Lever handle with colored plastic index button.
 - 3. Turret base.
 - 4. Serrated hose end.
 - a. Outlets shall be 115mm 4-1/2 inches, nominal, from turret centerline.

- b. Centerline of serrated hose end shall be 52mm 2-1/16 inches, nominal, above bench top.
- 5. Mounting shank.
- 6. Fixture shall satisfy requirements for accessibility (ADA).
- G. NG6: Wall/panel-mounted, single, angle pattern laboratory push/turn gas valve fitting.
 - 1. Base Product: Water Saver CT5160IFT-325/225WSA-CV.
 - 2. Hooded, epoxy coated handle with pop up indicators and colored plastic index button.
 - 3. Provide mounting flange, all applications:
 - 4. At wall-mounted applications: Flange shall be threaded in a manner to be installed tight to wall surface and allow fitting to be installed plumb.
 - 5. Serrated hose end.
 - 6. End of serrated hose end shall be 133mm 5-1/4 inches, nominal, from end of turret to wall.
 - 7. Mounting shank for panel applications.
 - 8. Check valve to prevent back flow.
- H. PWV-2: Cold Water Ball Valve for OFOI Polishing Stations or other equipment. Wall Mounted.
 - 1. Features: Handle to be 4-arm style handle, removal serration hose end.
 - 2. Model: WaterSaver L4800F-225WSA
- I. RO: Bench-mounted purified water fixture:
 - 1. Base Product: Water Saver L7833MSC.
 - 2. Forged brass valve body and 200mm 8 inches spread riser with polypropylene interior and lining.
 - 3. Self-closing lever that can also be turned to operate in a stay-open mode.
 - 4. Polypropylene serrated hose end.
 - 5. Deck mounting flange.
 - 6. Mounting shank.
 - 7. End of serrated hose end shall be 200mm 7-7/8 inches, nominal, above bench top.
- J. FHG1: Fume hood-mounted, remote control, laboratory needle valve for gas service.
 - 1. Base Product: Water Saver L739xN-L022WSA or L740N-022WSA.
 - 2. Panel-mounted valve.
 - 3. Four-arm handle with colored plastic index button.
 - a. Handle shall be 70mm 2-3/4 inches long from panel to index button.
 - 4. Locking ring.
 - a. Valve body to be located behind panel at front of fume hood.
 - b. Panel-mounted, color epoxy coated brass flange with angled serrated hose end.
 - c. Outlet shall be 85mm 3-3/8 inches, nominal, from panel.
 - d. Mounting shank for outlet.
- K. Quick Connect Fittings:
 - 1. General:
 - a. Provide plug and socket (2-piece) quick connect service fittings.
 - 2. WAGD1: Wall/panel-mounted, quick connect assembly.
 - a. Base Product: Water Saver Panel Mounted Quick Connect Assembly.
 - b. Panel-mounted Type 316 stainless steel keyed quick-connect body and plug.
 - 1) Body shall be flanged and mounted on mounting plate.
 - 2) Stainless steel shall be polished to a satin finish.
 - 3) All internal components shall be Type 316 stainless steel.
 - 4) Quick connects shall be CSA certified for natural gas service.
 - 5) All keys shall have a uniform diameter and a uniform look.
 - 6) Quick connects shall be 10mm 3/8 inches.
 - 7) Configuration: DESO, double-ended shut off stem.
 - 8) O-Ring: Buna N.
 - 9) Pressure rating, coupled, room temperature: 17.25 bar 250 psiG.
 - 10) Pressure rating, uncoupled, room temperature: 17.25 bar 250 psiG.
 - c. Mounting plate:
 - 1) 100mm x 100mm x 2.8mm 4 inches x 4 inches x 12 GA Type 304 stainless steel with No. 4 finish.
 - 2) Mounting plate shall be pre-drilled for two countersunk fasteners.
 - 3) Provide two fasteners appropriate for wall construction.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Review conditions of installations, procedures and coordination with related Work.
- B. Carefully inspect the installed Work of all other trades and verify that all such Work is complete and ready for the installation of this Work to properly commence.
- C. Verify that all Work may be installed in complete accordance with the original design, reviewed submittals and manufacturer's recommendations.

3.2 PREPARATION

- A. Prior to delivery of fittings, carefully inspect the installed Work of all other trades and verify that all such Work is complete to the point where this installation may properly commence.
- B. Verify that all Work has been installed in complete accordance with the original design, approved submittals, and the manufacturer's recommendations.
- C. Discrepancy: In the event of discrepancy, immediately notify the Architect. Do not proceed until unsatisfactory conditions have been corrected.

3.3 INSTALLATION OF SERVICE FITTINGS

- A. Comply with requirements in Divisions 23 and 26 Sections for installing water and laboratory gas service fittings, piping, electrical devices, and wiring.
- B. Install fittings according to Shop Drawings and manufacturer's written instructions. Set bases and flanges of sink- and countertop-mounted fittings in sealant recommended by manufacturer of sink or countertop material. Securely anchor fittings, piping, and conduit to laboratory casework, unless otherwise indicated.

3.4 CLEANING AND PROTECTING

- A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
- B. Protect countertop surfaces during construction with 6-mil plastic or other suitable water-resistant covering. Tape to underside of countertop at minimum of 48 inches o.c.

END OF SECTION 11 53 43

SECTION 11 53 53

BIOLOGICAL SAFETY CABINETS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Biological safety cabinets.

1.3 RELATED REQUIREMENTS

- A. Section 11 53 43 - Laboratory Service Fittings
- B. Section 12 35 53 - Laboratory Casework
- C. Division 23 HVAC Sections
- D. Division 26 Electrical Sections

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.
- C. ASHRAE Std 110 - Methods of Testing Performance of Laboratory Fume Hoods.
- D. ASTM A568/A568M - Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction.
- F. NSF 49 - Biosafety Cabinetry: Design, Construction, Performance, and Field Certification.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For laboratory fume hoods. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Indicate details for cabinet to permanent building construction including locations of blocking and other supports.
 - 2. Indicate locations and types of service fittings together with associated service supply connection required.
 - 3. Indicate duct connections, electrical connections, and locations of access panels.
 - 4. Include roughing-in information for mechanical, plumbing, and electrical connections.
 - 5. Show adjacent walls, doors, windows, other building components, laboratory casework, and other laboratory equipment. Indicate clearances from above items.
- C. Include layout of cabinet in relation to lighting fixtures and air-conditioning registers and grilles.
- D. Samples for Verification: For interior lining and countertop material, in manufacturer's standard sizes.
- E. Product Test Reports: Based on evaluation of tests performed by manufacturer and witnessed by a qualified independent Testing Agency, indicate compliance of fume hoods with requirements based on comprehensive testing of hoods.
- F. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.
- G. Operating/Maintenance Manuals: Describe proper operating procedures, maintenance replacement schedules, component parts list, and closest factory representative for components and service.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Approved or certified by cabinet manufacturer to install Work of this Section.
 - 1. Minimum five years documented experience with projects of this size or larger, and an established organization and production facilities including all tools, equipment and special machinery necessary for specializing in the fabrication and installation of the type of equipment specified, with factory trained installers and an experienced engineering department.

2. Demonstrated knowledge, ability and the proven capability to produce the specified equipment of the required quality and the proven capacity to complete an installation of this size and type within the required time limits.
 - B. Source Limitations: Obtain cabinets through one source from a single manufacturer.
 - C. Product Designations: Drawings indicate sizes, types, and configurations of fume hoods by referencing designated manufacturer's catalog numbers. Other manufacturers' hoods of similar sizes, types, and configurations, and complying with the Specifications may be considered.
 - D. Safety Glass: Products complying with testing requirements in 16 CFR 1201 for Category II materials.
 1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.
 - E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Quality Control."
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Coordinate delivery of fume hoods with delivery of other laboratory casework components.
 - B. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.
- 1.8 PROJECT CONDITIONS
- A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work and utility roughing-in are complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- 1.9 COORDINATION
- A. Coordinate installation of cabinets with laboratory casework, exhaust ducts, and plumbing and electrical work.
- 1.10 ATTIC STOCK
- A. Furnish complete touchup kit for each type and color of fume hood finish provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to fume hood finish which may become damaged after Substantial Completion.

PART 2 PRODUCTS

2.1 BIOLOGICAL SAFETY CABINETS

- A. Manufacturers:
 1. The Baker Company
 2. Forma Scientific
 3. Labconco.
 4. NuAire Laboratory Equipment
- B. Basis of Design: NSF/ANSI Standard 49, Class II, Type B3.
 1. Type, refer to equipment schedule provided by owner. Verify components and cabinet specifications with UTSW.
 2. Carbon Sheet Steel: ASTM A568/A568M.
 3. Stainless Steel:
 - a. UNS number S30200 or S30400.
 - b. Finish: Number 4
 4. Work Surface Material: Stainless steel.
 5. Cabinet Material: Carbon sheet steel with manufacturer's standard baked-on enamel finish or stainless steel.
 6. Design and Performance Characteristics:
 - a. Biologically Contaminated Ducts, Plenums, and Work Area Sidewalls:
 - 1) Maintain under negative pressure or enclosed in negative pressure zone.
 - 2) Fabricate of permanent metal construction.

- b. Design with zoned down-flow velocity profile to provide higher velocity air down-flow behind view screen, relative to down-flow over work surface in cabinet.
 - c. Provide equipment listed by UL or Edison Testing Laboratories for electrical safety and integrity.
 - d. Design internal fluorescent lighting to provide 100 footcandles of illumination on work surface.
 - e. Design unit to automatically handle 80 percent minimum increase in filter loading without decrease in total air delivery of more than 10 percent.
7. Legs: Stainless steel telescoping assembly.
 - a. Fabricate to be removable.
 - b. Allow for adjusting work surface height from 30 to 36 inches above floor surface.
 8. Fabricate Work Surface With Radius (Rounded) Corners.
 9. Fabricate cabinet side walls and rear wall of single sheet of sheet metal.
 10. Audio and Visual Alarm:
 - a. Activate when air delivery drops more than 10 percent.
 - b. Activate when slide view screen is in unsafe position.
 - c. Connect to low-flow sensing device.
 11. Provide with sliding view screen capable of moving to fully closed position during shut-down periods.
 12. Fabricate with interior work area having minimum height of 29 inches.
 13. Return Air Slots: Purpose: Prevent contaminated air from being drawn into work area along sidewalls and from escaping from cabinet.
 - a. High air velocity type.
 - b. Locate at each end of front access opening.
 14. Provide scavenging slots at sliding sash to prevent migration of contamination behind glass view screen.
 15. Filters: Front loaded mounting.
 - a. Zero-probed HEPA 99.99 percent efficient on particles 1/8 inch and larger.
 16. Provide stainless steel air diffuser and filter protector in work area.
 17. Suction Gage Indicator: Indicator dial to show air-flow volume being provided to work area.
 - a. When motor-blower is not providing sufficient air-flow volume, gage needle shall drop into "red" overlay zone on indicator dial.
 18. Provide lower front work area airfoil to improve access opening containment ability.
 19. Provide One Petcock For Each Of Following:
 - a. Natural gas.
 - b. Laboratory vacuum.
 20. Exhaust Thimble Connection: Baker SG-TEC series or equivalent.
 - a. Connect to building exhaust system.
 - b. Construct of 16 gage cold rolled steel.
 - c. Include one gasketed decontamination plate assembly and housing for air flow monitor per unit.
 21. Equip with voltage compensating motor speed controller that automatically compensates for voltage changes to maintain constant motor voltage.
 22. Low-Flow Sensing Device: Provide one per cabinet mounted in "thimble connection" to monitor total exhaust capacity.
 - a. Include one Safety Alert Module to include tri-color jumbo light emitting diode indicator lights:
 - 1) Green: Normal flow
 - 2) Yellow: Caution.
 - 3) Red (Flashing): Low flow.
 - 4) Provide toggle switch to silence audio-visual alarm along with its own red colored light emitting diode indicator.
 - b. Include One Transformer for Field Installation: 120 to 24 volts, alternating current; 20 volt-amperes.
 - c. Include one airflow sampling transverse probe.
 - d. Include One Airflow Transducer-Sensor: House in integral housing mounted on thimble and permits visual observation by cabinet operating personnel.
 - 1) Preset for range of zero to 2000 FPM duct velocity.

23. Include magnehelic pressure gage to monitor loading; size for measuring up to 3 inches water gage pressure.
24. Provide Work Area With Two Duplex 120 Volt Outlets: Mount in drip-proof covers.
 - a. Provide each outlet with dedicated circuit breaker.
25. Lighting: Fluorescent lamps for illumination.
 - a. Provide one germicidal ultraviolet lamp for disinfection.
26. Include two 0.1 amp form "C" dry contacts on blower switch to coordinate and interact with room's environmental control system.

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 fume hoods.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:
 1. Install cabinets according to Shop Drawings and manufacturer's written instructions.
 2. Install level, plumb, and true; shim as required, using concealed shims, and securely anchor to building and adjacent laboratory casework.
 3. Securely attach access panels, but provide for easy removal and secure reattachment.
 4. Where cabinets abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- B. Comply with requirements in Division 12 Section "Laboratory Casework" for installing fume hood base cabinets, countertops, and sinks.
- C. Comply with requirements in Divisions 23 and 26 Sections for connecting sources of water, laboratory gas, ductwork, and electrical power to fume hoods.

3.3 FIELD QUALITY CONTROL, GENERAL

- A. Field test installed cabinets according to ASHRAE 110 as modified in Part 1 "Performance Requirements" Article to verify compliance with performance requirements.
 1. Adjust fume hoods, hood exhaust fans, and building's HVAC system, or replace hoods and make other corrections until tested hoods perform as specified.
 2. After making corrections, retest fume hoods that failed to perform as specified.

3.4 ADJUSTING AND CLEANING

- A. Adjust moving parts for smooth, near silent, accurate sash operation with one hand. Adjust sashes for uniform contact of rubber bumpers. Verify that counterbalances operate without interference.
- B. Clean finished surfaces, including both sides of glass; touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

END OF SECTION 11 53 53



DIVISION 12

FURNISHINGS



SECTION 12 24 13
ROLLER WINDOW SHADES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Manual roller shades.
- B. Motorized roller shades.

1.3 RELATED REQUIREMENTS

- A. 06 10 00 - Rough Carpentry for wood blocking and grounds for mounting roller shades and accessories
- B. Division 26 Sections for electrical service and connections for motor operators, controls, limit switches, and other powered devices and for system disconnect switches for motorized shade operation.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction.
- D. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2019.
- E. WCMA A100.1 - National Standard for Safety of Corded Window Covering Products; 2012.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.
 - 1. Motorized Shade Operators: Include operating instructions.
 - 2. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
- B. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work.
 - 1. Motorized Shade Operators: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
 - 2. Wiring Diagrams: Power, system, and control wiring.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Ceiling suspension system members and attachment to building structure.
 - 2. Ceiling-mounted or penetrating items including light fixtures, air outlets and inlets, speakers, sprinklers, recessed shades, and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.
 - 3. Shade mounting assembly and attachment.
 - 4. Size and location of access to shade operator, motor, and adjustable components.
 - 5. Minimum Drawing Scale: 1/4 inch = 1 foot (1:48).
- D. Samples for Verification:
 - 1. Complete, full-size operating unit not less than 16 inches (400 mm) wide for each type of roller shade indicated.
 - 2. For the following products:
 - a. Shade Material: Not less than 3 inches (76 mm) square, with specified treatments applied. Mark face of material.
 - b. Shade Material: Not less than 12-inch- square section of fabric, from dye lot used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of material.

- E. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.
 - F. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining roller shades and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
 - 3. Operating hardware.
 - 4. Motorized shade operator.
- 1.6 QUALITY ASSURANCE
- A. Installer Qualifications: Fabricator of products.
 - B. Source Limitations: Obtain roller shades through one source from a single manufacturer.
 - C. Fire-Test-Response Characteristics: Provide roller shade band 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:
 - 1. Flame-Resistance Ratings: Passes NFPA 701.
 - D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - E. Product Standard: Provide roller shades complying with WCMA A100.1.
 - F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Deliver shades in factory packages, marked with manufacturer and product name, and location of installation using same designations indicated on Drawings and in a window treatment schedule.
- 1.8 ATTIC STOCK
- 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 additional full-size units for each size, color, texture, pattern, and gloss indicated, equal to 1 percent of amount installed.
- 1.9 PROJECT CONDITIONS
- A. Environmental Limitations:
 - 1. Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 - B. Field Measurements:
 - 1. 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.
 - 2. Allow clearances for operable glazed units' operation hardware throughout the entire operating range.
 - 3. Notify Architect of discrepancies.
 - 4. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - C. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 PRODUCTS

2.1 ROLLER SHADES

- A. Manufacturers:
 - 1. Draper Inc.
 - 2. Hunter Douglas, Inc.; Hunter Douglas Window Fashions Division.
 - 3. MechoShade Systems, Inc.
- B. Basis-of-Design Product: Refer to Finish Legend.
 - 1. Standard Shade Fabric: 5 percent open.

2. Black Out Shade Fabric: 0 percent open.
- C. Shade Band Material: PVC-coated fiberglass.
 1. Pattern, Style, Color: Refer to Finish Legend.
 2. Bottom Hem: Straight.
- D. Rollers: Electro-galvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with manufacturer's standard method for attaching shade material. Provide capacity for two roller shade band(s) per roller, unless otherwise indicated on Drawings.
- E. Direction of Roll: Regular, from back of roller.
- F. Mounting Brackets: Fascia end caps, fabricated from steel finished to match fascia or headbox.
- G. Fascia: L-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; continuous panel concealing front and bottom of shade roller, brackets, and operating hardware and operators; length as indicated; removable design for access.
- H. Pocket with Ceiling Slot Opening: Six-sided box units for recessed installation; fabricated from formed-steel sheet, extruded aluminum, or wood; with a bottom consisting of slot opening of minimum dimension to allow lowering and raising of shade and a removable or an openable, continuous metal access panel concealing rollers, brackets, and operating hardware and operators within; capacity for two roller shades overlapping in queued pattern, front and back per pocket, unless otherwise indicated.
 1. Corner Section: Factory formed and welded.
- I. Bottom Bar: Steel or extruded aluminum, with plastic or metal capped ends. Provide-type bottom bar with concealed weight bar as required for smooth, properly balanced shade operation.
- J. Audiovisual Light-Blocking Shades: Designed for eliminating all visible light gaps when shades are fully closed; fabricated from blackout shade band material with fascia headbox pocket and bottom bar extended and formed for light-tight joints among shade components and between shade components and adjacent construction.
 1. Side Channels, Sill Channel or Angle, and Perimeter Seals: Manufacturer's standard design, including sill light seal attached to bottom bar, for eliminating light gaps when shades are closed.
 2. Shade Band Retention System: Manufacturer's standard design for guiding shade band material through range of travel and holding shade band flat with edges of material within side channels.]
- K. Mounting: Inside Recessed in ceiling pocket mounting permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.
- L. Shade Operation: Manual; with continuous-loop bead-chain, clutch, and cord tensioner and bracket lift operator.
 1. Pull: Manufacturer's standard hand-grip engaged pull.
 2. Clutch: Capacity to lift size and weight of shade; sized to fit roller or provide adaptor.
 3. Lift-Assist Mechanism: Manufacturer's standard spring assist for balancing roller shade weight and lifting heavy roller shades.
 4. Loop Length: Length required to make operation convenient from floor level.
 5. Bead Chain: Nickel-plated metal or stainless steel.
- M. Shade Operation: Manual.

2.2 ROLLER SHADE FABRICATION

- A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.
- B. Concealed Components: Non-corrodible or corrosion-resistant-coated materials.
 1. Lifting Mechanism: With permanently lubricated moving parts.
- C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
 1. Shade Units Installed between (Inside) Jamb: Edge of shade not more than 1/4 inch (6 mm) from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.
 2. Shade Units Installed Outside Jamb: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

- D. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting fascia, headbox, roller, and operating hardware and for hardware position and shade mounting method indicated.
- E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal non-corrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.
- F. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.
- G. Colors of Metal and Plastic Components Exposed to View: As indicated by manufacturer's designations, unless otherwise indicated.

2.3 MOTORIZED ROLLER SHADE OPERATORS

- A. Manufacturers:
 - 1. Elero USA Inc.
 - 2. SIMU US, Inc.
 - 3. SOMFY Systems.
- B. General: Provide factory-assembled motorized shade operation systems designed for lifting shades of type, size, weight, construction, use, and operation frequency indicated. Provide operation systems of size and capacity and with features, characteristics, and accessories suitable for Project conditions and recommended by shade manufacturer, complete with electric motors and factory-prewired motor controls, remote-control stations, remote-control devices, power disconnect switches, enclosures protecting controls and all 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 the building electrical system.
- C. Comply with NFPA 70.
- D. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6 with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
- E. Electric Motors: UL-approved or -recognized, totally enclosed, insulated motor, complying with NEMA MG 1, with thermal-overload protection, brake, permanently lubricated bearings, and limit switches; sized by shade manufacturer to start and operate size and weight of shade considering service factor or considering Project's service conditions without exceeding nameplate ratings.
 - 1. Service Factor: According to NEMA MG 1, unless otherwise indicated.
 - 2. Motor Characteristics: Single phase, 24V, 60 Hz.
 - 3. Motor Mounting: Within manufacturer's standard roller enclosure.
- F. Position of Motor and Electrical Connection: Left side of roller, as determined by hand of user facing shade from inside, unless otherwise indicated on Drawings.
- G. Remote Controls: Electric controls with NEMA ICS 6, Type 1 enclosure for surface mounting. Provide the following devices for remote-control activation of shades:
 - 1. Control Stations: Keyed, -contact, three-position, switch-operated control station with open, close, and off functions. Provide two keys per station.
 - 2. Individual/Group Control Stations: Momentary-contact, three-position, rocker-style, wall switch-operated control station with open, close, and center off functions for individual and group control.
 - a. Color: White.
 - b. Product: Subject to compliance with requirements, provide "Decora Plus" by Leviton Manufacturing Co. Inc..
- H. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop shade at fully raised and fully lowered positions.
- I. Operating Function: Stop and hold shade at any position.
- J. Operating Features: Include the following:
 - 1. Group switching with integrated switch control; single face plate for multiple switch cut-outs.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance.
 - 1. 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, and located so shade band is not closer than 2 inches (50 mm) to interior face of glass. Allow clearances for window operation hardware.
 - B. Connections: Connect motorized operators to building electrical system.
- 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 roller shades. Refer to Division 01 Section Demonstration and Training."

END OF SECTION 12 24 13

SECTION 12 35 53
LABORATORY CASEWORK

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Metal laboratory casework.
- B. Plastic-laminate laboratory casework.
- C. Utility-space framing at backs of base cabinets.
- D. Filler and closure panels.
- E. Laboratory casework system that includes support and utility-space framing, filler and closure panels, wall panels, under cabinet lighting, and modular countertops.
- F. Laboratory countertops.
- G. Tables.
- H. Shelves.
- I. Laboratory sinks.
- J. Laboratory accessories.

1.3 RELATED REQUIREMENTS

- A. Section 11 53 13 - Laboratory Fume Hoods
- B. Section 11 53 19 - Laboratory Specialty Equipment
- C. Section 11 53 43 - Laboratory Service Fittings
- D. Section 11 53 53 - Biological Safety Cabinets

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements
- B. SEFA 2.3 - Installations
- C. SEFA 7 - Laboratory Fixtures
- D. SEFA 8M - Metal Casework
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction.

1.5 DEFINITIONS

- A. Exposed Surfaces of Casework: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches (1200 mm) above floor, and visible surfaces in open cabinets or behind glass doors.
 - 1. Ends of cabinets, including those installed directly against walls or other cabinets, are defined as "exposed."
 - 2. Ends of cabinets indicated to be installed directly against and completely concealed by walls or other cabinets are defined as "concealed."
- B. Semi-exposed Surfaces of Casework: Surfaces behind opaque doors, such as cabinet interiors, shelves, and dividers; interiors and sides of drawers; and interior faces of doors.
- C. Concealed Surfaces of Casework: Include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.
- D. Hardwood Plywood: A panel product composed of layers or plies of veneer, or of veneers in combination with lumber core, hardboard core, joined with adhesive and faced both front and back with hardwood veneers.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Shop Drawings: For laboratory casework. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Indicate locations of hardware and keying of locks.
 - 2. Indicate locations and types of service fittings.
 - 3. Indicate locations of blocking and reinforcements required for installing laboratory casework.
 - 4. Include details of utility spaces showing supports for conduits and piping.
 - 5. Include details of support framing system.
 - 6. Include details of exposed conduits, if required, for service fittings.
 - 7. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and other laboratory equipment.
 - 8. Include coordinated dimensions for laboratory equipment specified in other Sections.
 - C. Samples For each type of cabinet finish and each type of countertop material indicated, in manufacturer's standard sizes.
 - D. Delegated-Design Submittal: For laboratory casework indicated to comply with seismic performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - E. Qualification Data: For qualified manufacturer.
 - F. Product Test Reports for Casework: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory casework with requirements of specified product standard and system structural performance specified in "Performance Requirements" Article.
 - G. Product Test Reports for Countertop Surface Material: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory countertop surface materials with requirements specified for chemical and physical resistance.
 - H. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.
- 1.7 QUALITY ASSURANCE
- A. Source Limitations: Obtain laboratory casework from single source from single manufacturer unless otherwise indicated.
 - 1. Obtain countertops sinks accessories service fittings from casework manufacturer.
 - B. Product Designations: Drawings indicate sizes and configurations of laboratory casework by referencing designated manufacturer's catalog numbers. Other manufacturers' laboratory casework of similar sizes and similar door and drawer configurations and complying with the Specifications may be considered. Refer to Division 01 Section "Product Requirements."
 - C. Casework Product Standard: Comply with SEFA 8M.
 - 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.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.
- 1.9 PROJECT CONDITIONS
- A. Environmental Limitations: Do not deliver or install laboratory casework until building is enclosed, utility roughing-in and wet work are complete and dry, and temporary HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- 1.10 COORDINATION
- A. Coordinate layout and installation of framing and reinforcements for support of laboratory casework.
 - B. Coordinate installation of laboratory casework with installation of fume hoods and other laboratory equipment.
- 1.11 ATTIC STOCK
- A. Furnish complete touchup kit for each type and color of metal laboratory casework provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged laboratory casework finish.

- B. Furnish complete touchup kit for each type and color of wood laboratory casework provided. Include scratch fillers, stains, finishes, and other materials necessary to perform permanent repairs to damaged laboratory casework finish.
- C. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Cabinet Mounting Clips and Related Hardware: Quantity equal to 5 percent of amount installed, but no fewer than 20 of each type.

1.12 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of casework that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. System Structural Performance: Laboratory casework and support framing system shall withstand the effects of the following gravity loads and stresses without permanent deformation, excessive deflection, or binding of drawers and doors:
 - 1. Support Framing System: 600 lb/ft (900 kg/m).
 - 2. Suspended Base Cabinets (Internal Load): 160 lb/ft. (240 kg/m)
 - 3. Work Surfaces (Including Tops of Suspended Base Cabinets): 160 lb/ft. (240 kg/m)
 - 4. Wall Cabinets (Upper Cabinets): 160 lb/ft. (240 kg/m)
 - 5. Shelves: 40 lb/sq. ft. (200 kg/sq. m)
- B. Modular Laboratory Bench System Structural Performance: Modular Laboratory Benches and support framing system shall withstand the effects of the following gravity loads and stresses without permanent deformation, excessive deflection, or binding of drawers and doors:
 - 1. Work Surface Table Frame:
 - a. Load Rating: 100 lbs per linear foot of width to a maximum or 800 lbs.
 - b. Maximum allowable deflection of 0.125-inch at center rail with 800 lbs uniformly distributed on an 8 foot table.
 - 2. Work Surfaces (Including Tops of Suspended Base Cabinets): 160 lb/ft.
 - a. Shelves: Load capacity of 40 lbs per linear foot up to 200 lbs on a 48-inch wide unit.
- C. Delegated Design: Design laboratory casework, including comprehensive engineering analysis by a qualified professional engineer licensed in State in which the Project is located, using seismic performance requirements and design criteria indicated.
- D. UTSW Finish Standards:
 - 1. Cabinets, Shelves, Tables, etc.: White.
 - 2. Stainless Steel Cabinets, Shelves etc.: Directional Satin Finish: ASTM A480/ASTM A480M, No. 4.
 - 3. Epoxy Countertops: Lunar White as manufactured by Kemresin.
 - 4. Stainless Steel Countertops: ASTM A 240/A 240M, Type 304.

2.2 METAL CABINET AND TABLE MATERIALS

- A. Metal: Cold-rolled, commercial steel (CS) sheet, complying with ASTM A 1008/A 1008M; matte finish; suitable for exposed applications.
- B. Stainless Steel Sheet: ASTM A240/A240M, Type 304.
- C. Nominal Metal Thickness:
 - 1. Sides, Ends, Fixed Backs, Bottoms, Tops, Soffits, and Items Not Otherwise Indicated: 0.048 inch (1.21 mm). Except for flammable liquid storage cabinets, bottoms may be 0.036 inch (0.91 mm) if reinforced.
 - 2. Back Panels, Doors, Drawer Fronts and Bodies, and Shelves: 0.036 inch (0.91 mm) except 0.048 inch (1.21 mm) for back panels and doors of flammable liquid storage cabinets and for unreinforced shelves more than 36 inches (900 mm) long.
 - 3. Intermediate Horizontal Rails, Table Aprons and Cross Rails, Center Posts, and Top Gussets: 0.060 inch (1.52 mm).
 - 4. Drawer Runners, Sink Supports, and Hinge Reinforcements: 0.075 inch (1.90 mm).
 - 5. Leveling and Corner Gussets: 0.105 inch (2.66 mm).

2.3 PLASTIC-LAMINATE CABINET MATERIALS

- A. General:
 - 1. Adhesives: Do not use adhesives that contain urea formaldehyde.
 - 2. Hardwood Plywood: Composition core three-ply plywood compliant with ANSI A208.1-199 and ANSI A208.2-1994, made without urea formaldehyde.
 - 3. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.
 - 4. Edgebanding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 3 mm thick at doors and drawer fronts, 1 mm thick elsewhere.
 - a. Colors: White .
- B. Exposed Materials:
 - 1. Plastic Laminate: Grade HGS.
 - a. Colors: White .
- C. Semi-exposed Materials:
 - 1. Plastic Laminate: Grade VGS.
 - a. Colors: White range.
 - b. Provide plastic laminate for semi-exposed surfaces unless otherwise indicated.
 - c. Provide plastic laminate for interior faces of doors and drawer fronts and where indicated.
 - 2. Solid Wood: Sound hardwood lumber, selected to eliminate appearance defects.
 - 3. Plywood: Hardwood plywood. Grade B faces and Grade J crossbands. Provide backs of same species as faces.
- D. Concealed Materials:
 - 1. Plywood: Hardwood plywood.
 - 2. Plastic Laminate: Type BKL.

2.4 COUNTERTOP / TABLE TOP / SHELF / SINK MATERIALS

- A. Chemical-Resistant Plastic Laminate:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arborite; a division of ITW Canada.
 - b. Formica Corporation.
 - c. Nevamar Company, LLC.
 - d. Panolam Industries International Incorporated; Pionite Decorative Surfaces.
 - e. Wilsonart International; Division of ITW Inc.
 - 2. High-pressure decorative laminate, complying with NEMA LD 3, that has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:
 - a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), amyl acetate, benzene, butyl alcohol, carbon tetrachloride, chloroform, dimethyl formamide, dioxane, ethyl acetate, ethyl alcohol, ethyl ether, formaldehyde (37 percent), gasoline, gentian violet, hydrogen peroxide (3 percent), methyl alcohol, methyl ethyl ketone, methylene chloride, mono chlorobenzene, naphthalene, toluene, trichloroethylene, xylene, zinc chloride (saturated), hydrochloric acid (37 percent), methyl red, nitric acid (30 percent), phenol (90 percent), phosphoric acid (75 percent), silver nitrate (saturated), sodium hydroxide (20 percent), and sulfuric acid (77 percent).
 - b. Slight Effect: Cresol, tincture of iodine, sodium sulfide (15 percent), phenol (90 percent), sodium hydroxide (20 percent), and methyl red.
 - c. Moderate Effect: Hydrochloric acid (37 percent), nitric acid (30 percent), phosphoric acid (75 percent), silver nitrate (saturated), and sulfuric acid (77 percent).
 - 3. Color: White.
 - 4. Core Materials for Plastic Laminate:
 - a. Exterior Plywood: DOC PS 1, Exterior A-C with fully sanded face.
 - 5. Adhesive for Bonding Plastic Laminate: Manufacturer's standard waterproof, urea-formaldehyde-free adhesive.
- B. Epoxy: Factory-molded, modified epoxy-resin formulation with smooth, non-specular finish.
 - 1. Basis of Design Manufacturers:
 - a. Kemresin.
 - b. American Epoxy Scientific.
 - 2. Alternate Manufacturers:

- a. Durcon.
 - 3. Physical Properties:
 - a. Flexural Strength: Not less than 10,000 psi (70 MPa).
 - b. Modulus of Elasticity: Not less than 2,000,000 psi (1400 MPa).
 - c. Hardness (Rockwell M): Not less than 100.
 - d. Water Absorption (24 Hours): Not more than 0.02 percent.
 - e. Heat Distortion Point: Not less than 260 deg F (127 deg C).
 - 4. Chemical Resistance: Epoxy-resin material has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:
 - a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), benzene, carbon tetrachloride, dimethyl formamide, ethyl acetate, ethyl alcohol, ethyl ether, methyl alcohol, nitric acid (70 percent), phenol, sulfuric acid (60 percent), and toluene.
 - b. Slight Effect: Chromic acid (60 percent) and sodium hydroxide (50 percent).
 - 5. Color:
 - a. Basis of Design: Lunar White as manufactured by Kemresin.
 - C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
- 2.5 METAL CABINETS AND TABLES
- A. Manufacturers:
 - 1. Kewaunee Scientific Corporation; Laboratory Products Group.
 - 2. Other manufacturers as approved by UTSW.
 - B. Fabrication:
 - 1. Assemble and finish units at point of manufacture.
 - 2. Use precision dies for interchangeability of like-size drawers, doors, and similar parts.
 - 3. Perform assembly on precision jigs to provide units that are square.
 - 4. Reinforce units with angles, gussets, and channels.
 - 5. Except where otherwise specified, integrally frame and weld cabinet bodies to form dirt and vermin-resistant enclosures.
 - 6. Where applicable, reinforce base cabinets for sink support.
 - 7. Maintain uniform clearance around door and drawer fronts of 1/16 to 3/32 inch (1.5 to 2.4 mm).
 - C. Finish: White.
 - D. Doors:
 - 1. Flush Doors: Outer and inner pans that nest into box formation, with full-height channel reinforcements at center of door. Fill doors with noncombustible, sound-deadening material.
 - 2. Glazed Doors: Welded inner and outer door panel to make 3/4-inch thick door with 1/8" tempered glass and rubber or vinyl continuous gasket.
 - E. Cabinet Style: Inset with square edges.
 - F. Hinged Doors: Mortise for hinges and reinforce with angles welded inside inner pans at hinge edge.
 - G. Drawers:
 - 1. Fronts made from outer and inner pans that nest into box formation, with no raw metal edges at top. Sides, back, and bottom fabricated in one piece with rolled or formed top of sides for stiffening and comfortable grasp for drawer removal. Fully coved at interior bottom on four sides. Provide drawers with rubber bumpers, polymer roller slides, and positive stops to prevent metal-to-metal contact or accidental removal. Provide 3/4-inch thick drawer head with drawer from cold-rolled steel.
 - H. Adjustable Shelves: Front, back, and ends formed down, with edges returned horizontally at front and back to form reinforcing channels.
 - I. Toe Space: Fully enclosed, 4 inches (100 mm) high by 3 inches (75 mm) deep, with no open gaps or pockets.
 - J. Tables: Welded tubing legs, not less than 2 inches (50 mm) square with channel stretchers as needed to comply with product standard. Weld or bolt stretchers to legs and cross-stretchers, and bolt legs to table aprons. Provide leveling device welded to bottom of each leg.
 - 1. Leg Shoes: Satin-finished stainless steel, open-bottom, slip-on type.
 - K. Utilities: Provide space, cutouts, and holes for pipes, conduits, and fittings in cabinet bodies to accommodate utility services and their support-strut assemblies.
 - 1. Provide base cabinets with removable backs for access to utility space.

- L. Utility-Space Framing: Laboratory casework manufacturer's standard steel framing units consisting of 2 steel slotted channels complying with MFMA-4, not less than 1-5/8 inches (41 mm) square by 0.105-inch (2.66-mm) nominal thickness, and connected at top and bottom by U-shaped brackets made from 1-1/4-by-1/4-inch (32-by-6-mm) steel flat bars. Framing units may be made by welding specified channel material into rectangular frames instead of using U-shaped brackets.
- M. Filler and Closure Panels: Provide where indicated and as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets and with hemmed or flanged edges unless otherwise indicated.
 - 1. Provide utility-space closure panels at spaces between base cabinets where utility space would otherwise be exposed, including spaces below countertops.
 - 2. Provide closure panels at ends of utility spaces where utility space would otherwise be exposed.
 - 3. Provide knee-space panels (modesty panels) at spaces between base cabinets, where cabinets are not installed against a wall or where space is not otherwise closed. Fabricate from back-to-back panels or of hollow construction to eliminate exposed hemmed or flanged edges.

2.6 PLASTIC-LAMINATE CABINETS

- A. Manufacturers:
 - 1. LSI Corporation of America; a Sagus International company.
 - 2. Southwest Solutions Group.
 - 3. TMI Systems Design Corporation.
- B. Design: Flush overlay.
- C. Finish: White.
- D. Construction: Provide plastic-laminate-faced laboratory casework of the following minimum construction:
 - 1. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch- (19-mm-) thick plywood plastic-laminate faced on exposed surfaces, thermoset decorative panels on semi-exposed surfaces.
 - 2. Shelves: 3/4-inch- (19-mm-) thick plywood, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semi-exposed surfaces.
 - 3. Backs of Cabinets: 1/2-inch- (12.7-mm-) thick plywood, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semi-exposed surfaces.
 - 4. Drawer Fronts: 3/4-inch- (19-mm-) thick plywood, plastic-laminate faced.
 - 5. Drawer Sides and Backs: 1/2-inch- (12.7-mm-) thick solid-wood or veneer-core hardwood plywood , with glued dovetail or multiple-dowel joints.
 - 6. Drawer Bottoms: 1/4-inch- (6.4-mm-) thick hardwood plywood glued and dadoed into front, back, and sides of drawers. Use 1/2-inch- (12.7-mm-) thick material for drawers more than 24 inches (600 mm) wide.
 - 7. Doors 48 Inches (1200 mm) High or Less: 3/4 inch (19 mm) thick, with solid-wood stiles and rails, plastic-laminate faced.
 - 8. Doors More Than 48 Inches (1200 mm) High: 1-1/8 inches (29 mm) thick, with plywood cores, plastic-laminate faced.
- E. Utility-Space Framing: Laboratory casework manufacturer's standard steel framing units consisting of 2 steel slotted channels complying with MFMA-4, not less than 1-5/8 inches (41 mm) square by 0.105-inch (2.66-mm) nominal thickness, and connected at top and bottom by U-shaped brackets made from 1-1/4-by-1/4-inch (32-by-6-mm) steel flat bars. Framing units may be made by welding specified channel material into rectangular frames instead of using U-shaped brackets.
- F. Filler and Closure Panels: Provide where indicated and as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as adjacent exposed cabinet surfaces unless otherwise indicated.
 - 1. Provide utility-space closure panels at spaces between base cabinets where utility space would otherwise be exposed, including spaces below countertops.
 - 2. Provide closure panels at ends of utility spaces where utility space would otherwise be exposed.
 - 3. Provide knee-space panels at spaces between base cabinets, where cabinets are not installed against a wall or where space is not otherwise closed. Fabricate from same material and with same finish as exposed cabinet backs.

2.7 LABORATORY CASEWORK SYSTEM

- A. Manufacturers:
 - 1. Kewaunee Scientific Corporation; Laboratory Product Group.
 - 2. Other manufacturer's as approved by UTSW.
- B. Provide casework manufacturer's standard integrated system that includes support framing, suspended modular cabinets, filler and closure panels, wall panels, under cabinet task-lighting fixtures, countertops, and fittings needed to assemble system. System includes hardware and fasteners for securing support framing to permanent construction.
 - 1. Cabinet Construction: Metal.
 - 2. Cabinets can be removed and reinstalled without use of special tools for relocation within system.
 - 3. Base cabinets can be removed without providing temporary support for, or removing, countertops.
 - 4. Sinks are supported independent of base cabinets.
 - 5. Support framing has provision for fastening pipe supports at utility space in not more than 1-inch (25-mm) increments.
 - 6. System includes filler and closure panels to close spaces between support framing, cabinets, shelves, countertops, floors, and walls unless otherwise indicated.
 - a. Fabricate panels from same material and with same finish as metal cabinets and with hemmed or flanged edges.
- C. Support Framing: Casework manufacturer's standard system consisting of vertical supports and connecting braces and rails as follows:
 - 1. Cabinets, shelves, and countertops are supported from vertical supports, except where floor-supported base cabinets are indicated. Vertical positioning of supported cabinets, shelves, and countertops can be varied in 1-inch (25-mm) increments through full height of supports.
 - 2. Vertical supports rest on adjustable leveling bases and are secured to floor with metal clips fastened to floor.
 - 3. Vertical supports are installed with braces and rails connecting them to each other and to permanent building walls to create a stable, rigid structure with framed utility spaces where indicated.
 - 4. Vertical supports are braced at floor with cantilevered horizontal leg members where indicated.
- D. Under cabinet Task-Light Fixtures: LED fixtures with switch and heavy-duty cord and plug.
 - 1. Finish: Baked enamel.
 - 2. Diffusers: Virgin acrylic with high resistance to yellowing and other changes due to aging, heat, and UV radiation.
 - 3. Ballast Sound Rating: A.
- E. Countertops: Provide in modular lengths indicated, without seams.
- F. Modular Table and Bench System: Adaptable lab benching system comprised on self-supporting workstation table including provisions for uprights for shelving.
 - 1. Table surfaces and shelving shall be adjustable in increments no greater than 1-inch.
 - 2. For mobile tables and height adjustable table feet, provide manufacturer's standard levelers.

2.8 METAL CABINET FINISH

- A. General: Prepare, treat, and finish welded assemblies after assembling. Prepare, treat, and finish components that are to be assembled with mechanical fasteners before assembling. Prepare, treat, and finish concealed surfaces same as exposed surfaces.
- B. Preparation: After assembly, clean surfaces of mill scale, rust, oil, and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
- C. Chemical-Resistant Finish: Immediately after cleaning and pre-treating, apply laboratory casework manufacturer's standard two-coat, chemical-resistant, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).
 - 1. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8. Acceptance level for chemical spot test shall be no more than four Level 3 conditions.
 - 2. Colors for Metal Laboratory Casework Finish: As indicated by manufacturer's designations.
- D. Stainless Steel: Directional Satin Finish: ASTM A480/ASTM A480M, No. 4.

2.9 HARDWARE

- A. General: Provide laboratory casework manufacturer's standard, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.
 - B. Hinges: Type 304 Stainless-steel, 5-knuckle hinges complying SEFA 8, with antifriction bearings and rounded tips. Provide 2 for doors 36 inches (914 mm) high or less and 3 for doors more than 36 inches (914 mm) high.
 - 1. Finish: Brushed satin.
 - C. Hinges for Wood Plastic-Laminate Cabinets: Frameless concealed hinges (European type) complying with BHMA A156.9, Type B01602, 135 degrees of opening.
 - D. Hinged Door and Drawer Pulls: Chrome-plated or stainless steel back-mounted pulls. Provide 2 pulls for drawers more than 24 inches (600 mm) wide.
 - 1. Design: Wire pulls, as selected from manufacturer's full range.
 - 2. Overall Size: 3/8-inch diameter stainless steel rod with brushed satin finish in 4-inch centers, as selected from manufacturer's full range.
 - E. Door Catches: Two-piece, heavy duty cam action positive catch. Nylon-roller spring catches. Provide 2 catches on doors more than 48 inches (1200 mm) high.
 - F. Elbow Catch: Catches and strike plate on left hand doors of double door cases where locks are not used. Burnished cast aluminum with bright brass finish.
 - G. Drawer Slides: Side mounted, epoxy-coated steel, self-closing, soft-close; designed to prevent rebound when drawers are closed; complying with BHMA A156.9, Type B05091.
 - 1. Provide Grade 1HD-100; for drawers not more than 6 inches (150 mm) high and 24 inches (600 mm) wide.
 - 2. Provide Grade 1HD-100; for drawers more than 6 inches (150 mm) high or 24 inches (600 mm) wide.
 - 3. Standard Duty (Grade 1): Full-extension type, with polymer rollers.
 - 4. Heavy Duty (Grade 1HD-200): Full-extension, ball-bearing type.
 - H. Drawer Slides for Wood Plastic-Laminate Cabinets: Hardwood runners under centers of drawers with polymer guides fastened to backs of drawers.
 - I. Label Holders: Stainless steel, aluminum, or chrome plated; sized to receive standard label cards approximately 1 by 2 inches (25 by 50 mm), attached with screws or rivets. Provide where indicated.
 - J. Locks for Metal Cabinets: Cam or half-mortise type with 5-pin tumbler, brass with chrome-plated finish; complying with BHMA A156.11, Type E07281, E07261, E07111, or E07021.
 - 1. Single bitted with no restricted keyways.
 - 2. Provide a minimum of two keys per lock and two master keys.
 - 3. Provide where indicated.
 - 4. Keying: Key locks as directed.
 - 5. Master Key System: Key all locks to be operable by master key.
 - K. Locks for Wood / Plastic-Laminate Cabinets: Cam type with 5-pin tumbler, brass with chrome-plated finish; complying with BHMA A156.11, Type E07281 or E07261.
 - 1. Single bitted with no restricted keyways.
 - 2. Provide a minimum of two keys per lock and two master keys.
 - 3. Provide where indicated.
 - 4. Keying: Key locks as directed.
 - 5. Master Key System: Key all locks to be operable by master key.
 - L. Adjustable Shelf Supports for Wood Plastic-Laminate Cabinets: Powder-coated steel shelf rests complying with BHMA A156.9, Type B04013.
 - M. Adjustable Shelf Supports for Wood Plastic-Laminate Cabinets: Mortise-type, powder-coated steel standards and shelf rests complying with BHMA A156.9, Types B04071 and B04091.
 - N. Adjustable Wall Shelf Supports: Surface-type steel standards and nickel-plated steel shelf brackets, with epoxy powder-coated finish, complying with BHMA A156.9, Types B04102 and B04112.
- 2.10 COUNTERTOPS, TABLE TOPS , SHELVES , TROUGHES, AND SINKS
- A. Countertops, General: Provide units with smooth surfaces in uniform plane free of defects. Make exposed edges and corners straight and uniformly beveled. Provide front and end overhang of 1 inch (25 mm), with continuous drip groove on underside 1/2 inch (13 mm) from edge.

- B. Sinks, General: Provide sizes indicated or laboratory casework manufacturer's closest standard size of equal or greater volume, as approved by Architect.
 - 1. Outlets: Provide with strainers and tailpieces, NPS 1-1/2 (DN 40), unless otherwise indicated.
 - 2. Overflows: Where indicated, provide overflow of standard beehive or open-top design with separate strainer. Height 2 inches (50 mm) less than sink depth. Provide in same material as strainer.
- C. Plastic-Laminate Countertops Shelves:
 - 1. Countertops: Chemical-resistant plastic laminate shop bonded to top surface and exposed edges of 3/4-inch- (19-mm-) thick core with plastic-laminate backing bonded to bottom surface. Sand surfaces to which plastic laminate is to be bonded.
 - a. Backsplash Core Thickness: 3/4 inch (19 mm) (25 mm).
 - b. Countertop Core: Exterior grade plywood.
 - c. Countertop Core for Counters Containing Sinks: Exterior grade plywood.
 - d. Countertop Configuration: Flat, with square edges, and flat backsplashes and end splashes. Finish faces and exposed edges of splashes with same plastic laminate as top.
 - e. Plastic-Laminate Grade for Flat Countertops: HGS.
 - f. Plastic-Laminate Grade for Backing: BKL.
 - 2. Table Tops: Chemical-resistant plastic laminate shop bonded to top surface and exposed edges of 3/4-inch- (19-mm-) thick core with plastic-laminate backing bonded to bottom surface. Sand surfaces to which plastic laminate is to be bonded.
 - a. Table-Top Core: Exterior grade plywood.
 - b. Plastic-Laminate Grade for Tables: HGS.
 - c. Plastic-Laminate Grade for Backing: BKL.
 - 3. Plastic-Laminate Shelves: Chemical-resistant plastic laminate shop bonded to both faces and all edges of 3/4-inch- (19-mm-) thick core. Sand surfaces to which plastic laminate is to be bonded.
 - a. Shelf Core: Exterior grade plywood.
 - b. Plastic-Laminate Grade for Shelves: HGL.
- D. Epoxy Countertops Table Tops Sinks:
 - 1. Countertop Fabrication: Fabricate with factory cutouts for sinks, holes for service fittings and accessories, and with butt joints assembled with epoxy adhesive and concealed metal splines.
 - a. Countertop Configuration: Flat, 1 inch (25 mm) thick, with beveled edge and corners, and with drip groove and applied backsplash.
 - b. Countertop Construction: Uniform throughout full thickness.
 - 2. Table-Top Fabrication:
 - a. Table-Top Configuration: Flat, 1 inch (25 mm) thick, with beveled edge and corners, and with drip groove at perimeter.
 - b. Table-Top Construction: Uniform throughout full thickness.
 - 3. Sink Fabrication: Molded in 1 piece with smooth surfaces, coved corners, and bottom sloped to outlet; 1/2-inch (13-mm) minimum thickness.
 - a. Provide with polypropylene strainers and tailpieces.
 - b. Provide integral sinks in epoxy countertops, bonded to countertops with invisible joint line.
 - c. Provide manufacturer's recommended adjustable support system for table- and cabinet-type installations.
- E. Stainless-Steel Countertops: Made from stainless-steel sheet, not less than 0.062-inch (1.59-mm) nominal thickness, with No. 4 satin finish.
 - 1. Extend top down 1 inch (25 mm) at edges with a 1/2-inch (13-mm) return flange under frame. Apply heavy coating of heat-resistant, sound-deadening mastic to undersurface.
 - 2. Form backsplash coved to and integral with top surface.
 - 3. Provide raised (marine) edge around perimeter of countertops containing sinks; pitch two ways to sink to provide drainage without channeling or grooving.
 - 4. Provide raised (marine) edge around perimeter of countertops at sinks, where indicated; pitch two ways to sink to provide drainage without channeling or grooving.
 - 5. Punch holes for service fittings at factory.
 - 6. Reinforce underside of countertop with channels or use thicker metal sheet where necessary to insure rigidity without deflection.
 - 7. Weld shop-made joints.

8. Where field-made joints are required, provide hairline butt-joints mechanically bolted through continuous channels welded to underside at edges of joined ends. Keep field jointing to a minimum.
 9. Where stainless-steel sinks or cup sinks occur in stainless-steel countertops, factory weld into one integral unit.
 10. After fabricating and welding, grind surfaces smooth and polish as needed to produce uniform, directionally textured finish with no evidence of welds and free of cross scratches. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean.
- F. **Stainless-Steel Shelves:** Made from stainless-steel sheet, not less than 0.050-inch (1.27-mm) nominal thickness, with No. 4 satin finish. Weld shop-made joints. Fold down front edge 3/4 inch (19 mm); fold up back edge 3 inches (75 mm). Provide integral stiffening brackets, formed by folding up ends 3/4 inch (19 mm) and welding to upturned back edge. After fabricating, grind welds smooth and polish as needed to produce uniform, directionally textured finish with no evidence of welds and free of cross scratches. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean.
- G. **Stainless-Steel Sinks:** Made from stainless-steel sheet, not less than 0.050-inch (1.27-mm) nominal thickness. Fabricate with corners rounded and coved to at least 5/8-inch (16-mm) radius. Slope sink bottoms to outlet. Provide double-wall construction for sink partitions with top edge rounded to at least 1/2-inch (13-mm) diameter. Provide continuous butt-welded joints. After fabricating and welding, grind surfaces smooth and polish as needed to produce uniform finish with no evidence of welds and free of cross scratches. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean.
1. Punch holes for fittings at factory.
 2. Provide with stainless-steel strainers and tailpieces.
 3. Provide with integral rims except where located in stainless-steel countertops.
 4. Apply 1/8-inch- (3-mm-) thick coating of heat-resistant, sound-deadening mastic to under-sink surfaces.
- H. **Cup Sinks:** Stainless steel, 3-by-6-inch (75-by-150-mm) oval.
1. Provide with stainless-steel strainers and integral tailpieces.
- I. **Cup Sinks:** Epoxy.
1. Provide epoxy cup sinks with polypropylene strainers and integral tailpieces.
- J. **Troughs:** Epoxy or stainless steel, as indicated. Pitch to drains not less than 1/8 inch/foot (10 mm/m). Except where troughs empty into sinks, provide NPS 1-1/2 (DN 40) outlets with strainers and tailpieces.
1. **Stainless-Steel Troughs:** Made from stainless-steel sheet, not less than 0.062-inch (1.59-mm) nominal thickness. Fabricate with corners rounded and coved to at least 5/8-inch (16-mm) radius. Provide continuous butt-welded joints. After fabricating and welding, grind surfaces smooth and polish as needed to produce uniform finish with no evidence of welds and free of cross scratches. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean. Provide stainless-steel strainers and tailpieces.

2.11 LABORATORY ACCESSORIES

- A. **Reagent Shelves:** Provide as indicated, fabricated from same material as adjacent countertop, unless otherwise indicated.
- B. **Upright Rod Assembly and Metal Crossbar:** Aluminum or stainless steel. Two vertical rods and 1 horizontal crossbar, 3/4 inch (19 mm) in diameter and 36 inches (900 mm) long, unless otherwise indicated; 2 flush socket receptacles and 2 crossbar clamps. Ends of vertical rods are tapered to fit receptacles; all other rod ends are rounded.
- C. **Greenlaw Arm Assembly:** Aluminum or stainless-steel vertical rod, tapered on one end to fit flush socket receptacle. Adjustable crossbar of hardwood with black, acid-resistant finish, secured to upright with adjustable clamp. Provide with receptacle.
- D. **Lattice Assembly:** Aluminum or stainless-steel, vertical and horizontal rod lattice assembly with 3/4-inch- (19-mm-) diameter rods at approximately 12 inches (300 mm) o.c. with 2 flush socket receptacles for mounting.
1. Size: 36 inches (900 mm) high.
- E. **Pegboards:** Stainless-steel pegboards with removable polypropylene pegs and stainless-steel drip troughs with drain outlet.
- F. **Casters:**

1. Cabinets with casters shall be constructed without toe spaces.
 2. Cabinets shall be constructed with a reinforced base capable of supporting a 4-inch-high caster assembly in each corner.
 3. Casters shall be swivel locking type and rated for a minimum of 250 pounds load each.
 4. Cabinets with casters shall be completely finished on all four sides and top.
- G. Grommets for Cable Passage: Manufacturer's standard options including but not limited to rubber, EPDM, silicone, neoprene, and FKM.
1. Size: Standard size provided by manufacturer.
 2. Shape: Oval.
- H. Fittings: Refer to 11 53 43 "Laboratory Service Fittings."

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of laboratory casework.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF CABINETS

- A. Comply with installation requirements in SEFA 2.3 . Install level, plumb, and true; shim as required, using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical. Do not exceed the following tolerances:
 1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet (1.5 mm in 3 m).
 2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet (3 mm in 3 m).
 3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet (3 mm in 3 m).
 4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch (0.8 mm).
 5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch (1.5 mm).
- B. Utility-Space Framing: Secure to floor with two fasteners at each frame. Fasten to partition framing, wood blocking, or metal reinforcements in partitions and to base cabinets.
- C. Base Cabinets: Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions with fasteners spaced not more than 24 inches (600 mm) o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.
 1. Where base cabinets are installed away from walls, fasten to floor at toe space at not more than 24 inches (600 mm) o.c. and at sides of cabinets with not less than 2 fasteners per side.
- D. Wall Cabinets: Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 24 inches (600 mm) o.c.
- E. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.
- F. Adjust laboratory casework and hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

3.3 INSTALLATION OF COUNTERTOPS

- A. Comply with installation requirements in SEFA 2.3 . Abut top and edge surfaces in one true plane with flush hairline joints and with internal supports placed to prevent deflection. Locate joints only where shown on Shop Drawings.
- B. Field Jointing: Where possible, make in same manner as shop-made joints using dowels, splines, fasteners, adhesives, and sealants recommended by manufacturer. Prepare edges in shop for field-made joints.
- C. Fastening:
 1. Secure countertops, except for epoxy countertops, to cabinets with Z-type fasteners or equivalent, using two or more fasteners at each cabinet front, end, and back.
 2. Secure epoxy countertops to cabinets with epoxy cement, applied at each corner and along perimeter edges at not more than 48 inches (1200 mm) o.c.
 3. Where necessary to penetrate countertops with fasteners, countersink heads approximately 1/8 inch (3 mm) and plug hole flush with material equal to countertop in chemical resistance, hardness, and appearance.
- D. Provide required holes and cutouts for service fittings.

- E. Seal unfinished edges and cutouts in plastic-laminate countertops with heavy coat of polyurethane varnish.
- F. Provide scribe moldings for closures at junctures of countertop, curb, and splash with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.
- G. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

3.4 INSTALLATION OF SINKS

- A. Comply with installation requirements in SEFA 2.3 .
- B. Underside Installation of Epoxy Sinks: Use laboratory casework manufacturer's recommended adjustable support system for table- and cabinet-type installations. Set top edge of sink unit in sink and countertop manufacturers' recommended chemical-resistant sealing compound or adhesive and firmly secure to produce a tight and fully leakproof joint. Adjust sink and securely support to prevent movement. Remove excess sealant or adhesive while still wet and finish joint for neat appearance.
- C. Semiflush Installation of Stainless-Steel Sinks: Before setting, apply sink and countertop manufacturers' recommended sealant under rim lip and along top. Remove excess sealant while still wet and finish joint for neat appearance.
- D. Drop-in Installation of Epoxy Cup Sinks: Rout groove in countertop to receive sink rim if not prepared in shop. Set sink in adhesive and fill remainder of groove with sealant or adhesive. Use procedures and products recommended by sink and countertop manufacturers. Remove excess adhesive and sealant while still wet and finish joint for neat appearance.
- E. Surface Installation of Epoxy Cup Sinks: Set sink in sealant or adhesive. Use procedures and products recommended by sink and countertop manufacturers. Remove excess sealant or adhesive while still wet and finish joint for neat appearance.

3.5 INSTALLATION OF LABORATORY ACCESSORIES

- A. Install accessories according to Shop Drawings, installation requirements in SEFA 2.3 , and manufacturer's written instructions.
- B. Securely fasten adjustable shelving supports, stainless-steel shelves, and pegboards to partition framing, wood blocking, or reinforcements in partitions.
- C. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.
- D. Securely fasten pegboards to partition framing, wood blocking, or reinforcements in partitions.

3.6 CLEANING AND PROTECTING

- A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
- B. Protect countertop surfaces during construction with 6-mil (0.15-mm) plastic or other suitable water-resistant covering. Tape to underside of countertop at a minimum of 48 inches (1200 mm) o.c.

END OF SECTION 12 35 53

SECTION 12 46 00
FURNISHING ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Interior waste and recycling containers.

1.3 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants for joint sealant requirements.

1.4 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable.
- E. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- G. Texas Accessibility Standards (TAS) - Texas Accessibility Standards.
- H. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005.

1.5 SUBMITTALS

- A. Submittals review shall include review and approval by UTSW Building Maintenance Sustainability Coordinator including confirmation of all messaging, logos, and wording.
- B. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Material and finish descriptions.
 - 3. Features that will be included for Project.
 - 4. Manufacturer's warranty.
- C. Samples: For each type of finish, provide finish sample in manufacturer's standard sizes.
- D. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.
- E. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify products using designations indicated.
- F. Maintenance Data: For each item including methods for cleaning and precautions to prevent damage.

1.6 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

1.7 WARRANTY

- A. Provide Manufacturer's standard 1 year warranty for deterioration or failure in materials.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Sealants: Coordinate joint sealant requirements with Section 07 92 00 - Joint Sealants.
- B. Stainless Steel: ASTM A666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
- C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 (Z180) hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

2.2 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and hinges square and tight.
- B. Keys: Provide universal keys for internal access. Provide minimum of six keys to Owner's representative.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install units level, plumb, and firmly anchored (where required) in locations indicated.
- B. Replace damaged units.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 12 46 00



DIVISION 13

SPECIAL CONSTRUCTION



SECTION 13 21 01

CONTROLLED ENVIRONMENTAL ROOM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Pre-manufactured Controlled Environmental Room.

1.3 RELATED REQUIREMENTS

- A. Section 01 79 00 - Demonstration and Training.
- B. Section 01 91 00 - General Commissioning Requirements.
- C. Section 08 71 00 - Door Hardware: Nonspecialized door hardware.
- D. Section 09 29 00 - Gypsum Board : For conventional enclosure construction.
- E. Section 23 00 00 - UTSW Mechanical Design Requirements.
- F. Section 23 08 00 - Commissioning of HVAC Systems.
- G. Section 26 05 19 - Building Wire Cable and Connectors (600V and Below).
- H. Section 26 08 00 - Commissioning of Electrical Systems.
- I. Section 26 27 26 - Wiring Devices and Floor Boxes.
- J. Section 26 51 00 - Interior Lighting: Cleanroom luminaires.
- K. Section 28 13 00 - Access Control System: Connection to access control system.

1.4 REFERENCE STANDARDS

- A. Comply with all applicable trade standards, ordinances, building codes and regulations and all standards and references noted herein.
- B. NFPA 70 - National Electrical Code.
- C. NSF 7 - Commercial Refrigerators and Freezers.
- D. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005.
- E. UL Label- Underwriter's laboratories Label of Approval for all components including wall panels.
- F. Texas Accessibility Standards (TAS).
- G. ADA Standards.
- H. NEC Article 310, Article 430 – National Electric Code.
- I. NFPA 70 - National Electric Code.
- J. NSF 7 - Commercial Refrigerators and Freezers.

1.5 SYSTEM DESCRIPTION

- A. Furnish and install laboratory controlled environmental room complete with all necessary equipment, controls, accessories, and hardware; and coordinate lighting and power with Division 23 and 26 to ensure a complete installation to perform intended function as specified herein, and as shown on the Drawings.
- B. Work includes installation of all piping, tubing, wiring and associated component materials necessary from controlled environmental rooms to compressors remotely located. Provide routing, chase, access and layout drawings and diagrams required to accomplish this Work. Seal all penetrations with a chemical resistant sealer and comply with requirements of the local Building and Fire Protection codes.

1.6 SUBMITTALS

- A. Product Data: Submit complete materials list, including catalog data, of all materials, equipment, and products specified in this Section.
- B. Shop Drawings:
 - 1. Submit complete shop fabrication and installation drawings, including plans, elevations, and sections at 1/4 inch scale minimum, details at 1/2 inch scale minimum, schedules, mechanical/electrical/plumbing requirements, and manufacturer installation requirements.

2. Show relationship to adjoining materials and construction including all required clearances for equipment and maintenance.
 3. Lighting: Furnish calculations indicating footcandle levels provided. Submittal shall include five plan photometric data for fixture to be furnished.
- C. Samples for Verification: Submit two samples of each type of specified finish and color range available.
 - D. Installer Qualification: Provide written certification from the manufacturer that installer is capable of meeting the quality and schedule criteria and is approved to install the product specified with a minimum of 5 years experience.
 - E. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.
 - F. Operation and Maintenance Manuals: Submit complete operation and maintenance manuals that describe proper operation procedures, maintenance and replacements schedules, components parts list, and closed factory representative for components.
 1. Operation and Maintenance Manuals shall be submitted digitally wherever possible.

1.7 QUALITY ASSURANCE

- A. Contractor Qualifications: Contractor is responsible for quality control of the Work.
- B. Manufacturer Qualifications: Manufacturer shall have a minimum of ten years documented experience and an established organization and production facilities including all tools, equipment and special machinery necessary for specializing in the fabrication and installation of the type of equipment specified, with skilled personnel, factory trained workers and an experienced engineering department. Each shall have the demonstrated knowledge, ability and the proven capability to produce the specified equipment of the required quality and the proven capacity to complete an installation of this size and type within the required time limits.
- C. Installer Qualifications: An installer trained in the use of the materials and equipment to be employed in the Work.
- D. 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.
- E. Single Source Responsibility: Provide products of same manufacturer for all Controlled Environmental Room equipment.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- G. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section, Project Coordination.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. General: Deliver materials in manufacturer's original packaging with label indicating pertinent information identifying the item. Store materials in accordance with manufacturer's instructions in a protected dry location off ground. Do not open packaging nor remove labels until time of installation.
- B. Protection: Maintain protective covers on equipment until installation is complete. Remove protective covers at final clean-up of installation.
- C. Use all means necessary to protect Work of this Section before, during and after installation including installed Work and materials of other trades.
- D. Replacement: Any damage shall be replaced, repaired and restored to original condition to the approval of the Architect at no additional cost or inconvenience to the Owner.

1.9 OPERATION AND MAINTENANCE DATA

- A. At the completion of the project, submit as-built operation and maintenance data under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements and Uniform General Conditions.
- B. Include manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.10 SEQUENCING AND COORDINATION

- A. Work of this Section requires close coordination with Work in Electrical and Mechanical Sections. Coordinate all Work to ensure an orderly progress in the Project, without removal of previously installed Work, and so as to prevent damage to finishes and products.

- B. Structural Coordination: Provide structural backing for all wall mounted laboratory furnishings and equipment shown on the Drawings.
- C. Mechanical Coordination: Ensure the following:
 - 1. Making openings for service penetrations to and from the Prefabricated Controlled Environmental Room.
 - 2. Providing all necessary piping and making final service connections to all equipment and service fittings inside the Prefabricated Controlled Environmental Room.
 - 3. Coordinate with other trades on avoiding obstructions or access to casework and/or equipment to be placed within Prefabricated Controlled Environmental Room.
 - 4. Coordinate with Division 23 to ensure that all required services are brought to within 5 feet of the Prefabricated Controlled Environmental Room.
 - 5. Properly sealing all service penetrations into the Prefabricated Controlled Environmental Room.
- D. Electrical Coordination: Ensure the following:
 - 1. Refer to the Electrical Drawings for the service voltage power feed, circuit breaker size and outlet type.
 - 2. Review the Electrical Drawings to verify that the electrical services are adequate and compatible with the Prefabricated Controlled Environmental Room. Provided all require electrical services.
 - 3. Provide control transformers in controller cabinets adequately sized for all control power for each control transformer shall be derived from the incoming main feeder conductors to each cabinet and shall be installed and pre-wired by the manufacturer for single point of connection in accordance with requirements of Division 26.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site, store and protect the products under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
- B. Protect components from physical damage by leaving factory packing cases in place before installation and providing temporary covers after installation.

1.12 WARRANTY

- A. General: Warranties shall be in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents. Provide written warranty, agreeing to replace/repair defective materials and workmanship. Warranty includes responsibility for removal and replacement of other work which may interfere with performing warranty work.
- B. Manufacturer's Warranty: In addition to warranty required under other Sections of the Specifications, the manufacturer shall provide a written warranty for each compressor for a period of five years, and the prefabricated panels for a period of fifteen years, from date of Substantial Completion.
 - 1. Mechanical refrigeration equipment, parts, and labor shall be warranted in written form for a period of one year from the date of Substantial Completion. The warranty shall guarantee that the Prefabricated Controlled Environmental Room will:
 - a. Maintain within the specified tolerance the selected temperature and humidity settings.
 - b. Be free from condensate on the outside of the chamber
 - c. Be free from defects due to faulty materials and workmanship.
 - 2. The insulated enclosure shall carry an additional nine-year warranty on material.
 - 3. The warranty shall not apply to equipment subjected to accidents, improper voltage, abuse or misuse.
 - 4. The manufacturer shall prominently place the name, address, and telephone number of installer/service agency to be contacted during warranty period on the equipment.

1.13 MAINTENANCE

- A. Provide a service contract proposal and warrant the equipment for a period of one year. The service contract shall provide emergency callback service, free of charge, on a 24-hour, 7-days a week basis during the warranty period. In addition, the manufacturer shall provide 8-hour emergency service and 24-hour non-emergency service by factory personnel or an authorized service center.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Operating Temperature: After Prefabricated Controlled Environmental Room has reached operating temperature door shall be fully opened to 75° Fahrenheit ambient for a period of one full minute, room shall recover to operating temperature within 5 minutes after closing door.
- B. Control Setpoint: Prefabricated room shall be designed to operate at ____ ° C temperature and _____ percent to _____ percent humidity. Control sensitivity is defined as the temperature measured at the point where the Controlled Environmental Room temperature control-sensing element is placed, at a given point in time. The control sensitivity is to be plus or minus 0.5° Centigrade within specified setpoint.
- C. Temperature Uniformity: Prefabricated room shall be designed to provide temperature uniformity of plus or minus 1° C. This is to be defined as an area on a horizontal plane 48 inches above the floor and within 24 inches of the walls at any point in the room. The uniformity is the variation between points across this plane as measured by a twelve-point strip chart recorder with the sensors evenly distributed and measured at a given point in time.
- D. Humidity Performance: Prefabricated Controlled Environmental Room shall be designed to provide a humidity variation of plus or minus 5 percent. This is to be defined as the total variation measured at the control-sensing element with a circular chart recorder. Controlled Environmental Room shall be factory set up and test run with a twelve point strip recorder for twenty four hours to ensure specified performance. Test results shall be forwarded to Owner.
- E. Design must meet ADA Standards and Texas Accessibility Standards (TAS) requirements for wheelchair access.

2.2 MANUFACTURERS

- A. Subject to compliance with requirements, as judged and approved by the Architect, provide Prefabricated Controlled Environmental Room by one of the following manufacturers:
 - 1. Norlake Scientific.
 - 2. Harris Environmental Systems.
 - 3. Kolpak.
- B. Substitutions: Under provisions of Section 01 25 00 - Substitution Procedures.

2.3 CONTROLLED ENVIRONMENTAL ROOM

- A. Assembly Description: Modular construction incorporating floor, wall and ceiling "sandwich panels". Panels shall consist of interior and exterior metal skins with a solid core of insulation. Panel shall incorporate an integral mechanical method of fastening and sealing the joints to provide a vapor tight seal. Construction shall allow disassembly for possible relocation or expansion at a later date.
 - 1. Controlled environmental room shall be complete with all necessary environmental conditioning controls, heating, refrigeration and air conditioning systems, lighting systems and all necessary mechanical and electrical components to provide the environmental conditions herein described and as indicated on the Drawings.
- B. Modular Panel Construction: Wall, ceiling and 2-inch floor panels shall be prefabricated modular construction consisting of 100 percent foamed-in-place polyurethane insulation 4-inch thick, bonded by an adhesive to the interior and the exterior metal pan skins and heat cured for life long stability. Each wall panel skin shall be formed using a double 90° bend on each edge to add strength and rigidity. Panels shall be in widths of 6-inch increments, with a minimum width of 6 inches and a maximum width of 48 inches.
 - 1. All panels are to bear the UL label.
 - 2. Panels shall incorporate cam lock type fasteners as joining devices for the adjacent tongue and groove panels. Each device is to consist of a cam action-locking arm and a steel rod in the adjoining panel so that by rotating the locking arm the hook engages over the rod and the cam action draws the panels together. The resulting panel joints shall be sealed by a foamed-in-place, continuous one-piece gasket.
 - 3. Panel joints are to be precisely formed male and female tongue and groove shapes fabricated to force the male edge to contact the female edge, providing additional seal.
 - 4. The panel edge shall have a gasket, which provides a positive seal that meets NSF standards. Gasket shall be "locked" to the skins and run in a continuous piece, completely around the panel with only one break to provide the optimal seal. Gasket is locked to the skins by being foamed-in-place as an integral part of the finished panel. The gasket is to fit completely around the double 90° bend on the edge of the panel skin.

5. Mechanical panel fasteners shall have wings, which provide the necessary strength to support the cam action of the locking mechanism when the panels are drawn together. Locks shall be factory oiled prior to assembly within panel. Access holes to the locking mechanism shall be cleared of foam and concealed with NSF listed synthetic plug buttons to provide a sanitary seal.
6. Insulation shall be 4-inch thick, UL Class 1 rigid foamed-in-place polyurethane with a 2.0 cubic foot density plus or minus 10 percent. Poured-in-place foam injection is not acceptable.
 - a. "K" factor shall be no more than 0.135 BTU per hour per square foot tested at -20°F mean core temperature, per inch thickness, per degree Fahrenheit of temperature difference.
 - b. Heat transfer "U" factor shall not exceed 0.033. The "R" value shall be a minimum of 30.00 tested at -20°F mean core temperature. Insulation shall be 95 percent closed cell structure.
 - c. Flame spread rating according to ASTM E-84/ UL 723 shall be 25 or less.
 - d. Polyurethane foam shall be expanded with HFC-134a. The use of an ozone depleting CFC or HCFC as a blowing agent is specifically prohibited.
7. Wall Panel Reinforcement: Shall be included where wall hung shelving and wall mounted casework is to be provided. Support shall be 3/4-inch thick APA rated plywood backing, permanently foamed within Prefabricated Controlled Environmental Room panel. Mounting wall shelving to insulated panel walls is prohibited.
8. Provide heavy-duty high temperature Santoprene gasket for all wall panels.
- C. Floor Panels: 2-inch thick with one-piece foamed-in-place edge caps. Floor panels shall be designed to withstand uniformly distributed loads of 600 pounds per square foot. The joint between the floor and wall shall form a 45° angle to allow for easy cleaning.
 1. Provide 1/8 inch aluminum diamond tread plate covering the complete interior floor.
 2. Ramps/Entrance: Interior Ramp: Shall be factory installed to match the width of accompanying door, and as follows:
 - a. Depth of ramp shall be 24 inches from inside door threshold.
 - b. Ramp construction shall include foamed-in-place, minimum 22-gauge type 304 stainless steel with heavy underlayment to support top wear surface.
 - c. Ramp surface shall include non-skid strips for safety.
 - d. Provide interior ramp as required.
- D. Ceiling Panels: 4-inch thick with one-piece foamed-in-place edge caps. Metal face skins shall incorporate seams using a double 90° bend at a maximum width of two feet for additional strength. The joint between the ceiling and wall shall form a 45° angle to allow for easy cleaning.
 1. Self supporting ceiling shall use galvanized hanger brackets which securely lock between ceiling panels and securely fasten to load bearing supports. System shall be designed to support the ceiling span.
- E. Finishes:
 1. Ceiling Topside: 26 gauge smooth galvanized steel.
 2. Floor underside: 26 gauge smooth galvanized steel.
 3. Interior Floor: Mill finish diamond-plate aluminum.
 4. Interior Walls and Ceilings: 26 gauge smooth galvanized steel with factory-applied white epoxy paint finish.
 5. Exposed Exterior Walls: 26 gauge embossed galvanized with aluminum coating.
 6. Unexposed Exterior Walls: 26 gauge embossed galvanized with aluminum coating.
- F. Door Construction: Entrance door shall be in-fitting, flush design with a minimum opening of 36 inches width by 78 inches height, mounted in a 48 inch wide panel.
 1. The door section shall provide a full 4 inches of polyurethane HFC-134a insulation, construction and finish shall be the same as the adjoining wall panels in accordance with manufacturer written requirements.
 2. Door shall be constructed to incorporate heavy-duty, molded ABS breaker strip, which is permanently foamed-in-place. Bottom of door shall seal with an adjustable double sweep gasket, uniquely designed to provide complete seal between door, threshold, and doorjamb.
 3. Door jamb to be a fully coved, extruded, welded, structural anodized aluminum, rigid frame design for easy cleaning and maintenance. Threshold plate provided shall be constructed of extruded aluminum for bearing strength.
 4. Provide anti-sweat heater wire around the entire perimeter of the door opening and under threshold. Heater wire shall provide enough heat to prevent condensation. Heater wire shall be

provided in an electrically safe housing and be easily replaceable without the need for clips or special tools. Control panel shall thermostatically control heater wire.

- a. Conduits for the inner wiring of the door panel shall be totally concealed in the polyurethane foam panel, exposed conduit is not acceptable.
5. Door section to be field wired to surface mounted light fixture base on the interior door panel.
 6. The complete door section shall be UL listed and so labeled.
- G. Door Hardware:
1. High-pressure die-cast zinc with a polished chrome finish. Hardware shall include a hydraulic piston driven door closer, cam lift hinges, and door handle assembly with bumpers and inside safety release.
 2. Door handle assembly shall include a deadbolt lock capable of being locked with a key and padlock. For added security the deadbolt mechanism of the assembly shall be mounted to the doorframe section securing the door if the handle is removed. All hardware shall be attached to extra large 1/2 inch thick, non-conducting synthetic tapping plates.
 - a. Non-Lift Door Hinges: Walk-in swing door shall be provided with hinges that are non-lift off and secured to the doors and frames with non-reversible screws. Provide three hinges per door leaf.
 - b. Door Closer/Pneumatic: Shall be installed on door section to positively close door. The door closer shall allow door to open more than 120 degrees and shall be equipped with hold open feature. Additional adjustments for closing speed and backcheck shall be standard.
 - c. Door Observation Window: Shall be 14 inches by 24 inches three-pane tempered SIGMA approved safety glass. Controlled Environmental Room shall have heated frames and heated glass.
 - d. A light tight removable window cover shall cover entire observation window and provide for easy installation or removal.
 - e. Provide special Santoprene high temperature door gaskets.
 - f. Kickplate: Minimum 16-gauge stainless steel, shall be factory installed to the interior and exterior of door and frame surface. Kickplate is to extend up a minimum of 36 inches from floor.
 - g. Strip Curtains (if required): Shall be supplied to match the width of accompanying door. Vinyl strips shall be 6 inches wide with a minimum thickness of 0.070 inch and be of a design to yield a minimum overlap dimension of 2 inches. Each vinyl strip curtain assembly will be 96 inches in length and be trimmed in the field to sweep on the finished floor surface.
 - h. Gasket: NSF approved, extruded polyvinyl chloride gasket shall have smooth surface on all sides with no place to harbor dirt or bacteria. Gasket shall be easily cleaned and replaceable for the entire perimeter of door.

2.4 EQUIPMENT

- A. Lighting: Rooms operating above freezing shall utilize 5000 deg K, 48 inch LED lights. Lamps and remote low temperature ballasts are to be mounted in vapor proof gasketed UL listed fixtures, designed for use in damp and wet locations.
1. Light fixtures shall be surface mounted on the ceiling and provided in sufficient quantity to maintain a light intensity of 100 foot candles average when measured 36 inches above floor.
 2. Locate light switch with pilot light adjacent to door with all inner wiring in concealed conduit inside the polyurethane foam of the door section and terminated at a surface mounted light fixture base on the interior door frame.
 3. All light fixtures shall operate on 115 VAC.
- B. Instruments and Control Systems:
1. Controller Manufacturer:
 - a. KE Controller.
 - b. Substitutions: Under provisions of Section 01 25 00 - Substitution Procedures with written approval from UTSW Utilities.
 2. General:
 - a. Control panel incorporating a key locked door with a smoked acrylic cover shall be required for viewing and protecting the controls from damage or unauthorized adjustments.

- b. Control panel shall be mounted onto the wall panel adjacent to the door, and shall comply to the Americans with Disabilities Act.
 - c. The conduit is to be stubbed to the ceiling topside and covered with matching trim closure.
 - d. All line voltage components including circuit breakers for lights, outlets, and unit coolers shall be located in a NEMA 1 line voltage enclosure directly above the controls.
3. Temperature Controller:
- a. To be a fully programmable microprocessor providing user interface through a liquid crystal alphanumeric display with 4 by 20 characters. Dials, toggle switches, calibration via setpoint and non-alphanumeric controls are not acceptable.
 - b. All set points are to be adjustable by the multi function interface keypad.
 - c. Interface shall be completely separate from the control board allowing all systems to continue to operate with the interface disconnected.
 - d. Control features are to include sensors with a repeatability of better than plus or minus 0.07°C.
 - e. Product and air temperature display selectable for Fahrenheit or Centigrade scale.
 - f. System mode indicator heating/cooling.
 - g. Controller must have high/low audible and visual alarms for both the product and air temperature, limits adjustable by the user with alarm silence feature.
 - h. Provide dry contacts for product alarm.
 - i. Power failure alarm.
 - j. Controller shall have user adjustable service prompts to provide working hour display for the mechanical devices indicating service times and maintenance information.
 - k. Controller shall include sensor failure alarms with user selectable system shutdown feature and a user password entry system.
 - l. System shall include expansion slots on control board for the ability to add at a later date the option of a real time clock, and serial communication interface with capabilities for operation or monitoring of the entire system via a host computer.
 - m. System shall have a minimum of 12 digital inputs, 6 analog inputs, 13 digital outputs and 2 analog outputs to allow for additional user selected operating devices.
 - n. Additional outputs provided specifically for Multi Compressor control.
 - o. The control panel is to operate on low voltage 24V VAC for user safety with 50 to 60 Hz capabilities.
4. For safety purposes, the controller shall shut off all power to the controlled Prefabricated Controlled Environmental Room whenever product alarm preset limits are exceeded.
5. Temperature Recorder:
- a. Shall be housed in main control panel case and have a 10 inch circular chart capable of recording seven days of operation with a minus 50 degrees Centigrade to plus 75 degrees Centigrade recording range.
 - b. Ambient temperature error shall be no more than 0.04 percent of span per degree Centigrade deviation from 25 degrees Centigrade.
 - c. Chart making shall be by means of a disposable felt tip pen. Input to the recorder shall be from a 100 ohm RTD sensor.
 - d. The sensor shall be immersed in a glycerin solution and the container secured to the interior wall of the Prefabricated Controlled Environmental Room.
 - e. Power input to the recorder shall be 115VAC / 60 Hertz provided by the NEMA 1 line voltage panel.
6. Monitoring:
- a. Provide alarms connected to Building Automation System (BAS).
 - 1) Independent temperature sensor mounted inside controlled environmental room shall be tied directly to BAS.
 - 2) Additional monitoring per project to be confirmed with OSBC.
- C. Environmental Conditioning Plenum:
- 1. A diffusion grating of high grade injection molded acrylic consisting of multiple open cells shall be provided below the Prefabricated Controlled Environmental Room ceiling panels in order to provide a positive pressure air plenum extending across the entire room ceiling.

2. All room lighting, air handling equipment consisting of evaporator coils, heaters, and drain pans are to be within this positive pressure plenum to allow light and conditioned air to be diffused uniformly into the room.
3. Bottom of diffusion grating shall be mounted not lower than 7 feet above Prefabricated Controlled Environmental Room Floor.

2.5 MECHANICAL SYSTEMS

A. Refrigeration System:

1. General: Refrigeration system shall be specifically designed, engineered and manufactured to achieve and maintain the scheduled room temperature requirements and performance. System shall include high/low pressure controls, receiver, sight glass, liquid line dryer, suction accumulator, vibration eliminators, expansion valves and other equipment required to achieve the performance specified.
 - a. All refrigeration systems to have 100 percent redundant backup systems.
 - 1) System to include condensing unit, evaporative coil(s), controller, and emergency power.
 - b. Provide automatic switchover to cycle between redundant refrigeration systems.
2. Provide R448A refrigerant or latest EPA approved product.
3. Condensing Units: Air-cooled; accessible hermetic compressor, designed for industrial use. Condensing unit shall be factory assembled and UL listed. The condensing unit shall be mounted remotely outdoors or within mechanical room (preferred). Compressor is to be mounted in a rack with hood and any equipment necessary to perform in the ambient conditions of its specified location. Outdoor units shall have all weather hoods, crankcase heaters and head pressure controls.

B. The Evaporator Coil: Copper tube aluminum fin design having 6 fins per inch. Evaporators shall be UL listed and be forced air type designed for ceiling installation. Fan motors, guards, multi-fin and tube-type coil shall be housed in heavy gauge aluminum housing. Unit shall have drain pan with suitable drain pipe connection. Evaporators for use at or below 0° Centigrade (32° Fahrenheit) shall use electric defrost and be time initiated and temperature terminated with built-in fail-safe. Rooms requiring heaters to maintain specified temperature shall have strip heaters mounted to unit cooler housing. Strip heaters shall have chrome steel sheath with large finned area for increased working temperatures and faster heat transfer. Final hookup to evaporator drains shall be provided in accordance with Division 23.

1. Continuous operation shall be incorporated by the use of hot gas by-pass to provide close control of room temperature. Compressor and matching evaporator shall be designed to operate continuously for longer life and greater efficiency.
2. Hot gas shall be controlled by a fully modulating three way electronic proportional valve. Proportional valve shall receive input from a programmable microprocessor control to vary capacity based on changes in load conditions. To prevent leaks the valve shall contain no moving parts other than a floating core. The use of solenoids, mechanical actuated proportional valves or valves with external valve stems are not acceptable.

C. Relative Humidity shall be induced by a highly efficient centrifugal atomizer with a system capacity of 3 lbs/hr., designed to provide rapid absorption and achieve 20 – 95 percent RH (plus or minus 5 percent).

2.6 ROOM SERVICES

A. Electrical and Plumbing Requirements:

1. General: All electrical components utilized for Controlled Environmental Room shall be UL listed or recognized with interior wiring practices in accordance with Underwriters Laboratories and the National Electrical Code. Conductors to conform to Article 310 of N.E.C. and all motors to conform to Article 440 of the N.E.C.
2. Plumbing: Controlled Environmental Room manufacturer shall provide all plumbing work inside the controlled environmental room. Final connection from controlled environmental room condensate drain connection to sink trap drain, or other drain outside the Room as shown on Drawings shall be in accordance with provisions of applicable Division 23 Sections. Coordinate work with other trades to avoid obstructions or access to casework and/or equipment to be placed within environmental chamber.
3. Final power service rough-ins to controlled environmental room components including power to the control panel, and install fused disconnect switches at remote condensing units shall be in accordance with applicable provisions of Division 26.

4. Final power service rough-ins to laboratory furniture and casework shall be in accordance with applicable provisions of Division 26.
5. Required water service and drain line provisions including all final hookups shall be in accordance with applicable provisions of Division 23.

2.7 ACCESSORIES

A. Electrical and Instrument Accessories:

1. Concealed through panel electrical: All panels requiring 115/60/1 electrical shall be provided with concealed through panel electrical. Panels shall be foamed with conduit concealed within the polyurethane and stubbed to junction box on the exterior ceiling ready for final connection.
2. Exposed conduit on the interior or exterior of the Controlled Environmental Room shall not be accepted.
3. Duplex Receptacles: Prefabricated Controlled Environmental Room shall have not less than five 115/60/1 weatherproof duplex receptacles. Receptacles are to be fully recessed in the wall panels with no exposed conduit. The conduit shall be concealed within the polyurethane and stubbed to the ceiling topside to a junction box.
4. Personnel Emergency Alarm: Provide each Prefabricated Controlled Environmental Room with reset type electronically powered personnel emergency alarm system, power shall be provided by the room electrical input. The system shall consist of a heavy-duty actuator with a red button marked, "EMERGENCY ALARM - PULL TO RESET."
 - a. The actuator shall be mounted on the interior wall of the room adjacent to the door jamb and 12 inches above the floor level.
 - b. The system shall have audible and visual alarms affixed to the front exterior of the room.
 - c. The audible alarm shall provide a high decibel level of sound output at a frequency distinct from room parameter alarms.
 - d. The visual alarm shall be prominently labeled "PERSONNEL EMERGENCY."
 - e. Alarm shall include a set of dry contacts for user hook-up to a remote alarm station.

B. Utility Penetration Ports: Provide 2 inch diameter polypropylene sleeves with threaded ends and caps for use with Argon, Nitrogen, DI water, H/CW, and CW eyewash. When not in use, ports shall be capped and sealed on interior and exterior opening.

C. Light Switch: Door Controlled Light Switch: Shall be factory installed and pre-wired through foamed-in place conduit to surface mounted light fixture base on the interior doorframe. Lights shall be wired to the door-controlled switch so as to turn the lights on when the door is opened.

D. Trim Strips and Closures Panels:

1. Trim Strips: Shall be of the same finish as the Prefabricated Controlled Environmental Room exterior to be provided and installed to fill the area between the building wall and the sides of the Room. All dimensions shall be verified by the Contractor.
2. Closure Panels: Shall be of the same finish as the Prefabricated Controlled Environmental Room exterior are to be provided and installed to fill the area between the building ceiling and the top of the Room. All dimensions shall be verified by the Contractor.
3. Closure panels are to be installed between top and bottom rails for easy removal.
4. Closure panels to include louvers as required providing maximum air interchange for equipment enclosed above Prefabricated Controlled Environmental Room.

E. Ventilation: Exhaust Fan shall be provided to provide 15 cfm per person working inside the Room (minimum of 30cfm) and is to include a fresh air inlet damper. The inlet damper is to be located on the return air side of the unit cooler. The exhaust fan shall be located across the Room from the inlet damper. Supply air shall come from ambient treated air and must pass through the room dehumidifier before entering the Room.

1. Coordinate with supply and exhaust air provisions of applicable Division 23 sections.

PART 3 EXECUTION

3.1 EXAMINATION

- #### A. Inspection: Prior to installation of controlled environmental room, carefully inspect the installed Work of all other trades and verify that all such Work is complete to the point where this installation may properly commence.

- B. Verify that Work can be installed in strict accordance with all pertinent codes and regulations, the original design, approved submittals, and manufacturer's recommendations.
- C. Do not proceed with installation until unsatisfactory conditions have been corrected.
- D. Discrepancies: In the event of discrepancy, immediately notify the Architect.

3.2 INSTALLATION

- A. General: Install room and systems in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.
- B. Install all panels, components, controls, systems and accessories necessary to provide complete functional assembly.
- C. Provide necessary vertical and horizontal closure panels and strips to enclose opening between Room and adjacent corridor, building partitions, and ceiling. Finish shall match room exterior.
- D. All service line penetrations into room shall be properly sealed with silicone sealant as specified in Section 07 92 00 - Joint Sealants.
- E. All panels shall be installed without distortion, properly aligned and flush.

3.3 FIELD QUALITY CONTROL

- A. Certification and Testing: Acceptance testing to be performed by the Controlled Environmental Room installer upon completion of the installation and shall consist of demonstration of sustained operation for 24 hours at minimum, maximum and one intermediate temperature condition. The recorder charts shall be provided to and retained by the Owner. Acceptance test shall be witnessed by manufacturer's factory representative and the Owner's designated representative.
 - 1. All piping shall be pressure leak tested and witnessed by the Owner.
 - 2. Start up shall require replacement of all filters prior to turning equipment over to Owner.
- B. Provide written certification from the manufacturer that Room performance complies with specified criteria; equipment is installed per applicable codes and standards, adjusted and ready for intended function.

3.4 CERTIFICATION AND TESTS

- A. Acceptance Test: These tests shall be made on the demonstration unit at the factory and on each individual room installed at the building project.
- B. These tests shall be conducted by a Factory Engineer in the presence of the A/E and Owner. The procedure shall be as follows:
 - 1. At the appointed time of the test, the room shall have had the temperature set and stabilized at the lowest values at which the room is to operate for a period of at least 12 hours.
 - 2. Rooms with a low operating limit of from +5 degrees C to 0 degrees C shall have been operating at its low value for 12 hours prior to this test.
 - 3. Rooms with a low operating limit of from 0 to -20 degrees C shall have been operating at its lowest value for 24 hours prior to this test.
 - 4. The reviewing personnel shall have the opportunity to visually inspect the physical features of the room and its attendant equipment.
 - 5. All controls and recorders are to be in operation.
 - a. The recorder chart shall be a multi-channel strip chart type or Digital Data Logger, regardless of what is specified for the control panel.
 - 6. Defrost systems will utilize air or the hot-gas phase of the refrigerant to remove frost from the evaporator coils:
 - a. A programmable electronic timer shall control the interval and duration of the defrost system.
 - b. Automatic bypass of the defrost cycle shall be provided for use when rooms are operated above 8 degrees C.
 - c. Rooms operating from 0 degrees C to 8 degrees C shall defrost in a maximum time of 6 minutes of each 12 hours.
 - d. Room air temperature shall not rise more than 2 degrees C.
 - 7. Rooms operating from 0 degrees to -20 degrees C shall defrost in a maximum of 12 minutes of each 6 hours. Room air temperature shall not rise more than 8 degrees C.
 - 8. Rooms operating at 4 degrees C and above shall recover preset operating temperature, as defined by a thermocouple mounted mid chamber, within 5 minutes after door has been opened to 75 degrees F ambient for a period of one full minute.

9. Rooms operating at 3 degrees C and below shall recover preset operating temperature within 7 minutes after door has been opened to highest operating temperature of the adjoining room.
 10. This test shall be run only at the lowest temperature setting the room is to operate at
 11. Set temperature at intermediate values and verify this condition can be held for two hours
 - a. After stabilization, the chamber shall meet the temperature and uniformity performance requirements.
 12. Set temperature at upper operating limits and verify this condition can be held for two hours.
 - a. After stabilization, the chamber shall meet the temperature and uniformity performance requirements of paragraph.
 13. During the above test the following shall be demonstrated:
 - a. Safety limit controls.
 - b. Alarm signals.
 - c. Indicator lights.
 14. An NIST Certified Thermometer, or approved equivalent will be used to verify the accuracy of the temperature indicator on the room control panel.
 - a. The certified thermometer must have current certification at the ranges being monitored.
 - 1) This will be done in the presence of the A/E and Owner's representative.
- C. A multiple point potentiometric strip chart recorder shall provide six temperature readings at six different locations within the control zone throughout the test.
1. Recorder thermocouples shall be calibrated at the beginning and end of test.
 2. A digital data logger may be used to record the test conditions if approved the A/E or Owner's representative.
 3. Test results shall be summarized and witnessed by a Factory Representative and the Owner's Representative with a copy provided for each.
 4. The test equipment recorder, and NIST Certified Standard shall be furnished by the Environmental Room Manufacturer.
- D. Acceptance: Shall be provided on completion of satisfactory acceptance test as witnessed by Owner's Representative and Factory personnel of both the factory test and the as-installed test at the site. At the site, the room operation will become the Owner's responsibility, and the warranty period initiation will coincide with the site acceptance.
- 3.5 CLEANING
- A. At the end of each work day, remove unused materials, debris and containers from the site.
- 3.6 DEMONSTRATION AND TRAINING
- A. General: Manufacturer's Representative shall provide a demonstration for designated Owner's Representative to inform them of proper Environmental Room operation and maintenance. Provide video recording of demonstration to Owner and provide training requirements per Section 01 79 00 - Demonstration and Training.
1. Services of a factory-trained representative shall be made available for one man-day minimum to tune controls and to instruct the Owner on proper use and care of the Room.
 2. In Service Seminars: The manufacturer shall have available factory-instructed service seminars on this type of equipment to assure the maintenance staff's familiarity and competence with all operation and maintenance functions to allow self-directed maintenance if desired.
- 3.7 PROTECTION
- A. Protect the Work so it will not deteriorate or be damaged. Remove protection at time of Substantial Completion.

END OF SECTION 13 21 01



DIVISION 21

FIRE SUPPRESSION



SECTION 21 08 00

COMMISSIONING OF FIRE PROTECTION SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Commissioning process requirements for Fire Protection systems, assemblies, controls, and equipment.
- B. This project will have selected building systems commissioned.

1.3 RELATED REQUIREMENTS

- A. Section 23 08 00 - Commissioning of HVAC Systems.
- B. Section 26 08 00 - Commissioning of Electrical Systems.
- C. Section 28 08 00 - Commissioning of Fire Alarm Systems.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 SUBMITTALS

- A. Certificate of Readiness, signed by the Contractor, certifying that systems, assemblies, equipment, components, and associated controls are ready for testing.
- B. Manufacturer's completed start-up reports for equipment and systems.
- C. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.6 CONTRACTOR'S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend commissioning meetings.
- C. Provide information requested by the CxA for functional testing and for final commissioning documentation.
- D. 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.
- E. Functional testing of systems will be carried out solely by contractor's personnel, under the direction of CxA. Provide experienced personnel, familiar with the systems being installed under this project.

1.7 CXA'S RESPONSIBILITIES

- A. CxA will direct commissioning testing.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 GENERAL TESTING REQUIREMENTS

- A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in Division 21 Sections. Provide submittals, test data, inspector record, and certification to the CxA.
- B. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- 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.

3.2 SYSTEM START-UP

- A. Contractor is solely responsible for system start-up.

- B. CxA may, at their discretion, witness start up procedures, but will not perform any Functional Testing of systems until Contractor has completed start-up and resolved all operating deficiencies, and has so certified.

3.3 TESTING PREPARATION

- A. Certify that Fire Protection systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that testing, adjusting, and balancing procedures for Fire Protection systems have been completed and submitted, discrepancies corrected, and corrective work approved.
- C. Set 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).
- D. Inspect and verify the position of each device and interlock identified on checklists.
- E. Check safety cutouts, alarms, and interlocks with life-safety systems during each mode of operation.

3.4 DEFERRED TESTING

- A. Initial commissioning will be done as soon as contract work is completed, though building may not be at full occupancy and equipment may not be at full loading.

3.5 DOCUMENTATION REQUIRED AT COMMISSIONING

- A. State Fire Marshal documentation forms shall be provided at the completion of the testing and approval of the system to the Director of Fire and Occupational Safety (AHJ) or their designee. This includes the placement of all required service tags identifying the system has been properly inspected and approved by the AHJ.
- B. A minimum of two copies signed by the appropriately licensed employee of the vendor as defined in the Texas State Fire Marshal rules and regulations for licensing shall be provided at the time of the commissioning.
- C. Failure to provide the required paperwork to OSBC Fire Safety will result in the failure of the inspection. The contractor is required to provide all documentation to receive approval to use the system. System as-builts shall be provided to OSBC Fire Safety within 30 days of system approval.
- D. Delays in the use of the system due to inaccurate or inadequate paperwork shall solely be the responsibility of the contractor or general contractor. The AHJ will not be held liable nor responsible for fines, fees, penalties, or the forfeiture of benefits as stipulated in the project contract documents.

END OF SECTION 21 08 00

SECTION 21 13 13

AUTOMATIC FIRE SPRINKLER SYSTEMS

PART 1-GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Components required for the complete installation of automatic sprinkler systems as specified and indicated on the Drawings. Requirements for installation, review, and permitting for the following:
 - 1. Wet-pipe sprinkler system.
 - 2. Automatic Fire Sprinkler Systems

1.3 RELATED REQUIREMENTS

- A. Division 09 Painting Sections.
- B. Section 23 05 29 - Supports and Anchors.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
- C. ASME B16.3 - Malleable Iron Threaded Fittings, Class 150 and 300.
- D. ASME B16.4 - Cast Iron Threaded Fittings, Class 125 and 250.
- E. ASME B16.5 - Pipe Flanges and Flanged Fittings.
- F. ASME B16.9 - Factory-made Wrought Steel Butt welding Fittings.
- G. ASME B16.11 - Forged Steel Fittings, Socket-welding and Threaded.
- H. ASME B16.18 - Cast Copper Alloy Solder-Joint Pressure Fittings.
- I. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- J. ANSI/ASME B16.25 - Butt welding Ends.
- K. ASME B16.25 - Welded and Seamless Wrought Steel Pipe.
- L. ASME B16.34 - Valves - Flanged, Threaded and Welding End
- M. ASME BPVC-IX - Welding and Brazing Qualifications.
- N. ASTM A135/A135M - Electric-Resistance-Welded Steel Pipe.
- O. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.
- P. ASTM B32 - Solder Metal.
- Q. AWS A5.8/A5.8M - Brazing Filler Metal.
- R. AWWA C110/A21.10 - Ductile Iron and Gray Iron Fittings.
- S. AWWA C151/A21.51 - Ductile Iron Pipe, Centrifugally Cast.
- T. ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless.
- U. ASTM A234/A234M - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- V. ASTM A795/A795M - Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
- W. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings.
- X. ASTM B75/B75M - Seamless Copper Tube.
- Y. ASTM B88 - Seamless Copper Water Tube.
- Z. ASTM B251/B251M - General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
- AA. ASTM F438 - Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
- BB. ASTM F439 - Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- CC. ASTM F442/F442M - Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR).
- DD. ASTM F493 - Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.

- EE. AWS B2.1/B2.1M - Specifications for Qualification of Welding Procedures and Welders for Piping and Tubing.
- FF. NFPA 13 - Installation of Sprinkler Systems.
- GG. NFPA 14 - Standpipe and Hose Systems.
- HH. NFPA 24 - Installation of Private Fire Service Mains and Their Appurtenances
- II. NFPA 45 - Standard on Fire Protection for Laboratories Using Chemicals
- JJ. Texas State Fire Marshal - Notice 2016 and Government Code 417.008 - Signage requirements for FDC signage and wording.

1.5 SYSTEM DESCRIPTION

- A. System to provide adequate coverage for entire structure.
- B. Design system in accordance with the currently adopted edition of the National Fire Protection Association Standard for the Installation of Sprinkler Systems (NFPA 13), Standpipe and Hose System (NFPA 14), Standard for the Installation of Stationary Pumps for Fire Protection (NFPA 20) by the Texas State Fire Marshal.
 - 1. Any variation will require written approval from the Director of Fire and Occupational Safety (University Fire Marshal).
- C. Determine volume and pressure of incoming water supply from residual pressure water flow test. Water supply test shall be conducted within 1 year of system installation and noted of the fire sprinkler plans.
- D. Fire sprinkler system shall interface with the fire alarm system for the structure.
- E. Provide fire department connections as indicated. All hose threads, coupling types, etc., utilized in the fire protection systems shall conform to the standards and requirements of the local municipal fire department providing fire suppression services.
- F. Fire department signage of the FDC; painting and identification of piping
- G. In buildings that will not be heated and where fire protection systems will be exposed to freezing temperatures, temperature monitoring must be installed for a wet, dry-pipe, or pre-action fire sprinkler riser room to ensure the temperature does not drop below 40°F. These alarms should report to the Fireworks alarm monitoring system in a color other than yellow or orange.

1.6 SUBMITTALS

- A. Separate submittals are required by companies and/or individuals who are licensed by the Texas State Fire Marshal to install the following:
 - 1. Automatic Fire Sprinkler System
- B. Shop Drawings:
 - 1. Automatic Fire Sprinkler: At a minimum, all information referenced in NFPA 13 is necessary to approve the installation of a fire sprinkler system shall be provided.
 - 2. Shop Drawings shall be submitted and approved by Director of Fire and Occupational Safety (University Fire Marshal) or approved designee prior to fabrication.
 - a. Shop drawings shall include detailed plans of sprinkler systems to include but not be limited to all components necessary to properly install system in accordance with the applicable codes. Indicate and note all exterior drain locations coordinated with site conditions.
 - b. Shop Drawings shall become an integral part of these Specifications.
 - 3. Exterior test outlets and all drains shall drain only into landscape areas, not onto sidewalks. Sprinkler system piping shall be configured so that the drawings will not erode landscape or allow pooling of standing water on sidewalks or driveways.
 - 4. Where necessary, the test outlets or drains shall be connected to the appropriate underground wastewater removal system. A site glass shall be provided at a marked (convenient) location where the inspector can view water moving in accordance with the requirements of NFPA.
- C. Product Data: Provide data on all manufacturers' catalogue information for products used in the building. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- D. Submit Shop drawings, product data, and hydraulic calculations to the University of Texas Southwestern Medical Center Director of Fire and Occupational Safety (University Fire Marshal) or designee for review and approval. Information shall be directed through the assigned UT Southwestern Project Manager.
- E. Submit PDF electronic files of scanned record prints.
- F. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds requirements specified, and suggested by listed codes.

- G. Manufacturer`s Field Report: Indicate time of start-up of treatment systems and include analysis of system water after cleaning and treatment.
- H. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.7 QUALITY ASSURANCE

- A. Sprinkler Systems: Perform work to NFPA 13.
- B. Standpipe and Hose Systems: Perform to NFPA 14.
- C. Welding Materials and Procedures: Perform to ASME Code.
- D. Valves: Bear UL label or marking. Provide manufacturer`s name and pressure rating marked on valve body.
- E. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

- A. Installer: Company licensed to perform work in accordance with the requirements of the State of Texas Fire Marshal Sprinkler Certificate of Registration (SCR). Additionally, three successful years of working with organizations similar to UT Southwestern Medical Center is required.
- B. System shall be installed by a firm regularly engaged in the design and installation of automatic sprinkler systems in accordance with requirements of the National Fire Protection Association and licensed by the Texas State Fire Marshal as a Responsible Managing Employee- General (RME-G) licensed by the Texas State Fire Marshal or a Professional Engineer with experience in fire protection.
- C. Design sprinkler system under direct supervision of a Responsible Managing Employee- General (RME-G) licensed by the Texas State Fire Marshal or a Professional Engineer with experience in design of this work and licensed in the State of Texas. Design submittal documents and shop drawings shall bear the responsible parties signature or Professional Engineer`s Seal.

1.9 REGULATORY REQUIREMENTS

- A. Hydraulic Calculations, Product Data, and Shop Drawings: Products must be Underwriters Laboratory Listed (UL).

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and protect products on site under provisions of Division 01.

1.11 ATTIC STOCK

- A. Provide extra sprinkler heads as required (type and size) under provisions of NFPA 13.
- B. Provide suitable wrenches for each head type.
- C. Provide lockable metal sprinkler head storage cabinet in location designated.

PART 2 - PRODUCTS

2.1 SYSTEM LAYOUT

- A. Fire sprinkler areas, piping, head locations, etc. as indicated are for Contractor`s reference as areas to be protected and possible piping routes.
- B. If header or manifold sizes are given on the drawings, sizes given shall be minimum sizes installed.
- C. Actual number, spacing and location of heads. Size and routes of piping shall be provided in accordance with the applicable Specifications and Shop Drawings.
- D. Layouts, head spacing, coverage, etc., required by the referenced authorities and/or Architectural and Structural conditions shall be made without increase in cost to the Owner or the Architect/Engineer.
- E. Modifications to head spacing, pipe routes, etc. shall be closely coordinated with the work of all other trades.
- F. Fire Sprinkler Subcontractor shall be responsible for the design and installation of the fire sprinkler system as described and on the project drawings.

2.2 MATERIALS AND EQUIPMENT

- A. Materials and equipment used in the installation of the sprinkler system shall be listed as approved by the Underwriters` Laboratories, Inc., List of Inspected Fire Protection Equipment and Materials.
- B. Fire Protection Devices and Devices Involving Fire Hazard, shall be the latest design of the manufacturer.
- C. Piping, control valves, drain valves, fittings, etc. shall be as specified, utilizing welded, flanged, and threaded fittings only.

1. Roll-grooved couplings and mechanical fittings are also permitted and shall be manufactured by Victaulic.
2. Roll-grooved couplings and mechanical fittings shall be UL listed.
3. Cut-grooved couplings and mechanical fittings are not permitted.
4. Steel pipe shall be Schedule 40, 300 pound malleable iron, A120 Schedule 40 black steel pipe and fittings. If galvanized pipe or fittings are installed, the contractor shall be responsible to remove galvanized pipe or fittings and replace them with specified materials as soon as possible prior to further installation of the system.

2.3 SPRINKLER HEADS

- A. Unless otherwise specified or indicated on the Drawings, sprinkler heads shall be regular automatic closed type spray heads of the upright, pendant, or sidewall ordinary degree temperature rating type except that sprinkler heads to be installed in the vicinity of heating equipment and lights shall be of the temperature rating required for such locations by NFPA 13.
- B. Concealed sprinkler heads in offices, exam rooms, workrooms, and common areas are preferred to prevent the accumulation of dust.
- C. Locate heads in a symmetrical pattern related to ceiling features such as grid, beams, light fixtures, diffusers, etc. Where applicable, heads shall be located symmetrically with the ceiling grid, centered in two directions.
- D. Provide spare heads in the types and amounts as required by NFPA 13 and in accordance with The Joint Commission Life Safety and Environment of Care Standards LS.02.01.35.
- E. Heads shall be packed in a suitable wall mounted sprinkler cabinet and be representative of, and in proportion with the number of each type and temperature rating heads installed.
- F. In addition to spare heads, provide not less than one special sprinkler head wrench for each type of head.
- G. Locate cabinet where directed by the Director of Fire and Occupational Safety (University Fire Marshal) or assigned designee.
- H. Use sprinkler heads manufactured by Reliable Sprinkler Corp.

2.4 PIPING

- A. Installation of piping, fittings and valves shall be as specified in the System Components; NFPA 13, except where noted otherwise.
- B. Conceal piping in areas with finished ceilings.
- C. Piping shall be clean and free of dirt, oil, and other contaminants prior to and following installation.
- D. Provide O.S. & Y. valves as specified.
- E. Provide materials as specified.
- F. Use of piping bushings for any purpose is explicitly prohibited.
- G. Pipe used for fire protection standpipe systems and fire sprinkler systems shall be Schedule 40 black steel pipe.
- H. Piping with a diameter of 2 inches or less shall have threaded connections.
- I. Piping with a diameter of 2 -1/2 inches or more is permitted to have either rolled, threaded, or welded connections.
- J. Automatic fire sprinkler piping shall meet or exceed the applicable ASTM standards for Aboveground Pipe and Tube in accordance with the adopted version of NFPA 13: Standard for the Installation of Fire Sprinkler Systems.
- K. No pipe smaller than 4 inches nominal pipe size shall be used for such fire lines except for individual runout to one hose cabinet.
- L. 1-1/2 or 2-2/12 inch runout to cabinet shall have a maximum center line height of 60 inches.

2.5 PIPE PAINTING

- A. Piping shall be cleaned and free of dirt, oil, and other contaminants prior to and following installation.
- B. Exposed piping shall be painted Sherwin-Williams – Real Red SW 6868 or equivalent.
 1. If piping is located in high traffic areas, a variance for piping to be painted to match ceiling may be allowed by AHJ.
 2. If a variance is allowed, piping shall be labeled, "FIRE SPRINKLER" along with the directional arrow.
- C. Coordinate painting with Architect in accordance with Division 09 painting sections.

- D. Remove protective bags, tape, wrappings etc. visually examine equipment to ensure there is no paint applied to areas not intended.
 - 1. Clean overspray.
 - 2. Application of paint on items which prevent, damage, or alter proper operation of the device (gauges, sprinkler heads, fire alarm devices etc.) shall be removed and replaced with new device of same specification. Variations will require written approval of the Director of Fire and Occupational Safety (University Fire Marshal). For the identification of all piping.
 - E. Existing sprinkler piping in the areas that will be worked in shall be painted in accordance with this Section.
 - 1. "In the area" is intended to mean any adjacent space where the sprinkler pipe is exposed and visible. If work is being done in a room, all unpainted sprinkler pipe in that room shall be brought up to specification. If work is being done on entire floor, any sprinkler pipe that is exposed, visible, and not painted shall be painted in accordance with this specification.
 - 2. "In the area" is intended to mean all parts of that room or floor in which work is being done and where the sprinkler pipe is visible. For example, if sprinkler work is being done in one area of the basement (not crawlspace), exposed, visible, and unpainted sprinkler pipe throughout the basement shall be painted.
- 2.6 WATER FLOW ALARM SWITCH
- A. Indicate location of flow switches on piping. Coordinate with fire alarm installation manufacturer.
- 2.7 STANDPIPES
- A. Locate fire hose standpipes in stairwell floor landing.
 - B. Standpipes shall be 2-1/2 inch Bass Hose Angle Valve with a National Standard Thread connection.
 - C. Calculate standpipes to meet minimum standards for flow and pressure at the top most remote outlets as prescribed in NFPA 14.
- 2.8 COMBINED SYSTEMS
- A. Combined Automatic Fire Sprinkler and Standpipe Systems in Buildings:
 - 1. Unless written approval by the Director of Fire and Occupational Safety/Fire Marshal or their designee, all buildings shall feature a combined automatic fire sprinkler and standpipe system.
 - 2. The system shall be automatic wet and designed in concrete with each other to provide the minimum flow (gallons per minute) and pressure (pounds per square inch) requirements as required by the State of Texas Fire Marshal currently adopted edition of NFPA 13 and NFPA 14.
 - 3. This shall be done using existing water system pressures or with the assistance of a UL listed fire pump installed within the building.
 - 4. External fire pumps (fire apparatus) are not permitted to provide the pressure necessary to meet requirements of the fire code.
- 2.9 ALARM VALVES
- A. Wet Valve: The alarm valves shall be Underwriters' Laboratories approved, connected to water supply and indicated on the Shop Drawings.
 - 1. Provide each alarm valve with a circuit closer.
 - 2. Valves shall conform to the equipment of National Fire Protection Association Standard for the Installation of Fire Sprinklers (NFPA 13), complete with retarding chamber and pressure switch.
 - B. Deluge Valve: Alarm valve shall be Underwriters' Laboratories approved.
 - 1. Valves shall conform to the equipment of NFPA 13, complete with retard chamber and pressure switch.
- 2.10 HYDRAULIC CALCULATIONS
- A. Provide hydraulic calculations for fire sprinkler and standpipe systems.
 - 1. Minimum residual safety pressure factor of 10 psi (pounds per square inch) is required for all hydraulic calculations.
- 2.11 TESTS
- A. Upon completion and prior to acceptance of the installation, the Contractor shall subject the system to the test procedures as described by National Fire Protection Association Standard for the Installation of Fire Sprinklers (NFPA 13), which shall be witnessed by the Director of Fire and Occupational Safety

(University Fire Marshal) or assigned designee. Where dry system or double interlock pre-action, additional air tests shall be required in accordance with NFPA 13.

2.12 FITTINGS

- A. Welding type steel fittings employed in fabricating fire protection system including fire sprinkler systems shall conform to ASTM A234/A234M.
 - 1. Threaded fittings shall be 300 pound malleable iron fittings.
 - 2. Grooved type fittings will not be accepted for use in standpipe only systems.
 - 3. Pipe size changes shall be performed through the use of reducing tees or reducers designed for that purpose.
 - 4. Use of bushings is explicitly prohibited.
- B. Threaded fittings shall be used when shown and shall be used from the point of connection of the pipe to the riser to each fire hose cabinet.
 - 1. Threaded fittings shall be Crane or Grinnell Company's 300 pound malleable iron fittings.
- C. Extra heavy "Thread-o-lets" shall be used at each point of departure from the riser to the fire hose or valve cabinet.
 - 1. Install "Thread-o-let" below the level of valve cabinet with minimum two (2) threaded ells to provide a swing joint connection from the riser to valve in the cabinet.
- D. Roll-grooved couplings and mechanical fittings are permitted and shall be manufactured by Victaulic.
 - 1. Roll-grooved couplings and mechanical fittings shall be UL listed.
 - 2. Cut-grooved couplings and mechanical fittings shall not be permitted.

2.13 VALVES

- A. Locate valves such that the removal of their bonnets is possible.
 - 1. Flanged valves shown in horizontal lines with the valve stem in a horizontal position.
 - 2. Screw pattern valves placed in horizontal lines shall be installed with their valve stems inclined at an angle of a minimum of 30 degrees above the horizontal position.
 - 3. Valves must be true and straight at the time the system is tested and inspected for final acceptance.
 - 4. Valves shall be installed as nearly as possible to the locations indicated in the Construction Drawings.
 - 5. Changes in valve location must be indicated on the Record Drawings.
 - 6. Provide threaded or flanged type valves.
 - 7. Solder connected fitting valves are not permitted.
 - 8. Bronze and iron body gate and globe valves shall be the product of one manufacture for each project.
 - a. Valves shall be from same manufacturer.
- B. Class 300 valves shall be constructed of all ASTM B61 composition.
 - 1. Gate, globe, and angle valves shall be union or screw-over-bonnet design.
 - 2. Metal used in the stems of bronze gate, globe and angle valves shall conform to ASTM B371 Alloy 694, ASTM B99 Alloy 651, or other corrosion resistant equivalents.
 - 3. Written approvals from Director of Fire and Occupational Safety (University Fire Marshal) must be secured for the use of alternative materials.
- C. Iron body valves shall have the pressure containing parts constructed of ASTM designated of 126 class B iron.
 - 1. Stem material shall meet ASME B16.1 Alloy 360 or ASTM B371/B371M Alloy 876 silicon bronze or its equivalent.
 - 2. Gates and globes shall be bolted bonnet with OS&Y (outside screw and yoke) and rising stem design.
 - 3. A lubrication fitting is preferred on yoke cap for maintenance lubrication of the yoke bushing.
- D. Cast steel body valves shall have the pressure containing parts constructed of ASTM designation A-216-GR-WCB carbon steel.
 - 1. Gate and globe valves shall be bolted bonnet outside and screw and yoke design with pressure-temperature rating conforming to ASME B16.34.
 - 2. Wedge (gate valves) may be solid or flexible type and shall meet ASTM A182/A182M F6 chromium stainless steel on valves from 2 to 6 inches.

- a. Sizes 8 inches and larger may be A-216-WCB with forged rings or overlay equal to ASTM A182/A182M -F6.
 - b. Seat ring shall be hard faced carbon steel or 13 percent chromium ASTM A182/A182M -F6 stainless.
 - c. Handwheels shall be A47 Grade 35018 malleable iron or Ductile Iron ASTM A536.
- E. Forged steel body valves shall have the pressure containing parts constructed of ASTM 105, Grade 2 forged carbon steel.
- 1. Seat and wedges shall meet ASTM A182/A182M F6 chromium stainless steel.
 - 2. Seat rings shall be hard faced. Valves shall conform to ASME B16.34 pressure-temperature rating.
- F. Valves shall be repackable, under pressure, with the valve in the full open position.
- 1. Gate valves, globe valves, angle valves and shutoff valves of every character shall have malleable iron hand wheels, except iron body valves 2-1/2 inches and larger which may have either malleable iron or ASTM A126 Class B, gray iron hand wheels.
- G. Packing for valves shall be free of asbestos fibers and selected for the pressure-temperature service of the valve.
- 1. It is incumbent upon the manufacturer to select the best quality, standard packing for the intended valve service.
 - 2. At the end of one year, period spot checks will be made, and should the packing show signs of hardening or causing stem corrosion then all valves supplied by the manufacturer shall be repacked by the Contractor, at no expense to the Owner, with a packing material selected by the Owner.
- H. Valves located with stem in horizontal position shall be drilled and tapped in accordance with MSS-SP-45 at Boss G to accommodate a drain valve.
- I. Gate Valves for Fire Protection Service:
- 1. 2 inch and smaller, bronze body, outside screw and yoke, rising stem, solid wedge, Underwriters` Laboratories Listed screw pattern. Iron body
 - 2. 2-1/2 inches and larger wedge, flanged pattern, OS&Y rising stem. Underwriters Laboratories Listed and Factory Mutual Approved.
 - 3. Butterfly valves UL listed with tapped full lug body and gear operated with malleable mop hand-wheel and position indicator may also be used.
- J. Check Valves Fire Protection System: Iron body, swing-check, bronze disc, seat ring and hinge pin, 175 psi rated working pressure, Underwriters` Laboratories approved. Provide complete with ball drip assembly.
- K. Standard of Quality for Valves:

(inches)			Milwaukee	Nibco	Stockham or as Noted
2 and Smaller	Gate Valve	Fire Protection		T-104-0	B-133
2-1/2 and Larger	Gate Valve	Fire Protection		F-607-0	
2 and Smaller	Check Valve	All Water Systems	510	T-433	B-345
2-1/2 and Larger	Check Valve	*Fire Protection		F-908-W	G-940
*Check valve requires ball drip assembly					
Note: For valves not listed, see Section 22 11 16.					

2.14 STRAINERS

- A. Strainers, 2 inch and smaller, bronze body, screwed ends, No. 10 mesh strainer, screwed cap with bronze blow-off valve (size to be determined by standard tap size in cap).
- B. Cast iron body, 2-1/2 inch and larger, isolating type flanged ends where installed in copper lines, No. 7 perforated monel strainer, flanged cap with bronze ball blow-off valve (size of blow-off valve shall be determined by standard tap size in cap).
- 1. Strainers 6 inches and larger shall have studs mounted in the body flange in lieu of bolts for removal of cap.
 - 2. Baskets for strainers 6 inches and larger shall have stainless steel reinforcing bands at ends to prevent collapsing.

- C. Suction diffusers shall be Paco or approved equivalent, cast iron body and cover, steel diffuser, and stainless steel strainer, 125 pound ASA (flat face) flange for a working pressure of 175 psi and temperature of 300°F.

2.15 UNIONS

- A. Provide and install unions at proper points to permit removal of pipe and various equipment and machinery items without injury to other parts of the system.
 - 1. Unions will not be required in welded lines or lines assembled with solder joint fittings except at equipment items, machinery items and other special pieces of apparatus.
 - 2. Unions in 2 inch and smaller in ferrous lines shall be Class 300 AAR malleable iron unions with iron to brass seats, and 2-1/2 inches and larger shall be ground flange unions.
 - 3. Unions in copper lines shall be Class 125 ground joint brass unions or Class 150 brass flanges if required by the mating item of equipment.
 - 4. Companion flanges on lines at various items of equipment, machines and pieces of apparatus shall serve as unions to permit removal of the particular items.
- B. Unions connecting ferrous pipe to copper or brass pipe shall be dielectric type equivalent to Epcoc.
- C. Use dielectric coupling at transition in domestic water lines where material of pipe is changed from ferrous to copper or brass.

2.16 WELDED PIPING

- A. General: Applies to piping systems providing for welded piping, fittings, and other appurtenances. Specific systems requiring welded piping include, but are not limited to: Chilled water, steam, steam condensate, and fire protection systems.
- B. Materials: Fittings and piping shall be USA factory made wrought carbon steel butt-welding fittings conforming to ASTM A234/A234M and ASME B16.9, latest edition, manufactured by one of the following:
 - 1. Weld Bend
 - 2. Tube Turn
 - 3. Hackney
 - 4. Ladish Company
- C. Each fitting shall be stamped as specified by ASME B16.9 and, in addition, shall have the laboratory control number metal stenciled on each fitting for ready reference as to physical properties required for any fittings selected at random.
 - 1. Only one manufacturer of weld fittings will be approved for the project.
 - 2. Fittings which have been machined, remarked, printed or otherwise produced domestically from nondomestic forgings or materials will not be acceptable.
 - 3. Fittings shall be manufactured in accordance with MSS SP-25.
 - 4. Place markings on fittings at the farthest point from the edge to be welded to prevent disfiguring from the welding process.
 - a. Submittal data for these fittings shall include a letter signed by an official of the manufacturing firm certifying compliance with these specifications.
- D. Execution
 - 1. Piping and fittings shall be welded and fabricated in accordance with ASME B31.1 for all systems, and ASME B31.3 for Steam and Condensate systems, from the Code for Pressure Piping. Machine beveling in shop is preferred. Field beveling may be done by flame cutting to recognized standards.
 - 2. Ensure complete penetration of deposited metal with base metal.
 - a. Provide filler metal suitable for use with base metal.
 - b. Keep inside of fittings free from globules of weld metal.
 - c. Welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process.
 - d. Pipe shall have the ends beveled 37-1/2 degrees and all joints shall be aligned true before welding. Except as specified otherwise, all changes in direction, intersection of lines, reduction in pipe size and the like shall be made with factory-fabricated welding fittings. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction will not be permitted.
 - 3. Align piping and equipment so that no part is offset more than 1/16 inch. Set all fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.

4. Do not permit any weld to project within the pipe so as to restrict it. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.
 5. Do not split, bend, flatten or otherwise damage piping before, during or after installation.
 6. Remove dirt, scale and other foreign matter from the inside of piping, by swabbing or flushing, prior to the connection of other piping sections, fittings, valves or equipment.
 7. In no case shall Schedule 40 pipe be welded with less than three passes including one stringer/root, one filler and one lacer.
 8. Schedule 80 pipe shall be welded with not less than four passes including one stringer/root, two filler and one lacer.
 9. In all cases, however, the weld must be filled before the cap weld is added.
- E. Testing
1. Welds are subject to inspection, visual and/or X-ray, for compliance with specifications.
 2. The owner will, at the owner's option, provide employees or employ a testing laboratory for the purposes of performing said inspections and/or X-ray testing.
 3. Initial visual and X-ray inspections will be provided by the owner.
 4. The contractor shall be responsible for all labor, material and travel expenses involved in the re-inspection and retesting of any welds found to be unacceptable.
 5. In addition, the contractor shall be responsible for the costs involved in any and all additional testing required or recommended by ASME B31.1 and ASME B31.3 due to the discovery of poor, unacceptable or rejected welds.
 6. Welds lacking penetration, containing excessive porosity or cracks, or are found to be unacceptable for any reason, must be removed and replaced with an original quality weld as specified herein. All qualifying tests, welding and stress relieving procedures shall, moreover, be in accord with Standard Qualification for Welding Procedures, Welders and Welding Operators, Appendix A, Section 6 of the Code, current edition.
- F. Materials shall be USA factory made wrought carbon steel butt welding fittings conforming to ASTM A234/A234M and ASME B16.9 as made by one of the following:
1. Grinnell
 2. Tube Turn
 3. Hackney
 4. Taylor Forge
 5. Ladish Company
- G. Each fitting shall be stamped as specified by ASME B16.9 and, in addition, shall have the laboratory control number metal stenciled on each fitting for ready reference as to physical properties and chemical composition of the material.
- H. Complete test reports may be required for any fittings selected at random. Only one manufacturer of weld fittings will be approved for each project.
- I. Fittings which have been machined, remarked, printed or otherwise produced domestically from imported forgings or materials will not be acceptable.
- J. Each fitting shall have the manufacturer's trademark permanently identified in accordance with MSS SP-25.
- K. Markings shall be placed on the fittings at the farthest point from the edge to be welded to prevent disfiguring from the welding process.
- L. Submittal data for these fittings shall include a letter signed by an official of the manufacturing firm certifying compliance with these Specifications.

2.17 FLANGES

- A. 150 lb. and 300 lb. ANSI flanges shall be weld neck and shall be domestically manufactured, forged carbon steel, conforming to ASTM A181/A181M Grade I or II or ASTM A105/A105M.
- B. Manufactured by one of the following:
 1. Tube Turn
 2. Hackney
 3. Ladish Company
 4. Slip on flanges shall not be used.

5. Each fitting shall be stamped as specified by ASME B16.9 and in addition, shall have the laboratory control number stenciled on each fitting for ready reference as to physical properties and chemical composition of the material.
 6. Complete test reports may be required for any fitting selected at random. Flanges which have been machined, remarked, painted or otherwise produced domestically from imported forges will not be acceptable.
 7. Flanges shall have the manufacturer's trademark permanently identified in accordance with MSS SP-25.
 8. Submit data for firm certifying compliance with these Specifications.
 9. Bolts used shall be carbon steel bolts with semi-finished hexagon nuts of American Standard Heavy dimensions.
 10. Allthread rods will not be an acceptable for flange bolts.
 11. Bolts shall have a tensile strength of 60,000 psi and an elastic limit of 30,000 psi.
 12. Flat faced flanges shall be furnished where required to match flanges on check valves, strainers, etc.
 13. Only one manufacturer of weld flanges will be approved for each project.
- C. Flanges shall be gasketed. Contractor shall place gasket between flanges of flanged joints.
1. Gaskets shall fit within the bolt circle on raised face flanges and shall be full face on flat face flanges.
 2. Gaskets shall be cut from 1/16 inch thick, non metallic, non asbestos gasket material suitable for operating temperatures from -150°F to +750°F, Klingenseal C-4400, Manville Style 60 service sheet packing, or equivalent.

2.18 WALL, FLOOR AND CEILING PLATES

- A. Except as otherwise noted, provide C.P. (Chrome plated) brass floor and ceiling plates around all pipes, conduits, etc., passing exposed through walls, floors, or ceilings, in any spaces accept underfloor and attic spaces.
- B. Size plates to fit snugly against the outside of the pipe or against the insulation on lines which are insulated and positively secured to such pipe or insulation.
- C. Plates will not be required for piping where pipe sleeves extend 3/4 inch above finished floor.
- D. Equipment rooms are classified as finished areas.
- E. Round and rectangular ducts shall have closure plates (NOT chrome plated) made to fit accurately at all floor, wall and ceiling penetrations.

2.19 SLEEVES, INSERTS, AND FASTENINGS

- A. General: Openings through floors, walls, and roofs, etc., regardless of material for the passage of piping, ductwork, conduit, cable trays, etc., shall be sleeved.
- B. Penetrations must pass through sleeves except soil pipe installed under concrete slabs on fill.
- C. Set sleeves in new construction before concrete is poured. Cutting holes through any part of the concrete will not be permitted unless acceptable to the Architect/Engineer. If a penetration is cored into an existing concrete, masonry or stone structure, then the installation of a sleeve will not be necessary.
- D. Minimum clearance between horizontal penetrations including insulation where applicable, and sleeve shall be 1/4 inch, except that the minimum clearance shall accommodate a Thunderline Link-seal closure where piping exits the building, or penetrates a wall below ground level.
 1. Contractor shall be responsible for the accurate location of penetrations in the slab for his pipe, duct, etc.
 2. Penetrations shall be of ample size to accommodate the pipe, duct, etc. plus any specified insulation.
 3. Sleeve materials shall be rigid metal of adequate strength.
 4. Void between sleeve and pipe shall be filled with Nelson Flameseal Firestop or approved equal caulk or putty.
- E. Installation of sleeves in walls shall be the same as for floors. Refer to the details on the project drawings.
- F. Sleeves for penetrations passing through walls or floors on or below grade shall be removed, if practical, and after the pipes have been installed, the void space around the pipe shall be caulked with a suitable material to effect a waterproof penetration or fire rated material depending on wall type.

1. Note that the practicality of the removal of the sleeve shall be the decision of the Construction Inspector.
 2. The decision of the Inspector shall be final.
- G. Inserts: Suitable concrete inserts for pipe and equipment hangers shall be set and properly located for all pipe and equipment to be suspended from concrete construction. If the inserts are later found not to be in the proper location for the placement of hangers, then drilled anchors shall be installed. Drilled anchors in concrete or masonry shall be submitted for the approval by the Owner.
- H. Fasteners: Fastening of pipes, conduits, etc., in the building shall be as follows:
1. Wood members - by wood screws; to masonry - by threaded metal inserts, metal expansion screws, or toggle bolts, whichever is appropriate for the particular type of masonry; to steel - machine screws or welding (when specifically permitted or directed), or bolts, and to concrete by suitable inserts anchored to reinforcing steel, and poured in place unless other means are indicated on the plans.
 2. Power-actuated fasteners (shooting) will not be acceptable under any circumstances. If it is necessary to install a method of fastening a hanger after the structure has been installed, then only clamps or drilled anchors shall be used.
 3. Plastic anchors and expansion shields are not allowed.
- I. Rat-proofing: Open space around all ductwork, piping, etc., passing through the ground floor and/or exterior walls shall be rat-proofed in a manner acceptable to the Architect/Engineer and Building Maintenance and Operations representative.
- J. Weatherproofing: Annular space between a pipe and its sleeve in exterior walls or through floor to below grade shall be filled with polyurethane foam rods 50 percent greater in diameter than the space as backing and fill material and made watertight with a permanent elastic polysulfide compound. Seal both surfaces of wall or floor.
- K. Air Plenums: Space around piping, ductwork, etc., passing through air plenums shall be made airtight in a manner acceptable to the Architect/Engineer.
- L. Fireproofing:
1. Each fire protection, mechanical and electrical contractor shall seal all cable trays, pipe, conduit, duct, etc., penetrations through roof, fire rated walls and floors with a foam or sealant as described below that will form a watertight, vermin-tight barrier that is capable of containing smoke and fire up to 2000 degrees F for two hours.
 2. Sealing of cable trays and conduits that extend through rated walls from ends of cable tray shall be done after conductors have been installed.
 - a. Wet Locations: Foam material shall be a silicone RTV foam or an approved equal.
 - b. Dry Locations: Premixed putty equal to Nelson Flameseal Firestop putty may be used.

2.20 FOUNDATIONS, HANGERS, AND SUPPORTS

- A. General: Special foundations and supports, hangers, anchors, and guides required for the proper installation of equipment and pipe shall be provided as hereinafter specified, unless otherwise indicated on the Drawings.
- B. Concrete foundations for the support of equipment such as floor mounted panels, pumps, etc., shall not be less than 6 inch high and extend 4 inch on all sides beyond the limits of the mounted equipment unless otherwise noted and shall be poured in forms built of new-dressed lumber.
1. Corners of the foundations shall be neatly chamfered by means of sheet metal or triangular wood strips nailed to the form.
 2. Foundation bolts shall be placed in the forms when the concrete is poured, the bolts being correctly located by means of templates.
 3. Each bolt shall be set in a sleeve of size to provide 1/2 inch clearance around bolt.
 4. Allow 1 inch below the equipment bases for alignment and grouting.
 - a. After grouting, the forms shall be removed and the surface of the foundations shall be hand rubbed with Carborundum.
 5. Foundations for equipment located on the exterior of the building shall be provided as indicated.
 - a. Foundations shall be constructed in accordance with Shop Drawings submitted by the Contractor for review by the Architect.
- C. Pipe Supports, Hangers, Anchors, and Guides:

1. Supports, hangers, anchors and guides shall be provided for all horizontal and vertical piping. Shop Drawings shall be provided, indicating locations and details of anchors, guides, expansion loops and joints, hangers, etc. The hanger design shall conform to the ASME Code for Pressure Piping.
2. Auxiliary steel required for pipe supports, anchors, guides, etc. shall be provided by the Mechanical Trades unless specifically indicated to be provided by others.
3. Contractor shall review all Drawings, including Structural Drawings, for details regarding pipe supports, anchors, hangers, and guides.
4. All pipe supports shall be of type and arrangement to prevent excessive deflection, to avoid excessive bending stresses between supports, and to eliminate transmission of vibration.
5. Rod sizes indicated are minimum sizes. This trade shall be responsible for structural integrity of all supports, anchors, guides, etc. Structural hanging materials shall have a safety factor of 5 built in.
6. Anchor points as indicated on Drawings or as required shall be located and constructed to permit the piping system to take up its expansion and contraction freely in opposite directions away from the anchored points.
7. Guide points shall be located and constructed wherever required or indicated on Drawings and at each side of an expansion joint or loop, to permit free axial movement only.
8. Pipe supports, hangers, anchors, and guides shall be fastened to the structure only at such points where the structure is capable of restraining the forces in the piping system.

D. Pipe Hangers:

1. Hangers supporting and contacting brass or copper lines 3 inch in size and smaller shall be Grinnell Fig. CT-65 carbon steel clevis type hanger with a copper finish. Hangers supporting and contacting brass or copper lines 4 inch and larger shall be Grinnell Fig. 260 with high density rubber tape wrapped around the pipe for protection. Isolate all copper or brass lines from ferrous metals with approved dielectric materials.
2. Hangers supporting insulated lines where the outside diameter of the insulation is the equivalent of 8 inch dia. pipe or smaller in size and supporting all ferrous lines 6 inch and smaller in size shall be clevis type hangers.
3. Hangers supporting and contacting lines larger than 6 inch in size and outside of insulation on lines with the outside dia. equivalent to 10 inch dia. pipe shall be Grinnell Fig. 260, clevis hangers with two nuts on each support rod.
4. Other special type of hangers may be employed where so specified or indicated on the Drawings, or where required by the particular conditions. In any case, all hangers must be acceptable to the Engineer.
5. Each hanger shall be properly sized to fit the supported pipe or fit the outside of the insulation on lines where specified. Hangers for dual or low temperature insulation pipes shall bear on the outside of the insulation, which shall be protected by support shields as specified.
6. Protect insulation from crushing by means of a section of rigid insulation to be installed at hanger points.
7. Hangers for insulated pipes shall be encased in the insulation unless supported by trapezes in which case shield and rigid insulation shall be provided as specified above for low temperature insulated pipes.
8. Hanger Rods:

Pipe Sizes (inches)	Rod Diameter (inches)
4 and smaller	3/8
5 thru 8	1/2
10 and 12	5/8
14 and larger	3/4 or as necessary

9. Supports for vertical piping shall be as manufactured by: Grinnell, or other approved equal, with each end having equal bearing on the building structure, and located at each floor. Note that two-bolt riser clamps installed at the floor in exposed stairwells are not acceptable. Where brass or copper lines are supported on trapeze hangers or Kindorf channels the pipes shall be isolated from these supports with plastic tape with insulating qualities, or strut clamps as manufactured by specialty Products Company, Stanton, California, or equal.
10. Hangers shall be attached to the structure in a manner to support the minimum weight requirements of Standard for the Installation of Fire Sprinklers (NFPA 13).

- E. Perforated strap iron or wire will not, under any circumstances, be acceptable as hanger material.
- F. Vibration Isolation: Resilient hangers shall be provided on all piping connected to rotating equipment (pumps, etc.). Piping that may vibrate and create an audible noise shall also be isolated. Spring hangers or supports shall be provided where indicated and/or specified.
- G. Attachment:
 - 1. Load and spacing on each hanger and/or insert shall not exceed the safe allowable load for any component of the support system, including the concrete which holds the inserts.
 - a. Reinforcement at inserts shall be provided as required to develop the strength required.
 - 2. Inserts for piping shall be of a type which will not interfere with reinforcing as shown on the structural Drawings and which will not displace excessive amounts of structural concrete.
 - 3. Pipe supports shall be designed and installed to avoid interference with other piping, hangers, ducts, electrical conduit, supports, building structures, equipment, etc.
 - a. All piping shall be installed with due regard to expansion and contraction and the type of hanger method of support, location of support, etc. shall be governed in part by this Specification.
 - 4. Pipe hangers shall be attached to the structure as follows:
 - a. Poured In Place Concrete:
 - 1) Where pipes and equipment are supported under poured in place concrete construction, each hanger rod shall be fitted with a nut at its upper end, which nut shall be set into an Underwriters` Laboratories, Inc. listed universal concrete insert placed in the form work before concrete is poured.
 - 2) Where inserts are placed in the bottom faces of concrete joists which are too narrow to provide adequate strength of concrete to hold the insert properly or where a larger insert would require displacement of the bottom joist steel, the hanger rod shall be suspended from the center of a horizontal angle iron, channel iron, I-beam, etc. spanning across two adjacent joists.
 - 3) The horizontal support shall be bolted to non-adjustable concrete inserts of the "spot" type, of physical size small enough to avoid the bottom joist steel.
 - b. Steel Bar Joists:
 - 1) Where pipes and loads are supported under bar joists, hanger rods may be run through the space between the bottom angles and secured with a washer and two nuts.
 - 2) Where larger lines are supported beneath bar joists, hanger rods shall be secured to angle irons of adequate size; each angle shall span across two or more joists as required to distribute the weight properly and shall be welded to the joists or otherwise permanently fixed thereto.
 - c. Steel Beams: Where pipes and loads are supported under steel beams, approved type beam clamps shall be used.
 - d. Wood Framing: Where pipes and loads are supported from wood framing, hanger rods shall be attached to framing with side beam brackets or angle clips.
 - e. Pre-Cast Tee Structural Concrete:
 - 1) Hanger supports, anchors, etc. required for mechanical systems attached to the precast, double tee, and structural concrete system are to be installed in accord with approved shop Drawings only.
 - 2) Holes required for hanger rods shall be core drilled in the "flange" of the double tee only; impact type tools are not allowed under any circumstances.
 - 3) Core drilling in the "stem" portions of the double tee is not allowed. Holes core drilled through the "flange" for hanger rods shall be no greater than 1/4 inch larger than the diameter of the hanger rod.
 - 4) Hanger rods shall be supported by means of bearing plates of size and shape acceptable to the Architect, with welded double nuts on the hanger rod above the bearing plate.
 - 5) Cinch anchors, lead shields, expansion bolts, and studs driven by explosion charges are not allowed under any circumstances in the lower 15 inch of each stem and in the "shadow" of the stem on the top side of the "double tees".
- H. Hanger spacing shall be in accordance with Standard for the Installation of Fire Sprinklers (NFPA 13).
- I. Trapezes:

1. Where multiple lines are run horizontally at the same elevation and grade, they may be supported on trapezes of Kindorf, Elcen, or approved equal, channel-suspended on rods or pipes.
 2. Trapeze members including suspension rods shall each be properly sized for the number, size, and loaded weight of the lines they are to support.
- J. Finishes:
1. Hangers on piping including clevis hangers, rods, inserts, clamps, stanchions, and brackets, shall be dipped in Zinc Chromate Primer before installation.
 2. Rods shall be galvanized or cadmium plated after threading, in lieu of dipping in zinc chromate primer.
 3. Universal concrete inserts shall be cadmium plated.

2.21 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 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 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.
- E. ALUMINUM FINISHES
 1. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

2.22 MARKING OF VALVES, SUPPLY MAINS, AND PIPING OF CONCEALED PIPING

- A. Supply Piping shall have a red label with 1 inch white letters a minimum of size of 7 by 1-1/2 inches (Bold Face Font: Calibri or equivalent) permanently affixed to all of the incoming supply piping indicating the building designation, "FIRE PROTECTION WATER", and the direction of flow.
 1. Provide label within 10 feet of all fire sprinkler risers and every 30 feet.
 2. Locate labels immediately where the piping comes out of the ground inside the building.
- B. Mains and Branch lines shall have a red label with 1 inch white letters a minimum size of 7 by 1-1/2 inches (Bold Face Font: Calibri or equivalent) permanently affixed along the piping every 20 feet.
 1. Label shall indicate the two letter building designation and "FIRE PROTECTION WATER."
- C. Risers:
 1. Hydraulic information as required by NFPA 13 shall be permanently affixed to the piping direction over the alarm valve or clapper valve.
 2. Provide red label with 1 inch white letters a minimum of size of 7 by 1-1/2 inches (Bold Face Font: Calibri or equivalent) shall also be permanently affixed to the piping indicating which building designation, "FIRE PROTECTION WATER", and area being feed by the system.
- D. Floor Control or Isolation Valves:
 1. Provide red label with 1 inch white letters a minimum of size of 7 by 1-1/2 inches (Bold Face Font: Calibri or equivalent) shall be permanently affixed to the piping at the valve indicating the building designation, "FIRE PROTECTION WATER," and area being feed by the system.
- E. Drains:
 1. Red label with 1 inch white letters a minimum of size of 7 by 1-1/2 inches (Bold Face Font: Calibri or equivalent) shall be permanently affixed to all drain piping. The label shall indicate building designation, and "DRAIN". The label shall be located every 20 feet or as necessary to clearly indicate the pipe.
- F. Apply labels in a manner that they can be read from the ground without the assistance of a ladder.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate work of this Section with other affected work.

3.2 INSTALLATION, GENERAL

- A. Install equipment in accordance with manufacturer's written instructions.
- B. Provide double check valve assembly at sprinkler system water source connection.

- C. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent Siamese connectors to allow full swing of fire department wrench handle.
- D. Place pipe runs to minimize obstructions with other work.
- E. Place piping in concealed spaces above finished ceilings.
- F. Center heads in two directions in ceiling tile and provide piping offsets as required.
- G. Apply paper cover to ensure concealed sprinkler head and cover plates do not receive field paint finish.
- H. Install and connect fire pumps in accordance with NFPA 20.
- I. Flush entire piping system of foreign matter.
- J. Hydrostatically test entire system at 150 percent of charge or working pressure, whichever is greater.
- K. Require test be witnessed by the UT Southwestern Medical Center Director of Fire and Occupational Safety (University Fire Marshal) or designee

3.3 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.4 INSTALLATION

- A. Install piping in accordance with NFPA 13 for sprinkler systems, NFPA 14 for standpipe and hose systems, and NFPA 13 for service mains. Note that the piping sizes indicated in the plans are the minimum acceptable. The Qualified Contractor shall provide proper sizes, materials and installation as required in the appropriate NFPA Standard.
- B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- C. Install piping to conserve building space, and not interfere with use of space and other work.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- G. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- H. Do not penetrate building structural members unless indicated.
- I. Provide sleeves when penetrating footings, floors, and walls. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required. Refer to Section 23 05 29 - Supports and Anchors.
- J. Die cut screw joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.
- K. Install valves with stems upright or horizontal, not inverted. Remove protective coatings after installation.
- L. Provide ball valves for shut-off or isolating service.
- M. Provide drain valves at main shut-off valves, low points of piping and apparatus.

3.5 GENERAL FABRICATION OF SPRINKLER SYSTEM

- A. For new construction, sprinkler systems shall be drained to the exterior of the building. In draining to the exterior:
 - 1. Resulting sprinkler drain water shall not cross or collect at any pedestrian or egress path.
 - 2. If there is no feasible capability to drain fire sprinkler water to exterior of building Architect or Contractor shall:
 - a. Pipe sprinkler system drain into adequately sized building drain.
 - b. Include sight glass into drain plumbing in order to witness water flowing.
 - 1) Notify Director of Fire and Occupational Safety (University Fire Marshal) or designee if draining to the exterior is not feasible in the proposed solution.

3.6 GENERAL FABRICATION OF PIPE (EXCEPT FOR WELDED PIPING):

- A. Various piping systems shall be made up straight and true and run at proper grades to permit proper flow of the contained material. Lines shall also be graded for proper drainage.

- B. Piping shall follow as closely as possible the routes shown on Drawings which take into consideration conditions to be met at the site.
- C. Should any unforeseen conditions arise, lines shall be changed or rerouted as required after proper approval has been obtained.
- D. Install piping with regard to expansion and contraction and to prevent excessive strain and stress in the piping, in connections, and in equipment to which the lines are connected.
- E. Piping shall be clean when it is installed.
 - 1. Before installation, piping shall be checked, upended, swabbed, if necessary, and rust and dirt from storage or from lying on the ground shall be removed.
- F. Procedure of Assembling Screw Pipe Fittings:
 - 1. Screw joints shall be made with taper threads, properly cut.
 - 2. Joints shall be made tight with Teflon applied to the pipe threads only and not to fittings.
 - 3. When threads are cut on pipes, the ends shall be carefully reamed to remove any burrs.
 - 4. Before installing pipe that has been cut and threaded, the lengths of pipe shall be upended and hammered to remove all shavings and foreign material.

3.7 TESTING AND FLUSHING

- A. After the fabrication of fire protection piping systems has been completed, these systems shall be subjected to a hydrostatic test at a minimum pressure of 200 pounds per square inch without loss for 2 hours and shall be flushed at each valve through a temporary hose until the system is clean.
- B. Any leaks found shall be remedied in each instance in a manner approved in advance by the Owner's duly authorized representative.
- C. Systems shall be alternately tested and repaired where necessary until they have demonstrated their capability to withstand such a minimum 200 pound per square inch gauge hydraulic pressure for 2 hours without any drop in the test pressure initially applied.
- D. Tests shall be witnessed by Director of Fire and Occupational Safety (University Fire Marshal) or appointed designee.

3.8 PLAN REVIEW AND PERMITTING

- A. Submit digital plans and plan review application through the UT Southwestern Project Manager for delivery to The Office of Safety and Business Continuity – Fire Safety.
- B. Plan review process can take up to 30 days.
- C. Plans shall include all appropriate information, calculations, and manufactures information as required in National Fire Protection Association Standard on Installation of Sprinkler Systems (NFPA 13), Standpipe and Hose System (NFPA 14), Standard for the Installation of Stationary Pumps for Fire Protection (NFPA 20). Failure to provide the necessary information will result in a delay in the review of the project until all of the information is provided.
- D. Submittal of plans does not constitute approval.
 - 1. Contractors working on the project without a permit do so at their own risk. Contractor will be responsible to replace, without cost to the owner, any components necessary as required by the approved plans.
- E. Maintain copy of the approved, stamped, plans on project site at all times.
- F. UTSW Fire Safety shall provide permit with the approval of the submitted plans.
- G. A separate permit shall be issued for the following:
 - 1. Fire Sprinkler System
- H. When sprinkler heads are added, moved, or modified to an existing space for modification, renovation, or reconstruction coordinate the following:
 - 1. For three or more sprinkler heads submit sprinkler plans for review in accordance with plan review and permitting requirements specified.
 - 2. For ten or more fire sprinkler heads, meet requirements above and submit calculations for review in accordance with plan review and permitting requirements specified.
 - 3. For twenty or more fire sprinkler heads meet requirements above along with requirements to conduct hydrostatic testing of sprinkler system affected in accordance with NFPA 13. Coordination with UTSW Project Manager and approval by Director of Fire and Occupational Safety is required.

3.9 INSPECTION

- A. Inspections shall be witnessed and approved by the Director of Fire and Occupational Safety or assigned designee prior to acceptance and operation.
 - 1. Minimum of three (3) business day's notification is required prior to inspection.
 - 2. Coordinate Inspections with the UT Southwestern Medical Center Project Manager.
 - B. Hydrostatic tests shall be witnessed and approved by the Director of Fire and Occupational Safety or assigned designee prior to acceptance and operation.
 - 1. Piping pressures and testing duration shall be in accordance with the currently adopted edition of NFPA 13: Standard for the Installation of Fire Sprinklers for aboveground and underground piping.
 - 2. A 300 psi pressure gauge shall be maintained at the testing manifold and also at the furthest point of the piping being tested. Both gauges shall register the minimum pressure required by the Code at the beginning and end of the test.
 - C. State paperwork for testing shall be copied at the time of the conclusion for the test and signed by the contractor and UTSW Fire Safety representative.
 - 1. Copy of the test shall be maintained by the contractor and provided immediately to the Fire Safety representative.
 - 2. The test will not be considered passed under the paperwork for the test is complete.
 - D. Testing shutdowns shall be limited to one floor of building at a time. If two or more floors need testing, they shall be completed separately and independently of each other.
 - E. Fire sprinkler shutdowns and fire alarm bypassing within the same building shall occur independently of each other. At no time shall both systems be tested or bypassed at the same time.
- 3.10 AS BUILTS
- A. Provide As-built drawings in compliance with NFPA 13 to UTSW Fire Safety within 30 days of system acceptance.

END OF SECTION 21 13 13



DIVISION 22

PLUMBING



SECTION 22 00 10

BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Basic Plumbing Requirements specifically applicable to Divisions 22 and 23 Sections, in addition to Division 01 General Requirements.

1.3 GENERAL

- A. The Contractor shall execute work specified or indicated on accompanying Drawings.
- B. Contractor shall provide equipment necessary and usually furnished in connection with such work and systems whether or not mentioned specifically herein or on the Drawings.
- C. The Contractor shall be responsible for fitting material and apparatus into the building and shall carefully lay out work at the site to conform to the structural conditions, to avoid obstructions, to conform to the details of the installation and thereby to provide an integrated satisfactory operating installation.
- D. Mechanical, electrical, and plumbing Drawings are necessarily diagrammatic by their nature, and are not intended to show every connection in detail or every pipe or conduit in its exact location.
 - 1. These details are subject to the requirements of standards referenced elsewhere in these specifications, and structural and architectural conditions.
- E. Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work.
 - 1. Work shall be organized and laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted otherwise.
 - 2. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise note
- F. When the mechanical, electrical, and plumbing Drawings do not give exact details as to the elevation of pipe, conduit and ducts, the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with proper grades for the functioning of the system involved.
- G. New construction projects will be provided with a Hierarchy Drawing or sections and elevations, which clearly show the general elevations that utilities will be routed in N-S and E-W directions.
 - 1. The contractor shall not start work until this drawing has been provided.
- H. Piping, exposed conduit, and the duct systems are generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner.
 - 1. The drawings do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas.
 - 2. All equipment indicators shall face main traffic pathways unless noted otherwise.

1.4 DEFINITIONS

- A. Concealed/Exposed: "Concealed" areas are those areas which cannot be seen by the building occupants. "Exposed" areas are all areas which are exposed to view by the building occupants, including under counters, inside cabinets and closets, plus all mechanical and electrical rooms.

1.5 RELATED REQUIREMENTS

- A. Section 01 77 00 - Closeout Procedures and Submittals
- B. Section 01 79 00 - Demonstration and Training
- C. Section 01 91 00 - General Commissioning Requirements.
- D. Section 07 18 00 - Traffic Coatings.
- E. Section 07 84 00 - Firestopping.
- F. Section 07 84 43 - Joint Firestopping.

- G. Section 09 96 00 - High-Performance Coatings.
 - H. Section 22 05 53 - Plumbing Identification.
 - I. Section 22 07 19 - Plumbing Insulation.
 - J. Section 22 08 00 - Commissioning of Plumbing Systems.
- 1.6 PERMITS, UTILITY CONNECTIONS AND INSPECTIONS
- A. General: Refer to Division 01 for construction phasing and time increments.
 - B. Fees and Costs:
 - 1. If, during the course of the construction, a need arises to buy utilities, the Contractor shall pay all fees attendant.
 - 2. If City or privately owned utility piping or electrical cable needs to be extended, relocated, or terminated, the Contractor will pay all permits and construction/inspection fees associated with that particular work.
 - C. Work performed on this project is under the authority of the State of Texas, therefore no local construction fees or construction permits will be required except as may be required for new service taps, or new or modified connections to City controlled services. Confirm with specific project contract requirements.
 - 1. If inspections by City personnel are specifically required by this document, then the Contractor is responsible for any fees or permits in connection to those requirements.
 - D. Compliance:
 - 1. The Contractor shall comply in every respect with all requirements of National Fire Protection Association, local Fire Department regulations, and utility company requirements.
 - 2. In no case does this relieve the Contractor of the responsibility of complying with these Specifications and Drawings where specified conditions are of higher quality than the requirements of the above specified authorities.
 - 3. Where requirements of the Specifications and Drawings are more lenient than the requirements of the above authorities having jurisdiction, the Contractor shall make installations in compliance with the requirements of the above authorities with no extra compensation.
- 1.7 CONTRACT DOCUMENTS
- A. Dimensional information related to new structures shall be taken from the appropriate Drawings.
 - 1. All dimensional information related to existing facilities shall be taken from actual measurements made by the Contractor on the site.
 - B. The interrelation of the Specifications, the Drawings, and the schedules are as follows:
 - 1. Specifications determine the nature and setting of the several materials, Drawings establish the quantities, dimensions and details, and the schedules give the performance characteristics.
 - 2. If the Contractor requires additional clarification, request shall be made in writing, following the contractually prescribed information flow requirements.
 - C. Should the Drawings or Specifications conflict, the better quality, or greater size or quantity of work or materials shall be performed or furnished.
- 1.8 OWNER FURNISHED PRODUCTS
- A. Products furnished to the site and paid for by Owner will be noted on the drawings and utilities created/connected as required.
- 1.9 FUTURE WORK
- A. Future work will be noted on the Drawings.
- 1.10 ALTERNATES
- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at the Owner's option. Accepted Alternates will be identified in Owner-Contractor Agreement.
 - B. Coordinate related work and modify surrounding work as required.
 - C. Schedule of Alternates: See "Special Conditions" and Bid Form.
 - D. Any Alternate Proposals are summarized in Division 01 of the Specifications.
 - E. The Contractor is directed to refer to all Sections of the Specifications and Drawings for this project to determine the exact extent and scope of the various Alternate Proposals as each pertains to the work of all trades.
- 1.11 SUBMITTALS

- A. Refer to Division 01, UGC, and supplemental UGC's for specification requirements pertaining to timeliness of submission and review, quantity, and format.
- B. Each specification section describes the content of the submittals and any submittals which must be approved prior to submission of others.
- C. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.
 - 1. Mark dimensions and values in units to match those specified.
- D. Submit Fabrication Drawings in accordance with the following:
 - 1. Equipment proposed varies in physical size and arrangement from that indicated on the Drawings, thus causing rearrangement of equipment space.
 - 2. Where tight spaces require extreme coordination between ductwork, piping, conduit, and other equipment.
 - 3. Where called for elsewhere in these Specifications.
 - 4. Where specifically requested by the Architect/Engineer.
 - 5. Fabrication Drawings shall be made at no additional charge to the Owner or the Architect/Engineer.
- E. All required Fabrication Drawings, except as noted otherwise, shall be prepared at a scale of not less than 1/4 inch = 1 foot.
 - 1. Fabrication Drawings for ductwork, air handling units, and sections in Mechanical Rooms shall be drawn at a minimum scale of 3/8 inch = 1 foot.
 - 2. Submit digital and pdf prints of each Fabrication Drawing to the Architect/Engineer for review.
 - 3. Reproduction and submittal of the Construction Documents is not acceptable.
 - 4. The Architect/Engineer will review Drawings and return one print with comments.

1.12 SUBSTITUTION OF MATERIALS AND EQUIPMENT

- A. Refer to General Conditions for substitution of materials and equipment.
- B. General:
 - 1. Within thirty days after the date of contract award or work order, whichever is later, and before purchasing or starting installation of materials or equipment, the Contractor shall submit for review, a complete list of suppliers, contractors and manufacturers for all materials and equipment which will be submitted for incorporation into the project.
 - a. The list shall be arranged in accordance with the organization of the Specifications.
 - b. Initial list shall include the manufacturer's name and type or catalog number as required to identify the quality of material or equipment proposed.
 - c. List will be reviewed by the Engineer and the Owner and will be returned to the Contractor with comments as to which items are acceptable without further submittal data and which items will require detailed submittal data for further review and subsequent approval.
 - d. Initial list shall be submitted as specified.
 - e. Materials and equipment requiring detailed submittal data shall be submitted with sufficient data to indicate that all requirements of these Specifications have been met and samples shall be furnished when requested.
 - f. Manufacturers data used as part of the submittal shall have all inapplicable features crossed out or deleted in a manner that will clearly indicate what is to be furnished.
- C. It is not the intent of the Drawings and/or Specifications to limit products to any particular manufacturer or to discriminate against an "APPROVED EQUAL" product as produced by another manufacturer.
 - 1. Some proprietary products are mentioned to set a definite standard for acceptance and to serve as a reference in comparison with other products.
 - 2. When a manufacturer's name appears in these Specifications, it is not to be construed that the manufacturer is unconditionally acceptable as a provider of equipment for this project.
 - 3. The successful manufacturer or supplier shall meet all of the provisions of the appropriate specification(s).
 - 4. The specified products have been used in preparing the Drawings and Specifications and thus establish minimum qualities with which substitutes must at least equal to be considered acceptable.
 - 5. The burden of proof of equality rests with the Contractor.
 - 6. The decision of the designer is final.

- D. When requested by the Architect/Engineer, the Contractor shall provide a sample of the proposed substitute item. In some cases, samples of both the specified item and the proposed item shall be provided for comparison purposes.
- E. Timeliness:
 - 1. The burden of timeliness in the complete cycle of submittal data, shop Drawings, and sample processing is on the Contractor.
 - 2. The Contractor shall allow a minimum of 6 weeks time frame for review of each submission by the office of the design discipline involved after receipt of such submissions by that design discipline.
 - 3. The Contractor is responsible for allowing sufficient time in the construction schedule to cover the aforementioned cycles of data processing, including time for all re-submittal cycles on unacceptable materials, equipment, etc. covered by the data submitted.
 - 4. Construction delays and/or lack of timeliness in the above regard are the responsibility of the Contractor and will not be considered in any request for scheduled construction time extensions and/or additional costs to the Owner.
- F. Acceptance of materials and equipment:
 - 1. This is based on the manufacturer`s published data and will be tentative subject to the submission of complete shop Drawings indicating compliance with the contract documents and that adequate and acceptable clearances for entry, servicing, and maintenance will exist.
 - 2. Acceptance of materials and equipment under this provision shall not be construed as authorizing any deviations from the Specifications, unless the attention of the Architect/Engineer has been directed in writing to the specific deviations.
 - 3. Data submitted shall not contain unrelated information unless all pertinent information is properly identified.
 - 4. Equipment installed on this project shall have local representation, local factory authorized service, and a local stock of repair parts.
- G. Certification: The Contractor shall carefully examine all data forwarded for approval and shall sign a certificate to the effect that the data has been carefully checked and found to be correct with respect to dimensions and available space and that the equipment complies with all requirements of the Specifications.
- H. Physical Size of Equipment: Space is critical; therefore, equipment of larger sizes than shown, even though of specified manufacturer, will not be acceptable unless it can be demonstrated that ample space exists for proper installation, operation, and maintenance.
- I. Materials and Equipment Lists:
 - 1. Provide digital list of materials and equipment, the name of manufacturer, trade name, type, and catalog number shall be submitted to the Architect/Engineer.
 - 2. Lists shall be accompanied by digital copy sets of pictorial and descriptive data derived from the manufacturers` catalogs, sales literature, or incorporated in the Shop Drawings.
 - 3. Should a substitution be accepted, and should the substitute material prove defective, or otherwise unsatisfactory for the service intended within the guarantee period, this material or equipment shall be replaced with the material or equipment specified at no additional cost to the Owner.

1.13 MATERIALS AND WORKMANSHIP

- A. Materials, unless otherwise specified, shall be new, free from all defects, suitable for the intended use, and of the best quality of their respective kinds.
 - 1. Materials and equipment shall be installed in accordance with the manufacturer`s recommendations and the best standard practice for the type of work involved.
 - 2. Execute work by mechanics skilled in their respective trades, and the installations shall provide a neat, precise appearance.
 - 3. Materials and/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 materials and/or equipment.
- B. Responsibility for the furnishing of the proper equipment and/or material installation as intended by the manufacturer, rests entirely upon the Contractor who shall request advice and supervisory assistance from the representative of the specific manufacturers during installation.

1.14 FLAME SPREAD PROPERTIES OF MATERIALS

- A. Materials and adhesives incorporated in this project shall conform to NFPA.

- B. The classification shall not exceed a flame spread rating of 25 for all materials, adhesives, finishes, etc., specified for each system, and shall not exceed a smoke developed rating of 50.

1.15 REGULATORY REQUIREMENTS

- A. The "Authority Having Jurisdiction" for Fire and Life Safety related compliance in accordance with the rules and regulations promulgated by the Texas State Fire Marshal as an Agency of the State of Texas is UT Southwestern Medical Center Office of Safety and Business Continuity.
 - 1. Plan reviews, installations, inspections, and approvals shall be done as a function of the Fire and Occupational Safety program under the direction of the Director of Fire and Occupational Safety (University Fire Marshal).
- B. It is required that the installation shall meet the minimum standards prescribed in the currently adopted editions as identified in Section 01 41 00 - Regulatory Requirements and listed in other Specification sections. Additional requirements include but not limited to:
 - 1. National Fire Protection Association Standards (NFPA): Currently accepted edition.
 - 2. ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - 3. American Gas Association Publications (AGA): Directory of Approved Gas Appliances and Tested Accessories.
 - 4. American Society of Mechanical Engineers (ASME): Boiler and Pressure Vessel Codes.
 - 5. Air Conditioning and Refrigeration Institute Standards (ARI): All standards related to refrigeration and air conditioning equipment and piping furnished under these Specifications.
 - 6. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA): All current editions of applicable manuals and standards.
 - 7. Air Moving and Conditioning Association (AMCA): All current editions of applicable manuals and standards.
 - 8. American Society of Testing Materials (ASTM): All current editions of applicable manuals and standards.
 - 9. American Water Works Association (AWWA): All current editions of applicable manuals and standards.
 - 10. National Electrical Manufacturers` Association (NEMA): All current editions of applicable manuals and standards.
 - 11. International Codes, current edition or as listed elsewhere in the contract.
 - 12. Texas Occupational Safety Act: All applicable safety standards.
 - 13. Occupational Safety and Health Act (OSHA).
 - 14. TAS, ADA, and ANSI Standards: All work shall be in accord with all regulations and requirements of the Standards and Specifications for Handicapped and Disabled for the Construction of Public Buildings and Facilities in the State of Texas Usable by Physically Handicapped and Disabled persons, ANSI Standards, and the requirements of the American Disabilities Act.
 - 15. ASME A13.1
- C. Materials and workmanship shall comply with applicable state and national codes, Specifications, and industry standards.
 - 1. In all cases where Underwriters' Laboratories, Inc. has established standards for a particular type materials, such material shall comply with these standards.
 - 2. Evidence of compliance shall be the UL "label" or "listing" under Re-Examination Service.
- D. Contract Documents are intended to comply with the aforementioned rules and regulations; however, some discrepancies may occur.
 - 1. Where such discrepancies occur, the Contractor shall immediately notify the Architect/Engineer in writing of said discrepancies and apply for an interpretation.
 - 2. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with said regulations shall be paid for as covered by Division 1 of these Contract Documents, providing no work of fabrication of materials has been accomplished in a manner of noncompliance.
 - 3. Should the Contractor fabricate and/or install materials and/or workmanship in such a manner that does not comply with the applicable codes, rules and regulations, the Contractor who performed such work shall bear all costs arising in correcting these deficiencies to comply with said rules and regulations.

1.16 COMMISSIONING

- A. Comply with project requirements for commissioning. Refer to Section 01 91 00 - General Commissioning Requirements and associated sections.

1.17 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

- A. Storage at Site: The Contractor shall not receive material or equipment at the job site until there is suitable space provided to properly protect equipment from rust, weather, humidity, dust damage, and vandalism.
- B. Capacities shall be not less than those indicated but shall be such that no component or system becomes inoperative or is damaged because of startup or other overload conditions.
- C. Conformance with Agency Requirements:
 - 1. Where materials or equipment are specified to be approved, listed, tested, or labeled by the Underwriters` Laboratories, In, or constructed and/or tested in accordance with the standards of the American Society of Mechanical Engineers or the Air Moving and Conditioning Association, the Contractor shall submit proof that the items furnished under this Section of the Specifications conform to such requirements.
 - a. The label of the Underwriters Laboratories, In, applied to the item will be acceptable as sufficient evidence that the items conform to such requirements.
 - b. The ASME stamp or the AMCA label will be acceptable as sufficient evidence that the items conform to the respective requirements.
- D. Nameplates:
 - 1. Refer to Section 22 05 53 - Plumbing Identification for requirements.
 - 2. Each major component of equipment shall have the manufacturer`s name, address, and catalog number on a plate securely attached to the item of equipment. Industry standard attachments shall be appropriate for the sign type to the surface material, size, shape, and condition.
 - 3. Data on nameplates shall be legible at the time of Final Inspection.
- E. Prevention of Rust:
 - 1. Standard factory finish will be acceptable on equipment specified by model number; otherwise, surfaces of ferrous metal shall be given a rust inhibiting coating.
 - 2. The treatment shall withstand 200 hours in salt spray fog test, in accordance with Method 6061 of Federal Standard No.141.
 - 3. Immediately after completion of the test, the specimen shall show no signs of wrinkling or cracking and no signs of rust creepage beyond 1/8-inch on either side of the scratch mark.
 - 4. Where rust inhibitor coating is specified hereinafter, any treatment that will pass the above test is acceptable unless a specific coating is specified except that coal tar or asphalt type coating will not be acceptable unless so stated for a specific item.
 - 5. Where steel is specified to be hot-dip galvanized, mill-galvanized sheet steel may be used provided all raw edges are painted with a zinc-pigmented paint conforming to Military Specification MIL-P-26915.
- F. Protection from Moving Parts:
 - 1. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts shall be fully enclosed or properly guarded for personnel protection.
 - 2. Guards shall be compliant with OSHA requirements.
- G. Verification of Dimensions:
 - 1. The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades.
 - 2. The Contractor shall visit the premises and become thoroughly familiarize with all details of the work and working conditions, to verify all dimensions in the field, and to advise the Architect/Engineer of any discrepancy before performing any work.
 - 3. Adjustments to the work required in order to facilitate a coordinated installation shall be made at no additional cost to the Owner or the Architect/Engineer.

1.18 WALL, FLOOR, AND CEILING PLATES

- A. Except as otherwise noted, provide C.P. (Chrome plated) brass floor and ceiling plates around all pipes, ducts, conduits, etc., passing exposed through walls, floors, or ceilings, in any spaces except underfloor and attic spaces.

1. Plates shall be sized to fit snugly against the outside of the pipe or against the insulation on lines which are insulated and positively secured to such pipe or insulation.
2. Plates will not be required for piping where pipe sleeves extend 3/4-inch above finished floor.
3. Equipment rooms are classified as finished areas.
4. Round and rectangular ducts shall have closure plates (NOT chrome plated) made to fit accurately at all floor, wall and ceiling penetrations.

1.19 SLEEVES, INSERTS, AND FASTENINGS

A. General:

1. Openings through all floors, walls, and roofs, etc., regardless of material for the passage of piping, ductwork, conduit, cable trays, etc., shall be sleeved.
2. Penetrations must pass through sleeves except soil pipe installed under concrete slabs on fill.
3. Sleeves shall be set in new construction before concrete is poured, as cutting holes through any part of the concrete will not be permitted unless acceptable to the Architect/Engineer.
 - a. If a penetration is cored into an existing solid concrete or stone structure, then the installation of a sleeve will not be necessary.
4. Sleeves set in floors shall extend 4-inch above finished floor elevation and be sealed water tight to the floor.

B. The minimum clearance between horizontal penetrations including insulation where applicable, and sleeve shall be 1/4-inch, except that the minimum clearance shall accommodate a Link-seal by Garlock, an Enpro Company, closure where piping exits the building, or penetrates a wall below ground level.

C. Contractor shall be responsible for the accurate location of penetrations in the slab for pipe, duct, etc.

1. Penetrations shall be of ample size to accommodate the pipe, duct, etc. plus any specified insulation.
2. Sleeve materials shall be rigid metal of adequate strength.
3. Void between sleeve and pipe shall be filled with Nelson Flameseal Firestop or approved equal caulk or putty.

D. Sleeves:

1. Installation of sleeves in walls shall be the same as for floors.
2. Refer to the details on the project drawings.
 - a. Where the details differ from these specifications, the drawings take precedence.
3. Sleeves for penetrations passing through walls or floors on or below grade shall be removed, if practical, and after the pipes have been installed, the void space around the pipe shall be caulked with a suitable material to effect a waterproof penetration.
 - a. Note that the practicality of the removal of the sleeve shall be the decision of the Construction Inspector. The decision of the Inspector shall be final.

E. Inserts:

1. Where the construction schedule allows, suitable concrete inserts for pipe and equipment hangers shall be set and properly located for all pipe and equipment to be suspended from concrete construction
2. If the inserts are later found not to be in the proper location for the placement of hangers, then drilled anchors shall be installed.
3. Drilled anchors in concrete or masonry shall be submitted for approval.

F. Fasteners: Fastening of pipes, conduits, etc., in the building shall be as follows:

1. Wood members attached by wood screws.
2. Masonry fastening by threaded metal inserts, metal expansion screws, or toggle bolts, as appropriate.
3. Metal fastening by steel machine screws or welding (when specifically permitted or directed), or bolts.
4. Concrete fastening by suitable inserts anchored to reinforcing steel, and poured in place unless other means are indicated on the plans.
5. Power-actuated fasteners (shooting) will not be acceptable under any circumstances.
6. If it is necessary to install a method of fastening a hanger after the structure has been installed, then only clamps or drilled anchors shall be used.
7. Note: Plastic anchors or plastic expansion shields are prohibited.

- G. Rat-proofing: The open space around all ductwork, piping, etc., passing through the ground floor and/or exterior walls shall be rat-proofed in a manner acceptable to the Architect/Engineer.
- H. Weatherproofing: The annular space between a pipe and its sleeve in exterior walls or through floor to below grade shall be filled with polyurethane foam rods 50 percent greater in diameter than the space as backing and fill material and made watertight with a permanent elastic polysulfide compound.
 - 1. Seal both surfaces of wall or floor.
- I. Air Plenums: The space around piping, ductwork, etc., passing through air plenums shall be made airtight in a manner acceptable to the Architect/Engineer.
- J. Fireproofing:
 - 1. Each mechanical, plumbing, and electrical contractor shall seal all cable trays, pipe, conduit, duct, etc., penetrations through roof, fire rated walls and floors with a foam or sealant (as described below) that will form a watertight, vermin tight barrier capable of containing smoke and fire up to 2,000 degrees F for two hours.
 - 2. Sealing of cable trays and conduits that extend through rated walls from ends of cable tray shall be done after conductors have been installed.
 - 3. Refer to fireproofing and firestopping specifications in Division 07 for product requirements.

1.20 PROJECT/SITE CONDITIONS

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections.
 - 1. Obtain permission of Architect/Engineer before proceeding.
- C. Contractor shall thoroughly familiarize themselves with the existing system(s) and bring to the attention of the Architect/Engineer any situations, which deviate from those, indicated in the Contract Documents

1.21 MANUFACTURER`S RECOMMENDATIONS

- A. The manufacturer`s published directions shall be followed in the delivery, storage, protection, installation, piping, and wiring of all equipment and material.
 - 1. The Contractor shall promptly notify the Architect/Engineer, in writing, of any conflict between the requirements of the Contract Documents and the manufacturers` directions, and shall obtain the Architect/Engineer`s instructions before proceeding with the work.
 - 2. Should the Contractor perform any such work that does not comply with the manufacturers` directions or such instructions from the Architect/Engineer, the Contractor shall bear all costs arising in connection with the deficiencies.

1.22 SPACE AND EQUIPMENT ARRANGEMENT

- A. The size of mechanical, plumbing, and electrical equipment indicated on the Drawings is based on the dimensions of a particular manufacturer.
 - 1. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment they propose to furnish will fit in the space.
 - 2. Fabrication Drawings shall be prepared when required by the Architect/Engineer or Owner to indicate a suitable arrangement.
- B. All equipment shall be installed in a manner to permit access to all surfaces.
 - 1. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.
- C. All equipment intended for floor mounting shall be installed on housekeeping pads or above grouted baseplate that elevate the base away from damage.
 - 1. Housekeeping pads to be sealed to match floor waterproofing system, refer to Section 07 18 00 - Traffic Coatings.
 - 2. Housekeeping pad edges to be painted Safety Yellow.

1.23 LARGE APPARATUS

- A. Any large piece of apparatus which is to be installed in any space in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed.
- B. Following placement in the space, such apparatus shall be thoroughly, completely protected from damage as hereinafter specified.

1.24 PROTECTION

- A. The Contractor shall at all times take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of the work.
 - 1. Include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the cribbing of any items above the floor of the construction; and the covering of items in the incomplete building with tarpaulins or other protective covering; the installation of electric heaters in electrical switchgear and similar equipment to prevent moisture damage.
 - 2. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.
- B. Take particular care not to damage the building structure in performing work.
 - 1. All finished floors, step treads, and finished surfaces shall be covered to prevent any damage by workers or their tools and equipment during the construction of the building.
- C. Equipment and materials shall be protected from rust both before and after installation.
 - 1. Any equipment or materials found in a rusty condition at the time of final inspection must be cleaned of rust and repainted as specified elsewhere in these Specifications.

1.25 COOPERATION BETWEEN TRADES AND WITH OTHER CONTRACTORS

- A. Each trade, subcontractor, and/or Contractor must work in harmony with the various other trades, subcontractors and/or Contractors on the job as may be required to facilitate the progress to the best advantage of the job as a whole.
- B. Each trade, subcontractor, and/or Contractor must pursue its work promptly and carefully so as not to delay the general progress of the job.
- C. This Contractor shall work in harmony with Contractors working under other contracts on the premises.

1.26 ELECTRICAL WIRING OF MOTORS AND EQUIPMENT

- A. The Contractor shall note that the electrical design and Drawings are based on the equipment scheduled and indicated on the Drawings, and should any mechanical equipment be provided requiring changes to the electrical design, the required electrical changes shall be made at no cost to the Owner.
- B. The Electrical Trades shall provide all interconnecting wiring for the installation of all power.
- C. The Electrical Trades shall provide all disconnect switches as required for proper operation, as indicated on the Drawings or required by applicable code.
 - 1. All combination starters, individual starters, and other motor starting apparatus not specifically scheduled or specified as provided by the equipment manufacturer under the scope of Division 23, shall be provided under the scope of Division 26.
- D. The Mechanical Trades shall provide complete wiring diagrams indicating power wiring and interlock wiring.
 - 1. Diagrams shall be submitted for review within thirty (30) days after the submittals for equipment have been reviewed.
 - 2. Diagrams shall be based on accepted equipment and shall be complete full phase and interlock control Drawings, not a series of manufacturer's individual diagrams.
 - 3. After these diagrams have been reviewed, copies shall be transmitted to the Electrical Trades by the Contractor. They shall be followed in detail.
 - 4. See Section 23 09 23, ENERGY MANAGEMENT SYSTEM (EMS), for additional clarification.

1.27 SUPERVISION

- A. Each Contractor and subcontractor shall keep a competent superintendent or foreman on the job at all times. (Refer to the Uniform General Conditions for additional information concerning supervision.)
- B. It shall be the responsibility of each superintendent to study all Drawings and be familiarized with the work to be done by other trades.
- C. Coordinate work with other trades and before material is fabricated or installed, make sure that work will not cause an interference with another trade.
- D. Where interferences are encountered, they shall be resolved at the job site by the superintendents involved.
- E. Where interferences cannot be resolved without major changes to the Drawings, the matter shall be referred to the A/E for ruling.

1.28 SITE OBSERVATION

- A. Site observation by the Architect/Engineer is for the express purpose of verifying compliance by the Contractor with the Contract Documents, and shall not be construed as construction supervision nor indication of approval of the manner or location in which the work is being performed as being a safe practice or place.

1.29 PRECEDENCE OF MATERIALS

- A. Specifications determine the nature and setting of materials and equipment. The drawings establish quantities, dimensions and details.
- B. Installation precedence of materials shall be as follows. Note that if an interference is encountered, this shall guide the contractor in the determination of which trade shall be given the "Right-of-Way".
 - 1. Building lines.
 - 2. Structural Members.
 - 3. Soil and Drain Piping.
 - 4. Vent Piping.
 - 5. Supply, Return, and Outside Air Ductwork.
 - 6. Exhaust Ductwork.
 - 7. HVAC Water and Steam Piping.
 - 8. Condensate Piping.
 - 9. Fire Protection Piping.
 - 10. Natural Gas Piping.
 - 11. Domestic Water (Cold and Hot).
 - 12. Refrigerant Piping.
 - 13. Electrical Conduit.

1.30 RECORDS FOR OWNER

- A. Records shall comply with Section 01 77 00 - Closeout Procedures and Submittals and requirements of the section herein.
- B. The Contractor shall maintain a set of Drawings in the Field Office for the sole purpose of recording "installed" conditions.
 - 1. Daily note all changes made in these Drawings in connection with the final installation including exact dimensioned locations of all new underground utilities, services and systems and all uncovered existing active and inactive piping outside the building.
- C. At Contract completion, the Contractor shall provide a set of reproducible drawings and digital format of the drawings and digital set of specifications. The contractor shall transfer the information from the Drawings and Specifications maintained as described above, and turn over this neatly marked set of reproducible Drawings and Specifications representing the "as installed" work to the Architect/Engineers for verification and subsequent transmittal to the Owner. The Contractor shall refer to Division 01 of these Specifications, and to the Uniform General Conditions, for additional information. These Drawings shall include as a minimum:
 - 1. Addendum written drawing changes.
 - 2. Addendum supplementary drawings.
 - 3. Accurate, dimensioned locations of all underground utilities, services and systems.
 - 4. Identification of equipment work shown on Alternates as to whether alternates were accepted and work actually installed.
 - 5. Change Order written drawing changes.
- D. Electronic Media Transfer:
 - 1. AutoCAD files specific to a floor shall be provided (under formal transmittal letter) to the owner within 1 week of floor acceptance.
 - 2. The electronic files shall have the latest changes incorporated, and represent the most accurate design issued for construction.
 - 3. The files shall be in AutoCAD Version 2010 or higher unless UTSW PM indicates otherwise.
- E. Provide digital pdf's with optical character recognition (OCR) as well as hard copy set of marked up Drawings titled "AS INSTALLED DRAWING" with title block generally located in lower right hand corner of Drawing with Company name of the installing trade Subcontractor and with a place for the date and the name of the responsible company representative.

- F. In addition to the above, the Contractor shall accumulate during the progress of the job the following data, in digital format, prepared in a neat order or packet folder and turn over to the Architect/Engineer for review, and subsequent delivery to the Owner.
 - 1. All warranties and guarantees and manufacturers` directions on equipment and material covered by the Contract.
 - 2. Two sets of operating instructions and preventative maintenance procedures for heating and cooling and other mechanical and electrical systems.
 - 3. Valve tag charts and diagrams specified.
 - 4. Approved wiring diagrams and control diagrams representing "as installed" conditions.
 - 5. Copies of approved Shop Drawings.
 - 6. Any and all other data and/or drawings required as submittals during construction.
 - 7. Repair parts list of all major items and equipment including name, address and telephone number of local supplier or agent.
- G. All of the above data shall be submitted to the Architect/Engineer for approval, and shall be corrected as instructed by the Architect/Engineer prior to submission of the final request for payment.
- H. Refer to additional requirements in the commissioning section of Division 01.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be acceptable to the authority having jurisdiction as suitable for the use intended.
- B. Furnish products listed and classified by Underwriter's Laboratory, Inc. as suitable for purpose specified and shown.
- C. Unless otherwise specified materials shall be new and free from any defects.

2.2 ACCESS DOORS

- A. General: This Contractor shall provide wall, floor, or ceiling access doors for unrestricted access to all concealed items of mechanical, plumbing, or electrical equipment or devices including items requiring general maintenance or access.
- B. Utilize Section 08 31 13 - Access Doors and Frames for products and requirements.
- C. Access doors shall be a minimum of 24 x 24 inches in size unless approved by UTSW FM in writing. Location shall provide appropriate access.

PART 3 – EXECUTION

3.1 EXISTING FACILITIES

- A. The Contractor shall be responsible for loss or damage to the existing facilities caused by them and their workers, and shall be responsible for repairing or replacing such loss or damage.
 - 1. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and in service maintenance of all plumbing, heating, air conditioning, and ventilating services for the new and existing facilities.
 - 2. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.
- B. The Contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.
- C. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.
- D. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, all Contractors shall remove and reinstall in locations approved by the Architect/Engineer all devices required for the operation of the various systems installed in the existing construction.
 - 1. This includes but is not limited to temperature controls system devices, electrical switches, relays, fixtures, piping, conduit, etc.

- E. Outages of services as required by the new installation will be permitted but only at a time approved by the Owner.
 - 1. The Contractor shall allow the Owner two weeks in order to schedule required outages.
 - 2. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner.
 - 3. All costs of outages, including overtime charges, shall be included in the contract amount.

3.2 DEMOLITION AND RELOCATION

- A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the Drawings or required by the installation of new facilities.
 - 1. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage.
 - 2. Salvage materials shall remain the property of the Owner, and shall be delivered to such destination or otherwise disposed of as directed by the Owner.
 - 3. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition.
 - 4. The Contractor may, at their discretion, and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.
- B. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated.
 - 1. The Contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order.
 - 2. All relocations shall be performed by workers skilled in the work and in accordance with standard practice of the trades involved.
- C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner to such items and receive further instructions before removal.
 - 1. Items damaged in repositioning operations are the Contractor's responsibility and shall be repaired or replaced by the Contractor as approved by the Owner, at no additional cost to the Owner.
- D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the Drawings, specified, or acceptable to the Owner.
 - 1. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain.
 - 2. Such services shall be sealed, capped, or otherwise tied off or disconnected in a safe manner acceptable to the Owner.
 - 3. Disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas.
 - 4. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as specified.

3.3 EXCAVATION, TRENCHING AND BACKFILL

- A. Excavation (See Divisions 00 and 01 for special requirements related to excavation and trenching.):
 - 1. Any excavation and digging below 1 foot around the campus bird sanctuary must be approved by OSBC. The area of the bird sanctuary is Defined as the tree line surrounding it.
 - 2. The contractors shall perform all excavations of every description, for their particular installations and of whatever substances encountered, to the depths indicated on the Drawings and/or required for the installation of piping, conduit, utility systems, etc.
 - a. All exterior lines shall be installed with a minimum cover of 24-inches, unless otherwise indicated.
 - b. Generally, more cover shall be provided if grade will permit.
 - c. Excavation materials not required for backfill or fill shall be removed and wasted as acceptable to the Construction Inspector.
 - d. All excavations shall be made only by open cut.
 - e. The banks of trenches shall be kept as nearly vertical as possible and where required, shall be properly sheeted and braced.
 - f. Trenches shall be not less than 12-inches wider or more than 16-inches wider than the outside edges of the pipe to be laid therein, and shall be excavated true to line so that a clear space not less than 6-inches nor more than 8-inches in width is provided on each side of the pipe.

- g. For sewers, the maximum width of trench specified applies to the width at and below the level may be made as wide as necessary for sheeting and bracing, and the proper installation of the work.
3. The bottom of trenches shall be accurately graded to provide proper fall and uniform bearing and support for each section of the pipe on undisturbed soil or 2-inches of sand fill at every point along its entire length, except for portions of the pipe sections where it is necessary to excavate for bell holes and for the proper sealing of pipe joints.
 - a. Bell holes shall be dug after the trench bottom has been graded.
 - b. Where inverts are not shown, grading shall be determined by the Plumbing Code for the service intended and the size used.
 - c. Bell holes for lead pipe joints shall be 12-inches in depth below the trench bottom and shall extend from a point 6-inches back of the face of the bell.
 - d. Such bell holes shall be of sufficient width to provide ample room for caulking.
 - e. Bell holes for sewer tile and water pipe shall be excavated only to an extent sufficient to permit accurate work in the making of the joints and to insure that the pipe, for a maximum of its length, will rest upon the prepared bottom of the trench.
 - f. Depressions for joints other than bell and spigot shall be made in accordance with the recommendations of the joint manufacturer for the particular type of joint used.
 - g. Grading for electrical duct banks and conduits shall be from building to manhole, and from a high point between manholes to each manhole.
 - h. Special pipe beds shall be provided as specified hereinafter.
 4. The lower 4-inches of the pipe trenches measuring from an overhead line set parallel to the grade line of the sewer shall be excavated only a few feet in advance to the pipe laying, by workers especially skilled in this type of work.
 - a. Where damage is likely to result from withdrawing sheeting, the sheeting shall be left in place.
 - b. Except at locations where excavation of rock from the bottom of trenches is required, care shall be taken not to excavate below the depths required.
 - c. Where rock excavation is required, the rock shall be excavated to a minimum over depth of 6 inches below the trench depths specified.
 - d. The over depth rock excavation and all excess trench excavation shall be backfilled with sand.
 - e. Whenever wet or otherwise unstable soil is incapable of properly supporting the pipe is encountered in the trench bottom, such soil shall be removed to a depth and for the trench lengths required, and then backfilled to trench bottom grade, as hereinafter specified, with sand.
 - f. Where rock excavation is required, the rock shall be excavated to a minimum over depth of 6-inches below the trench depths specified.
 - g. The over depth rock excavation and all excess trench excavation shall be backfilled with sand.
 - h. Whenever wet or otherwise unstable soil is incapable of properly supporting the pipe is encountered in the trench bottom, such soil shall be removed to a depth and for the trench lengths required, and then backfilled to trench bottom grade, as hereinafter specified, with sand.
 5. All grading in the vicinity of excavation shall be controlled to prevent surface ground water from flowing into the excavations.
 - a. Any water accumulated in the excavations shall be removed by pumping or other acceptable method.
 - b. During excavation, material suitable for backfilling shall be stacked in an orderly manner a sufficient distance back from edges of trenches to avoid overloading and prevent slides or cave ins.
 - c. Material unsuitable for backfilling shall be wasted and removed from the job site as directed by the Construction Inspector.
 6. All shoring and sheeting required to perform and protect the excavations and to safeguard employees and/or adjacent structures shall be provided.
 7. Excavate as required under the building in order that all piping, ductwork, etc., shall clear the ground a minimum of 12-inches for a distance of 24-inches on either side.
 - a. Edges of such excavations shall slope at an angle of not over 45 degrees with the horizontal unless otherwise approved by the Construction Inspector.

- b. The bottom of such excavation shall be graded to drain in a manner acceptable to the Construction Inspector.
 - 8. Trenches for cast iron drain, storm water and sewer lines inside the building shall be properly excavated, following the procedures set out for exterior lines.
 - a. Where floors are to be poured over these lines, they shall be backfilled, tamped and settled with water.
 - b. Where no flooring is to cover the lines, they shall be backfilled to form a level grade.
 - 9. All surplus materials removed in these trenching operations becomes the property of the contractor, and shall be disposed of at the expense of the contractor, at a legal disposal site, off of the campus.
- B. Backfilling:
 - 1. Trenches shall not be backfilled until all required tests are performed and until the piping, utilities systems, etc., as installed are certified by the Owner's inspector to conform to the requirements specified hereinafter.
 - 2. The trenches shall be carefully backfilled with sand to a depth of 12 inches above the top of the pipe.
 - 3. The next layer and subsequent layers of backfill may be excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel, soft shale, or other approved materials free from large clods of earth or stones larger than 1-1/2 inch in diameter, flooded until the pipe has cover of not less than one foot.
 - 4. The remainder of the backfill material shall then be thrown into the trenches, moistened, and tamped or flooded in one foot layers.
 - 5. Blasted rock, broken concrete or pavement, and large boulders shall not be used as backfill material.
 - 6. Any trenches improperly backfilled, or where settlement occurs, shall be reopened to the depth required for proper compaction, then refilled and mounded over, and smoothed off.
 - 7. Backfill under concrete slabs on fill shall be as specified above, shall be gravel, or shall be other such materials more suitable for the application. Installation and compaction shall be as required for compatibility with adjacent materials.
- C. Opening and Re-closing Pavement and Lawns:
 - 1. Where excavation requires the opening of existing walks, streets, drives, other existing pavement, or lawns, such surfaces shall be cut as required to install new lines and to make new connections to existing lines.
 - 2. The sizes of the cut shall be held to a minimum, consistent with the work to be accomplished.
 - 3. After the installation of the new work is completed and the excavation has been backfilled and flooded, the area shall be patched, using materials to match those cut out.
 - 4. The patches shall thoroughly bond with the original surfaces and shall be level with them, and shall meet all the requirements established by the authorities having jurisdiction over such areas.
- D. Excavation in Vicinity of Trees:
 - 1. All trees including low hanging limbs within the immediate area of construction shall be adequately protected to a height of at least 5 feet to prevent damage from the construction operations and/or equipment.
 - 2. All excavation within the outermost limb radius of all trees shall be accomplished with extreme care.
 - 3. All roots located within this outermost limb radius shall be brought to the attention of the Construction Inspector before they are cut or damaged in any way.
 - 4. The Construction Inspector will give immediate instructions for the disposition of same.
 - 5. All stumps and roots encountered in the excavation, which are not within the outermost limb radius of existing trees, shall be cut back to a distance of not less than 18-inches from the outside of any concrete structure or pipeline.
 - 6. No chips, parts of stumps, or loose rock shall be left in the excavation.
 - 7. Where stumps and roots have been cut out of the excavation, clean compacted dry bank sand shall be backfilled and tamped, including but not limited to terminal leaking coils, humidifiers, dampers and the like.

3.4 INSTALLATION METHODS

- A. Where to Conceal: All pipes, conduits, etc., shall be concealed in pipe chases, walls, furred spaces, or above the ceilings of the building unless otherwise indicated.

- B. Where to Expose:
 - 1. In mechanical rooms, janitor`s closets tight against pan soffits in exposed "Tee" structures, or storage spaces, but only where necessary, piping may be run exposed.
 - 2. All exposed piping shall be run in the most aesthetic, inconspicuous manner, and parallel or perpendicular to the building lines.
- C. Support: All piping, ducts and conduits shall be adequately and properly supported from the building structure by means of hanger rods or clamps to walls as herein specified.
- D. Maintaining Clearance:
 - 1. Where limited space is available above the ceilings below concrete beams or other deep projections, pipe and conduit shall be sleeved through the projection where it crosses, rather than hung below them in a manner to provide maximum above-floor clearance.
 - 2. Sleeves shall be as specified.
 - 3. Approval shall be obtained from the Architect/Engineer for each penetration.
 - 4. Piping, ductwork and other installed materials should be located such to not obstruct maintenance clearance for mechanical components such as controls, filters and the like.
 - 5. Piping shall not create trip-hazards through floor-mounting but be routed in a manner overhead or below the floor.
- E. Piping:
 - 1. Piping shall be identified with both color and labels as indicated in Section 22 05 53 - Plumbing Identification.
 - 2. All pipe, conduits, etc., shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing.
 - 3. All ducts, pipes and conduits run exposed in machinery and equipment rooms shall be installed parallel to the building lines, except that piping shall be sloped to obtain the proper pitch.
 - 4. Piping, ducts and conduits run in furred ceilings, etc., shall be similarly installed, except as otherwise shown.
 - 5. Conduits in furred ceilings and in other concealed spaces shall be neatly grouped and racked indicating good workmanship.
 - 6. All conduit and pipe openings shall be kept closed until the systems are closed with final connections.
 - 7. All piping not directly buried in the ground shall be considered as "interior piping".
 - 8. Prior to the installation of any ceiling material, gypsum, plaster, or acoustical board, the Contractor shall notify the construction inspector so that arrangement can be made for an inspection of the above-ceiling area about to be "sealed" off.
 - a. The Contractor shall give as much advance notice as possible no less than 10 working days.
 - 9. All above-ceiling areas will be subject to a formal inspection before ceiling panels are installed, or installation is otherwise concealed from view.
 - a. All mechanical, plumbing, and electrical work at and above the ceiling, including items supported by the ceiling grid, such as air inlets or outlets and lighting fixtures, shall be complete and installed in accordance with contract requirements, including power to lighting fixtures, fans, and other powered items.
 - b. Adequate lighting shall be provided to permit thorough inspection of all above-ceiling items.
 - c. The inspection will include representatives of the following: General Contractor and each Subcontractor having work above the ceiling, Physical Plant, Architect/Engineer, UTSW PM, and the Resident Construction Manager`s Construction Inspector Areas to be included and time of inspection shall be coordinated with the Construction Inspector.
 - d. The purpose of this inspection is to verify the completeness and quality of the installation of the air conditioning systems, the electrical systems, the plumbing systems, and any other special above ceiling systems such as pneumatic tube, vacuum systems, fire sprinkler piping and cable tray systems.
 - e. The ceiling supports (tee bar or metal framing) shall be in place so that access panel and light fixture locations are identifiable and so that clearances and access provisions may be evaluated.
 - f. No ceiling materials may be installed until the resulting deficiency list from this inspection is worked off and the Construction Inspector has given approval.

- g. Proper accessibility to equipment may be required to be demonstrated by the commissioning agent or inspector.

3.5 CONNECTIONS FOR OTHERS

- A. The Contractor shall rough in for and make all gas, water, steam, sewer, etc. connections to all fixtures, equipment, machinery, etc., provided by others in accordance with detailed roughing-in Drawings provided by the equipment suppliers, by actual measurements of the equipment connections, or as detailed.
- B. After the equipment is set in place, this Contractor shall make all final connections and shall provide all required pipe, fittings, valves, traps, etc.
- C. Shutoff Valves: In each service line connected to an item of equipment or piece of machinery, provide a shutoff valve.
- D. Traps: On each drain not provided with a trap, provide a suitable trap.
- E. Provide all air gap fittings required, using materials hereinbefore specified. In each service line connected to an item of equipment or piece of machinery, provide a shutoff valve. On each drain not provided with a trap, provide a suitable trap.
- F. All pipe fittings, valves, traps, etc., exposed in finished areas and connected to chrome plated lines provided by others shall be chrome plated to match.
- G. Provide all sheet metal ductwork, transition pieces, etc., required for a complete installation of vent hoods, fume hoods, etc., provided by others.

3.6 CUTTING AND PATCHING

- A. General: Cut and patch walls, floors, etc., resulting from work in existing construction or by failure to provide proper openings or recesses in new construction.
- B. Methods of Cutting:
 - 1. Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to the Architect/Engineer.
 - 2. Impact type equipment shall not be used except where specifically acceptable to the Architect/Engineer. Openings in precast concrete slabs for pipes, conduits, outlet boxes, etc., shall be core drilled to exact size.
- C. Restoration: All openings shall be restored to "as new" condition under the appropriate Specification Section for the materials involved, and shall match remaining surrounding materials and/or finishes.
- D. Masonry:
 - 1. Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry.
 - 2. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation.
 - 3. All structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to the Architect/Engineer.
- E. Plaster:
 - 1. All mechanical work in areas containing plaster shall be completed prior to the application of the finish plaster coat.
 - 2. Cutting of finish plaster coat will not be permitted.
- F. Special Note: No cutting, boring, or excavating which will weaken the structure shall be undertaken.
 - 1. Rebar placement shall be determined prior to floor coring operations.
 - 2. Any rebar, which has been cut, shall be submitted in writing to the Architect/Engineer for evaluation.

3.7 ROOF PENETRATIONS AND FLASHING

- A. Pipe, conduit and duct sleeves, pitch pockets, and flashings compatible with the roofing installation shall be provided and installed by a qualified contractor for all roof penetrations.
- B. This shall be the responsibility of the General Contractor.

3.8 OPERATION PRIOR TO COMPLETION

- A. When any piece of mechanical equipment is operable and it is to the advantage of the Contractor to operate the equipment, they may do so, providing that they properly supervises the operation, and has the Construction Inspector's written permission to do so.

- B. The warranty period shall, however, not commence until such time as the equipment is operated for the beneficial use of the Owner, or date of substantial completion, whichever occurs first.
- 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 deficiency list items before final acceptance by the Owner.
 - 1. The date of acceptance and performance certification will be the same date.
- D. Additional requirements for operation of equipment prior to completion found in the commissioning sections of Division 1 and Division 22 shall be followed.

3.9 CLEANING AND PAINTING

- A. All equipment, piping, conduit, ductwork, grilles, insulation, etc., furnished and installed in exposed areas under Divisions 22, 23 and 26 of these Specifications and as specified shall be cleaned, prepared, and painted according to the following specification. Color of finish painting in Mechanical Rooms shall be painted in accordance with Color Schedule for machinery spaces using Sherwin Williams paint numbers, or approved equivalent.
 - 1. In the event of a conflict between the specifications referenced, the provisions of this specification shall prevail only for Divisions 22, 23 and 26 work.
 - 2. UTSW Approved paint colors: Refer to Section 22 05 53 - Plumbing Identification.
 - 3. Paint Specification: Refer to Section 09 96 00 - High-Performance Coatings.
 - 4. Natural gas piping shall be painted in its entirety.
- B. Equipment furnished by the mechanical, plumbing, and electrical subcontractors shall be delivered to the job with a suitable factory protective finish and shall be painted, after installation, with the color hereinafter specified.
- C. The following materials shall not be painted:
 - 1. Materials: copper, galvanized metal, stainless steel, fiberglass, PVC, and PVDF.
 - 2. Aluminum jacketing on insulation .
 - 3. Nameplates on equipment shall be protected during painting to prevent damage.
- D. Before painting, materials and equipment surfaces shall be thoroughly cleaned of cement, plaster, and other foreign materials, and all oil and grease spots shall be removed.
 - 1. Such surfaces shall be carefully wiped and all cracks and corners scraped out.
 - 2. Exposed metal work shall be carefully brushed down with the steel brushes to remove rust and other spots and left smooth and clean.
- E. Painting:
 - 1. Interior piping shall be primed before insulation installation.
 - 2. Exterior piping shall be primed and painted to finish before insulation installation.
 - 3. For painting purposes, the equipment and piping inside of built-up air handling units shall be painted the same as if they were within the walls of a Mechanical Room.
- F. Scope of painting for Divisions 22, 23, and 26 work in areas other than those defined as "exposed" is as follows:
 - 1. In addition to painting in mechanical rooms, electrical rooms, materials, piping, ductwork, conduit, gear, supports, foundations, equipment and appurtenances installed by the mechanical and electrical subcontractors in exposed areas shall be finish painted with two coats enamel paint of color selected by the Architect/Engineer, refer to Section 09 96 00 - High-Performance Coatings.
 - 2. Additional areas to be defined as "exposed" for purposes of painting, are defined on the Drawings.
 - 3. The surfaces to be finish painted shall first be prepared as follows:
 - a. Electrical switchgear, disconnect switches, contactors, etc., with suitable factory applied finishes shall not be repainted; except for aesthetic reasons where located in finished areas as directed by the Architect/Engineer and in a color selected by the Architect/Engineer.
 - 1) Where factory applied finishes are damaged in transit, storage or installation, or before final acceptance, they shall be restored to factory fresh condition by competent refinishers using the spray process.
 - b. Ferrous metal surfaces without a protective finish and not galvanized in exposed and concealed areas including chases, underfloor and above ceilings shall be painted with two (2) coats of P&L zinc chromate primer as the construction progresses to protect against deterioration.

3.10 CHECKING AND TESTING MATERIALS AND/OR EQUIPMENT

- A. Before the work is accepted, an authorized representative of the manufacturer of the installed materials and/or equipment shall personally inspect the installation and operation of his materials and/or equipment to determine that it is properly installed and in proper operating order.
 - 1. The qualifications of the representative shall be appropriate to the technical requirements of the installation.
 - 2. The qualifications of the representative shall be submitted to the owner for approval.
 - 3. The decision of the owner concerning the appropriateness of the representative shall be final.
 - 4. Testing and checking shall be accomplished during the course of the work where required by work being concealed, and at the completion of the work otherwise.
 - a. In addition, the Contractor shall submit to the Architect/Engineer a signed statement from each representative certifying as follows:
 - 1) "I certify that the materials and/or equipment listed below have been personally inspected by the undersigned authorized manufacturer's representative and is properly installed and operating in accordance with the manufacturer's recommendations".
- B. Check inspections shall include plumbing equipment, heating, air conditioning, insulation, ventilating equipment, controls, mechanical equipment and such other items hereinafter specified or specifically designated by the Owner or the Architect/Engineer.
- C. Refer to the commissioning sections of Division 1 and Division 22 for additional start-up, testing, and acceptance requirements.

3.11 TESTS

- A. The Contractor shall make, at no additional cost to the Owner, any tests deemed necessary by the inspection departments having jurisdiction, and in the National Fire Protection Association, ASTM, etc. Standards listed.
 - 1. The Contractor shall provide all equipment, materials, and labor for making such tests.
 - 2. Reasonable amounts of fuel and electrical energy costs for system tests will be paid by the Owner.
 - 3. Fuel and electrical energy costs for system adjustment and tests which follow beneficial occupancy by the Owner will be borne by the Owner.
- B. Additional tests specified under the various Specification Sections shall be made.
- C. The Construction Inspector shall be notified in writing at least 10 working days prior to each test and other Specification requirements requiring action on the part of the Construction Inspector.
- D. All equipment shall be placed in operation and tested for proper automatic control requirements before the balancing agency starts their work.
- E. Maintain Log of Tests as specified.
- F. See Specifications hereinafter for additional tests and requirements.
- G. All testing reports shall be submitted to UTSW Facilities Management for review and approval.

3.12 LOG OF TESTS

- A. All tests shall have pertinent data logged by the Contractor at the time of testing.
 - 1. Data shall include date, time, personnel, description, and extent of system tested, test conditions, test results, specified results, and other pertinent data
 - 2. Data shall be delivered to the Architect/Engineer and UTSW Facilities Management as specified under "Requirements for Final Acceptance" in Section 01 77 00 - Closeout Procedures and Submittals.
 - 3. All Test Log entries shall be legibly signed by the Project Contractor or his authorized job superintendent.

3.13 COOPERATION AND CLEANUP

- A. It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the job site in a clean and safe condition.
- B. At the end of each day's work, each trade shall properly store all tools, equipment and materials and shall clean his debris from the job. Upon the completion of the job, each trade shall immediately remove all of his tools, equipment, any surplus materials and all debris caused by that portion of the work.

3.14 CLOSEOUT ACTIVITIES

- A. As part of project punch list requirements per Section 01 77 00 - Closeout Procedures and Submittals, include UTSW Plumbing Shop, UTSW Building Maintenance, OSBC, UTSW PM, and other associated teams for plumbing focused review.
- B. Provide revised Operation and Maintenance Data including final installed components schedule, maintenance manuals, and warranty documentation to UTSW PM and to UTSW Building Maintenance.

3.15 TRAINING

- A. Refer to Section 01 79 00 - Demonstration and Training as well as individual technical Sections for specific training requirements.
- B. Where training is called for in other sections provide a minimum of 8 hours on site training for Owner's representatives.
- C. Training shall be presented by a qualified instructor with training experience and technical knowledge of the product.
- D. Submit a training agenda, proposed date, and instructor qualifications to the Owner for approval.

END OF SECTION 22 00 10

SECTION 22 00 11

MEP AUTOCAD PROCEDURES AND STANDARDS

PART 1 - GENERAL

1.1 PURPOSE

- A. The purpose of this Specification is to establish standardized procedures for UTSW engineering drawings submitted as required deliverables by Contractor.

1.2 APPLICABILITY

- A. This Specification applies to all MEP projects completed by any Architect/Engineering (A/E) firm with the Contractor providing as-built documents. .
- B. Prior to the acceptance of project closeout drawings the responsible Contractor shall submit an electronic copy of all drawings to the UTSW Planning Department, who shall certify that the electronic drawing files comply with these standards.
- C. Layers: The following layers shall be used for all mechanical, electrical, plumbing, and fire protection drawings. No other layer designations are permissible.
 1. HVAC/Mechanical:
 - a. M-AHUAir handler components
 - b. M-CHILLERChillers and refrigeration components
 - c. M-CONTROLSControl panels, sensors, wiring, and text
 - d. M-DEMOMechanical components scheduled for demolition
 - e. M-EQUIPUnspecified mechanical equipment
 - f. M-EXHExhaust duct
 - g. M-EXH-VAVExhaust VAV
 - h. M-EXH-GRILLEExhaust grille
 - i. M-HVTEXTHVAC duct size and CFM text
 - j. M-LPDUCTAll low pressure ductwork down stream of the VAV
 - k. M-PADEquipment pads
 - l. M-PUMPAll pumps
 - m. M-RA-DUCTReturn air ducting
 - n. M-RA-GRILLEReturn air grille
 - o. M-SA-COLDCold deck supply air (medium pressure)
 - p. M-SA-DIFFSupply air diffusers
 - q. M-SA-HOTHot deck supply air (medium pressure)
 - r. M-VAVVariable air volume boxes (VAV)
 - s. M-TEXTGeneral mechanical text and notes
 2. ELECTRICAL:
 - a. E-120V-CKTAll 120 volt circuits, panels, text, etc.
 - b. E-120V-RECPAll 120 volt receptacles and plug mold only
 - c. E-120V-LGHTAll 120 volt ceiling mounted lights only
 - d. E-120V-LCKTAll 120 volt lighting circuits, panels, text etc.
 - e. E-120V-UCLTAll 120 volt under cabinet lights, circuits, and text
 - f. E-208V-RECPAll 208 volt receptacles only
 - g. E-208V-CKTAll 208 volt circuits, panels, text etc.
 - h. E-277V-CKTAll 277 volt circuits, panels, text etc.
 - i. E-277V-LCKTAll 277 lighting circuits, panels, text, etc.
 - j. E-277V-LGHTAll 277 volt ceiling mounted lights only
 - k. E-480V-CKTAll 480 volt circuits, panels, text, etc.
 - l. E-480V-DISCAAll 480 volt disconnects only
 - m. E-CTRAYAll cable tray
 - n. E-DEMOElectrical components scheduled for demolition
 - o. E-CONDUITAll conduit
 - p. E-TEXTGeneral electrical text and notes
 3. PIPING:
 - a. P-AIRCompressed air piping and text

- b. P-AWAcid wastes and vents piping and text
 - c. P-CO2-GASCarbon dioxide gas piping and text
 - d. P-CNSCondenser water supply and text
 - e. P-CNRCondenser water return and text
 - f. P-CRSteam condensate return and text
 - g. P-CWRChill water return piping and text
 - h. P-CWSChill water supply piping and text
 - i. P-DEMO Plumbing components scheduled for demolition
 - j. P-DIRDe-ionized water return piping and text
 - k. P-DISDe-ionized water supply piping and text
 - l. P-FUELFuel oil system piping and text
 - m. P-HWRHot water return piping for HVAC coils and text
 - n. P-HWSHot water supply piping from HVAC coils and text
 - o. P-LAB-HWLaboratory hot water piping and text
 - p. P-LAB-CWLaboratory cold water piping and text
 - q. P-NGASNatural gas piping and text
 - r. P-N2-GASNitrogen gas piping and text
 - s. P-N2-LIQLiquid nitrogen piping and text
 - t. P-SANSanitary sewer piping, vents, and text
 - u. P-STORMStorm sewer piping and text
 - v. P-STEAMSteam supply piping and text
 - w. P-TEXTGeneral non-specific piping text
 - x. P-VACVacuum piping and text
 - y. P-VALVEValves and text
4. FIRE PROTECTION:
- a. F-ALARMAll alert devices (audible, strobe, etc.) and text
 - b. F-CO2CO2 suppression system and text
 - c. F-DAMPERSmoke dampers, fire dampers, and text
 - d. D-DEMOFire protection components scheduled for demolition
 - e. F-HALONHalon or other type suppression system and text
 - f. F-PIPINGFire protection piping and text
 - g. F-PENDANTDrop ceiling sprinkler heads only
 - h. F-SPRNKSprinkler heads other than drop ceiling
 - i. F-TEXTGeneral non-specific fire protection text
 - j. F-VALVESFire protection isolation valves and text
5. MISCELLANEOUS LAYERS:
- a. A-TEXTPaper space notes
 - b. VIEWPORTView ports
 - c. XREF-BASEAll drawings are to be x-reffed on this layer
- D. IMPORTANT: Use only the layers above. If additional layers are needed, add a numerical value. For example: P-STEAM1, P-STEAM2...

1.3 FLOOR MASTER DRAWING DESIGNATION

- A. Provide floor master drawings (if available) by e-mail or file transfer.
- B. Master drawings follow the following alphanumeric designations as shown in the examples below:
 - 1. NA01MPBuilding "NA", floor 1, mechanical floor plan
 - 2. B02PSBuilding B, floor 2, plumbing sectional views
 - 3. DC01ELBuilding DC, floor 1, lighting floor plan drawing
- C. Master drawings have the following classifications by discipline:
 - 1. MPHVAC/mechanical equipment floor plan
 - 2. MSHVAC/mechanical equipment sectional views
 - 3. EPElectrical power floor plan
 - 4. ELElectrical lighting floor plan
 - 5. ETCable tray
 - 6. ESElectrical sectional views
 - 7. PPPlumbing floor plan

8. PSPlumbing sectional views
 9. FPFire protection floor plan
 10. FSFire protection sectional views
- D. Note: the EP and EL Floor Masters are eventually combined. Maintaining separate electrical master drawings is left to A/E choice.
- E. The master drawing file name shall not be used as any project master. The file shall be copied, and the file name shall be changed per Section 5.0.
1. Do not return any electronic file with a floor master designation assigned.
- 1.4 PROJECT MASTER DRAWING DESIGNATIONS
- A. The Project Master Drawing is essentially an updated part of the Floor Master Drawing, and will eventually be blocked into the Floor Master Drawing for the building. The intent is to create a unique file that is readily identifiable and traceable.
- B. Project Drawing Masters shall the following alphanumeric designations as shown in examples listed below:
1. L5R262MBldg L, floor 5, room 262, mechanical HVAC
 2. NA8R410EBldg NA, floor 8, room 410, electrical
 3. B2R300PBldg B, floor 2, room 300, plumbing
- C. Where more than one room is being renovated, just one room number will be sufficient.
- D. DO NOT PLACE CONSTRUCTION NOTES ON PROJECT MASTER DRAWINGS
- E. Construction notes are unique to a particular project. Construction notes shall be placed on the presentation drawings.
- F. The text size used on all project master drawings shall be 4-1/2 inches. There are no exceptions.
- 1.5 SETTING UP PRESENTATION DRAWINGS
- A. Presentation drawings shall follow the following classifications by discipline:
1. M1.1, 1.2...HVAC/mechanical equipment demolition floor plans
 2. M2.1, 2.2...New HVAC/mechanical equipment floor plans
 3. M3.1, 3.2...HVAC/mechanical equipment sectional views
 4. M4.1, 4.2...HVAC/mechanical equipment details
 5. M5.1, 5.2...HVAC/mechanical equipment schedules
 6. E1.1, 1.2...Electrical demolition floor plans
 7. E2.1, 2.2...Electrical power floor plans
 8. E3.1, 3.2...Electrical lighting floor plans
 9. E4.1, 4.2...Electrical power and lighting details
 10. E5.1, 5.2...Electrical power and lighting schedules
 11. P1.1, 1.2...Plumbing demolition floor plans
 12. P2.1, 2.2...New plumbing floor plans
 13. P3.1, 3.2...Utility piping plans
 14. P4.1, 4.2...Plumbing details
 15. P5.1, 5.2...Plumbing fixture schedules
 16. F1.1, 1.2...Fire protection demolition floor plans
 17. F2.1, 2.2...New fire protection floor plans
 18. F3.1, 3.2...Fire protection sectional views
 19. F4.1, 4.2...Fire protection details
 20. F5.1, 5.2...Fire protection equipment schedules
- B. Presentation drawings are done in Paper Space, not Tiled Model Space.
- 1.6 DRAWING SCALE, FONTS, AND BLOCKS
- A. Refer to UTSW Design Guidelines Section C for Submittal Requirements for all Deliverables.UTSW deals with many A/E firms; many have their own choice and size of fonts. This proves to be a significant problem in drawing reconciliation.
- B. Drawing presentation shall be set up on 1/4inch scale.
- C. The A/E firm SHALL NOT use custom fonts, &archsty.shx is the font that UTSW uses for all architectural and engineering drawing. The font style Simplex.shx is considered an acceptable substitute for MEP drawings.

D. Presentation drawings submitted in AutoCAD shall be set up in paper space with a viewport depicting the project area. The font style is &archsty.shx, and UTSW will provide upon request.

E. All blocks shall be created and set to layer 0 prior to inserting into a drawing. The color shall be set to 'by

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 22 00 11

SECTION 22 00 13

UTSW PLUMBING DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 PURPOSE

- A. This Specification establishes University of Texas Southwestern Medical Center (UTSW) requirements for plumbing projects on campus. This document address design criterion not specifically covered by the Plumbing Code (UPC), or set requirements that may exceed the minimum requirements of the Code.

1.3 APPLICABILITY

- A. This standard applies to all plumbing projects designed and constructed by physical plant personnel, outside Architect/Engineering (A/E) firms, and all construction contractors. No substitutions to the standard are acceptable without the written authorization of the ENGINEER.

1.4 TERMS AND DEFINITIONS

- A. CDAS – Central Data Acquisition System. CDAS is the campus-wide central monitoring station, which is located in the Physical Plant Office (P Building).
- B. Dry Lab – Laboratories, which are not equipped with multiple utilities, but require a greater degree of electrical power and HVAC than an office area.
- C. Engineer – UTSW Engineer
- D. Gas Cylinder Room – Any room that contains carbon dioxide, nitrogen, or argon cylinders in excess of 50 Lbs. capacity.
- E. Wet Lab – Any laboratory equipped with sinks, fume hoods, biological safety cabinets, or other equipment, which requires multiple utilities (such as gas, air or vacuum), and a greater degree of HVAC than a dry lab.

1.5 GENERAL PLUMBING DESIGN DRAWING CRITERIA

- A. Flow diagrams shall be drawn for each piping system including but not limited to steam, heating water, chilled water, hot and cold water, distilled water, fire standpipe, oxygen, compressed air, condensing water, gas, vacuum, and refrigerant systems. Mains and major branches shall show quantities of flow with size. All valve sizes shall be indicated. Architectural room names and numbers shall be used to indicate locations.
- B. HVAC plumbing and air-conditioning systems shall be drawn as separate drawings. A complete roof plan shall be included both for air-conditioning plans and plumbing plans; one plan may serve for both.
- C. Floor plans for mechanical systems shall be drawn to show pipes, ducts, et on the floor in which they are installed.
- D. Plumbing riser diagrams must be drawn with one for each riser on the project. The risers must show all piping from the under-floor through the roof.

1.6 PLUMBING DESIGN FOR WET LABS

- A. UTSW has standardized the arrangement of horizontal plumbing utilities for laboratory counters and peninsulas. An AutoCAD detail of the horizontal plumbing chase is readily available from the ENGINEER.
- B. Acid waste piping is composed of glass. No acid waste or vent pipe shall be sized smaller than 2 inches diameter. Acid waste exposed to the potential for damage shall be constructed of either high silica cast iron (Duriron) or protected with unistrut guards.
- C. All de-ionized water fixtures shall be designed for recirculation, regardless of existing de-ionized water design or availability. If a return line is not available, the fitting will be capped for future.
- D. All fixtures serving laboratory Millipore filtration systems shall be equipped with a positive connection, such as a compression fitting. No “tube-and-turret-barb” configurations are acceptable. The standard procedure is to provide a Hayward 1/2 inch PVC Needle valve with double female connections, stock # NV10050T. The department provides the connections to the valve.

- E. Natural gas lines shall be of a welded black steel construction up to emergency shut-off valves within reach of occupants. Natural gas lines from emergency shut-off valves to lab tables or appliances may be screwed if not larger than 3/4 inch and if they are exposed.
- F. The emergency gas shutoff valve shall be located as close to the room exit as possible.
- G. All connections between dissimilar materials in the piping system shall be made with dielectric unions or couplings.
- H. At every point where piping penetrate a floor slab, except slabs on grade, a cast-in sleeve or other waterproof curbing at least 2 inch high shall be provided.
- I. Rebar shall be located prior to coring any holes.
- J. Wherever possible gravity drainage to a hub or floor sink is to be used. Condensate pumps shall not be use to drain equipment.

1.7 DESIGN OF GAS PIPING IN GAS CYLINDER ROOMS AND LABORATORIES

- A. All piping for vacuum and gases other than natural gas shall be ASTM B88, Type L hard drawn seamless copper pipe and tubing. Use brass mechanical connections where required. All vacuum and oxygen piping shall be dry nitrogen purged while being soldered.
- B. An isolation valve shall be provided for each branch circuit. Gas turrets shall not be relied upon as isolation valves.
- C. Greater than two tank installations require a manifold system and shall be hard piped. Piping for two tank installations is normally the responsibility of the Department.

1.8 LAVATORY AND MECHANICAL ROOM DESIGN CONSIDERATIONS

- A. Waste lines from lavatories shall be limited to two fixtures per arm. The wastes shall discharge into a Cast Iron (C.I.) stack behind the fixture. Back to back lavatories are permitted if connected to sanitary tapped crosses. Straight tapped crosses are not permitted.
- B. Floor drains shall be 4 inches in size serving 80 or more square feet. Areas less than 80 square feet shall be 3 inch diameter. Coordinate with architect to provide minimum 1 inch in 10 feet slope to room and area drains.
- C. Drains serving as indirect receptors for other drain piping shall be floor sink style.
- D. Clean-outs shall be shown on plans and on riser diagrams.
- E. Vent pipes shall be carried up adjoining soil and waste pipe, and they shall be connected into the main stack at top and bottom. Vents may be one size smaller than the traps they serve, except that no vent shall be less than 2 inch. The size of vent lines accommodating more than one fixture shall be sized in accordance with the International Plumbing Code.
- F. Specified fixtures shall conform to the requirements of UTSW Codes, Regulations, and standards, including the Texas Department of Health water saving performance standards.
 - 1. Photoelectric activated plumbing fixtures are generally not in use at the campus, and as a result of past maintenance problems their introduction is discouraged.

1.9 ROOF DRAINS

- A. Roof drain piping shall be sized in accordance with Table D-1 of the Plumbing Code. Use 4.0 inches per hour as a design rainstorm.
- B. Roof drains shall be run separately from all other storm water sources to a manhole outside the building. Downstream from this manhole, the piping shall be sized sufficiently large to prevent roof drain water from impeding the proper flow from area drains. All piping 50 feet or more below the roof shall be welded construction.
- C. No piping should be run in concrete floors. No piping should be buried beneath the lowest floor level with the exception of soil pipe.

1.10 MISCELLANEOUS

- A. Domestic water lines shall not be run to coffee makers, unless a drain is provided or the coffee maker is immediately adjacent to a sink.
- B. Drinking fountains shall be electric, wall type, surface mounted into a wall recess 30 inches wide x 14 inches deep except where ADA requirements dictate a different configuration. Do not construct fountains into the walls so that a building alteration is required in the event an exact duplicate is not available.

- C. All machine room floor sinks shall be a minimum of 4 inch diameter, with acid resisting interior, and shall be connected with trap primers. Floor drains in areas above grade and over crawlspaces shall have mechanical joints for easy access.
- D. Process or Laboratory Equipment shall not be directly connected to the hydronic chilled water system, including process chillers. A process cooling water loop consisting of a heat exchanger, filters, pumps, piping, and controls must be provided for service to Laboratory equipment.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 22 00 13

SECTION 22 05 16

PIPING EXPANSION COMPENSATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Flexible pipe connectors.
- B. Expansion joints and compensators.
- C. Pipe loops, offsets, and swing joints.

1.3 RELATED REQUIREMENTS

- A. Division 21 Fire Protection Sections.
- B. Section 22 00 10 - Basic Plumbing Requirements.
- C. Section 22 11 16 - Plumbing Piping.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 PERFORMANCE REQUIREMENTS

- A. Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.
- B. Expansion Calculations:
 - 1. Installation Temperature: 50 degrees F.
 - 2. Domestic Hot Water: 140 degrees F.
 - 3. Safety Factor: 30 percent.

1.6 SUBMITTALS

- A. Submit under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- C. Design Data: Submit calculations for the sizing of expansion loops and selection of expansion joints.
- D. Shop Drawings: Submit shop drawings indicating the exact location and calculated axial and lateral loads for all anchors, guides, expansion joints and loops. Provide drawings indicating the proposed method of attachment to the building structure.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and external controls.
- F. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.7 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

1.8 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Maintenance Data: Include adjustment instructions.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

- B. Design expansion compensating system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State of Texas.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.
- C. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.11 WARRANTY

- A. Provide five year warranty.
- B. Warranty: Include coverage for leak free performance of packed expansion joints.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Microflex, Inc.
- B. Amber Booth Company.
- C. The Metroflex Company.
- D. ADSCO Manufacturing Corporation.
- E. Mason Industries, Inc.
- F. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 EXPANSION JOINTS

- A. Laminated Stainless Steel Bellows Type as manufactured by Hyspan.
 - 1. Pressure Rating: 300 psig WOG and 500 degrees F.
 - 2. Joint: As specified for pipe joints.
 - 3. Size: Use pipe sized units.
 - 4. Application: Domestic hot and cold water piping.

2.3 ACCESSORIES

- A. Pipe Alignment Guides: Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inch travel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Construct spool pieces to exact size of flexible connection for future insertion.
- C. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.
- D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
- E. Rigidly anchor pipe to building structure where necessary. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.
- F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where indicated.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Prepare and start systems under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Provide inspection services by flexible pipe manufacturer's representative for final installing and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION 22 05 16

SECTION 22 05 19

METERS AND GAUGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Pressure gauges and pressure gauge connections.
- B. Thermometers and thermometer wells.
- C. Pressure/temperature test plugs.

1.3 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ASME B40.100 - Pressure Gauges and Gauge Attachments.
- C. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers.
- D. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.
- E. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service.

1.4 SUBMITTALS

- A. Submit under provisions of Division 01 and Section 22 00 10 - Basic Plumbing Requirements.
- B. Product Data: Include list for every meter and gauge to be provided which indicates use, operating range, total range and location.
- C. Samples: Submit one of each type of instrument specified upon request by Engineer.
- D. Submit manufacturer's installation instructions.
- E. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit record documents under provisions of Division 01 and Section 22 00 10 - Basic Plumbing Requirements.
- B. Accurately record actual locations of meters and gauges.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 - PRODUCTS

2.1 GAUGES AND GAUGE CONNECTIONS

- A. Pressure Gauges and Accessories: Provide Ashcroft gauges or approved equal, complete with lever handle shut-off cocks, and pulsation piston type dampeners, or approved equal. Porous type dampeners will not be accepted. Gauges shall have stainless steel movement and 1/2 of 1 percent accuracy. Gauges shall have back connection when used on a panel; otherwise they shall have bottom connections. Gauges shall have minimum 3 inch diameter faces.
- B. Pressure Gauge Connections: Provide where noted or indicated on the Drawings or called for elsewhere in the Specifications, gauge connections complete with lever handle union shutoff cocks, or approved equal. All gauge connections shall be made up with brass pipe, nipples and brass screw fittings.
- C. Siphon: Brass, 1/4 inch angle or straight pattern. Model SY14b manufactured by Weiss.
- D. Pressure Test Tap: 1/4 inch full port brass ball valve, 150 psig.

2.2 THERMOMETER AND THERMOMETER WELLS

- A. Provide thermometers of not less than 9 inch length scale complete with brass separable sockets (wells) with extension neck to allow for insulation of piping.

1. These thermometers shall be mercury red reading type in one piece glass tubes extending from top of scale to sensor, and shall be located so that they may be easily read.
 2. Field adjustable angle thermometers are acceptable.
 3. Thermometers shall be Weksler Industrial Thermometers, or approved equal.
- B. Thermometer test wells shall be 3/4 inch Weksler Thermal Wells, brass with stem of minimum length to extend beyond the mid-diameter of the pipe, 2-1/2 inch extension neck, and brass screw plug. Wells shall be suitable for use of industrial type thermometers.
- C. All thermometers shall be easily read from floor and readily visible from floor.

2.3 PRESSURE TEMPERATURE TEST PLUGS

- A. Test Plug:
1. 1/4 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe.
 2. Provide test plugs rated for 400 psig with neoprene core for temperatures up to 200 degrees F and Nordel core for temperatures up to 350 degrees F and manufactured by Fairfax or approved equal.
 3. Provide extensions for plugs installed on insulated piping.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
1. Pressure gauges shall be provided on the suction and discharge of base mounted pumps as indicated on the Drawings.
 2. Single pressure gauges shall be installed on in-line pumps as indicated on the Drawings.
 3. Install pressure gages with pulsation dampers. Provide gage cock to isolate each gage. Provide siphon on gages in steam systems. Install thread-o-lets on piping for gage installation, do not weld nipple directly to pipe.
 4. Install thermometers in piping systems in thermometer wells. Enlarge pipes smaller than 2-1/2 inch for installation of -thermometer sockets.
 5. Thermometer wells and thermometers shall be located where noted on the Drawings and where called for in other sections of the Specifications. Thermometer test wells only shall be installed in a vertical position in horizontal lines and at 45 degrees, in vertical lines to hold a fluid in the well.
 6. Locate pressure/temperature test plugs on the inlet and outlet of each heating coil in air terminal units, unit heaters, duct heating coils, etc. Mount short nipple with 1/4 inch ball valve. Place in accessible locations.

END OF SECTION 22 05 19

SECTION 22 05 29

HANGERS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Hangers for plumbing piping.

1.3 RELATED REQUIREMENTS

- A. Section 22 11 16 - Domestic Water Piping.
- B. Section 22 13 16 - Storm And Sanitary Waste And Vent Piping.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 SUBMITTALS

- A. Submit product data for review in accordance with the requirements of Division 01.
- B. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Anvil.
- B. Carpenter and Patterson.
- C. Fee and Mason.
- D. B-Line.
- E. Viking.
- F. Reliable.
- G. Michigan.
- H. Anvil model numbers are used for reference.

2.2 HANGERS

- A. Anvil Figure #260 MSS Type 1, clevis hangers for:
 - 1. Non-insulated steel and galvanized piping 2 inch through 24 inch diameter.
 - 2. Non-insulated cast iron pipe.
 - 3. Non-insulated PVC piping.
- B. Anvil Figure #260 clevis hangers with Figure 167, MSS Type 40 galvanized insulation protection shields (sized for supporting insulation having a compressive strength of 4 psi). Support piping on outside of insulation. Size hangers so that pipe insulation passes through them without interruption.
 - 1. Domestic hot water piping above 160 degrees F. 4 inch diameter and less.
 - 2. All other insulated piping.
- C. Anvil Figure CT-69, MSS Type 10 with adjustable wrought tubing ring hanger, copper plated for:
 - 1. Non-insulated copper tubing with no longitudinal movement.
 - 2. Isolation of copper tubing from dissimilar material shall also be accomplished through the use of PHD Manufacturing, Model Numbers 2501 - 2514 Unistrut clamps with PVC inserts or PHD model number 143 PVC coated swivel ring hangers.
- D. Anvil Figure #171, MSS Type 41 with pipe roller, Anvil Figure #167 protection saddle, MSS Type 40 galvanized insulation protection shields (sized for supporting insulation having a compressive strength of 4 psi, at 8 foot intervals). Support piping on outside of insulation. Size hangers so that pipe insulation passes through them without interruption. Use these for:
 - 1. Domestic hot water above 160 degrees F, 6 inch diameter and larger.

- E. Anvil Figure #CT-121, MSS Type 8, riser clamps (at floor penetrations) to support:
 - 1. Copper pipe risers.
- F. Anvil Figure #261, MSS Type 8, riser clamps (at floor slab penetrations) to support:
 - 1. Steel pipe risers.
 - 2. PVC pipe risers.
- G. Anvil Powerstrut Trapeze Hangers: Where three or more lines of pipe run parallel, support them with trapeze hangers.
- H. Water piping supports within walls to be by Caddy, Holdrite, Sioux Chief or approved equivalent. Support vertical drops and piping at fixture supplies in wall. Hanger material to be suitable for piping material installed. Piping supports shall be installed per manufacturer's recommendations.

2.3 INSERTS

- A. Concrete Insert: Anvil Figure #281, MSS Type 18, universal concrete inserts, adequately sized and correctly positioned to support full load operating systems.
- B. Concrete Insert, Wedge Type: Anvil Figure #281, 1/4 inch to 7/8 inch.
- C. Lightweight Concrete Insert: Anvil Figure #285.
- D. Continuous Concrete Insert: Anvil Powerstrut Figure #PS-349 pre-galvanized.

2.4 EXPANSION ANCHORS

- A. Hilti Kwik-bolt, zinc-plated, metal expansion anchor.
- B. Anchor to meet U.L., ICBO-4627 and FM listings.

2.5 HANGER RODS

- A. Provide mild steel all-thread rods with maximum loads as follows:
 - 1. 3/8 inch - 300 lbs
 - 2. 1/2 inch - 600 lbs
 - 3. 5/8 inch - 1,200 lbs
 - 4. 3/4 inch - 2,000 lbs
 - 5. 1 inch - 5,000 lbs

2.6 CLAMPS

- A. C-Clamps: Anvil Figure #92, MSS Type 23.
 - 1. Use these for attaching hangers to steel beams. Do not weld hanger rods to structural steel members.
- B. Malleable Beam Clamps: Anvil Figure #218, MSS Type 30: Use these for attaching hangers to bar joists. Attach clamps to top chord of bar joists only. Confirm with structural engineer for maximum loading and restrictions.

PART 3 - EXECUTION

3.1 PIPE HANGERS

- A. Support pipes on specified hangers so that equipment, pumps, and fittings do not bear weight or stresses from vibration and swaying of pipe. Support pipe risers at regular intervals in pipe shafts at least once at each floor level or a maximum of 12 feet apart. Do not use perforated metal, strap iron, or band iron. Do not make offsets in hangers.
- B. Maximum allowable spacing of pipe hangers is listed below. Space hangers and brackets at closer intervals where necessary to maintain levels, slopes, and drainage, or to prevent sagging or swaying of pipe.
- C. Steel Pipe - Water
 - 1. 1/4 inch to 1-1/2 inch - 7 feet O.C.
 - 2. 2 inch to 2-1/2 inch - 10 feet O.C.
 - 3. 3 inch to 4 inch - 12 feet O.C.
 - 4. 5 inch and above - 14 feet O.C.
- D. Steel - Vapor
 - 1. 1/4 inch to 1-1/2 inch - 8 feet O.C.
 - 2. 2 inch to 2-1/2 inch - 13 feet O.C.
 - 3. 3 inch and above - 15 feet O.C.
- E. Copper Pipe - Water

1. 1/4 inch to 1-1/4 inch - 5 feet O.C.
 2. 2 inch to 2-1/2 inch - 8 feet O.C.
 3. 3 inch and above - 10 feet O.C.
 4. 1-1/4 inch to 2 inch - 8 feet O.C.
- F. Cast iron pipe
1. Space hangers not to exceed 5 feet on centers. Provide minimum of two hangers per section within 18 inch of joint on barrel and at change of direction and branch connection. Install hanger and supports per CISPI 301-12.

END OF SECTION 22 05 29

SECTION 22 05 53

PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Nameplates.
- B. Pipe Markers.
- C. Ceiling Tacks.

1.3 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Section 22 62 19 - Medical Gas and Vacuum Systems for supply of pipe labels for placement by this Section.

1.4 RELATED REQUIREMENTS

- A. Section 22 00 10 - Basic Plumbing Requirements.
- B. Section 22 07 19 - Plumbing Insulation.

1.5 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems.
- B. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005.

1.6 SUBMITTALS

- A. Submit under provisions of Division 01 and Section 22 00 10 - Basic Plumbing Requirements.
- B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Obtain new equipment identification numbers from the Drawings or the Superintendent of Utilities.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Samples: Submit two of each type of label, tag, etc., of the approximate size specified or implied in the specification.
- F. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- G. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.7 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 01 and Section 22 00 10 - Basic Plumbing Requirements.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The Contractor shall make it possible for the personnel operating and maintaining the new equipment and systems in this project to readily identify the various pieces of equipment, major valves, piping, etc., by marking them.
 - 1. All items of equipment such as pumps, etc., shall be clearly marked using engraved nameplates as hereinafter specified.
 - 2. The item of equipment shall indicate the same number as shown on the Drawings. For example, pumps will be identified as 3A, 3B, 3C, etc.
 - 3. The equipment identification will be shown on the Drawings or provided by the Superintendent of Utilities.
 - 4. All piping shall be identified with pipe markers including pipe type, direction, and pipe diameter with colors to match UTSW requirements.
 - 5. Color coded pipe jacketing and fitting covers (to match jacketing type) shall match UTSW colors for mechanical and piping.

2.2 MECHANICAL SPACE AND PIPING COLORS

A. UTSW Colors in mechanical and exposed spaces shall be as follows:

1. Colors shown are with Sherwin Williams paint and approved equivalent are allowed per Section 09 96 00 - High-Performance Coatings.

ITEM	COLOR	PAINT NUMBER
Structural Elements and Railing	Gray	Structural Gray SW 4031
Equipment Supports	Light Gray	Nickel SW 4030
Floor	Gray	Slate Gray SW 4026
Housekeeping Curbs (Face)	Yellow	Safety Yellow SW 4084
Equipment Curbs (Face)	Color to Match Equipment	Confirm with Utilities
Clearances and Safety Marking on Floors and Walls	Yellow	Safety Yellow SW 4084
Walls	White	Extra White LRV 86%
Gantry Crane	Yellow	Safety Yellow SW 4084
Fire Sprinkler / Fire Safety	Red	Safety Red SW 4081
Boiler (Existing)	Match Existing Equipment	Match Existing Color
Boiler (New)	Manufacturer Standard Colors	Confirm with Utilities
Steam	Aluminum Lagging	Aluminum
Condensate Return	Aluminum Lagging	Aluminum
Hot Water (Supply)	Dark Orange	International Orange SW 4082
Hot Water (Return)	Orange	Safety Orange SW 4083
Natural Gas	Yellow	Safety Yellow SW 4084
Natural Gas Vent	Yellow	Safety Yellow SW 4084
Fuel Oil	Yellow	Junction Yellow SW 4034
City Water	Light Blue	Polymer Blue SW 4055
Exterior Water	Aluminum Lagging	Aluminum Lagging with Heat Trace
Chiller (Supply)	Dark Blue	Safety Blue SW 4086
Chiller (Return)	Blue	Turbine Blue SW 4064
Chiller Refrigerant Vent	Aluminum Lagging	Aluminum
Condensing Water (Supply)	Dark Green	Safety Green SW 4085
Condensing Water (Return)	Light Green	Generator Green SW 4070
Condensing Water (Exterior)	Aluminum Lagging	Aluminum
Compressed Air	Green	Green Byte SW 4076
Refrigerant Recovery	Purple	Plumb SW 4080
Vents / Roof Vents	Gray	Galvino SW 4027
Hanger Rods	Same as Related Pipe	Confirm with Utilities
Storm Water	White	Ultra White LRV 88%
Atmospheric Relief Lines	Sames as Related Pipe	Confirm with Utilities
Ductwork, AHU, Fans, and Insulation	Aluminum Lagging	Aluminum

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install plastic pipe markers in accordance with manufacturer's instructions.
- C. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- D. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.
- E. Identify pumps, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- F. Identify control panels and major control components outside panels with plastic nameplates.

END OF SECTION 22 05 53

SECTION 22 07 19
PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Piping insulation.
- B. Jackets and accessories.

1.3 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Section 21 13 13 - Automatic Fire Sprinkler Systems for placement of hangers and hanger inserts.
- B. Section 22 11 16 - Plumbing Piping for placement of hangers and hanger inserts.

1.4 RELATED REQUIREMENTS

- A. Section 09 96 00 - High Performance Coatings for paint types for pipe painting.
- B. Section 22 00 10 - Basic Plumbing Requirements.
- C. Section 22 05 53 - Plumbing Identification for required colors and labeling on piping.

1.5 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- D. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
- E. ASTM C335 - Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation.
- F. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
- G. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
- H. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- I. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
- J. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.
- K. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- L. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing.
- M. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
- N. ASTM C610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation.
- O. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- P. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
- Q. ASTM D1667 - Standard Specification for Flexible Cellular Materials--Poly(Vinyl Chloride) Foam (Closed-Cell).
- R. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.
- S. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- T. ASTM E96/E96M - Standard Test Methods for Water Vapor.
- U. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- V. UL 723 - Standard for Test for Surface Burning.

1.6 SUBMITTALS

- A. Submit under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Product Data: Provide product description, list of materials and thickness for each service, and locations.
- C. Samples: Submit two samples of any representative size illustrating each insulation type.
- D. Indicate procedures, which ensure acceptable workmanship and installation standards will be achieved.
- E. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.7 QUALITY ASSURANCE

- A. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with NFPA 255.

1.8 QUALIFICATIONS

- A. Applicator: Company specializing in performing the work of this section with minimum three years experience.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Store insulation in original wrapping and protect from weather and construction traffic.
- D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.
- C. All insulation materials to be asbestos free.

PART 2 - PRODUCTS

2.1 HOT AND COLD DOMESTIC WATER (INCLUDING LABS)

- A. Hot and cold water lines in buildings, including valves, strainers, unions, flanges, etc., except where specifically noted to the contrary, shall be insulated.
- B. Cold water lines shall be insulated with 1/2 inch thick minimum 3 1/2 pound density preformed fiberglass insulation with a factory applied All Service Jacket, vapor sealing all joints, and factory performed fittings with vapor seal, or a flexible, 1/2 inch thick, "25 50" rated, closed cell elastomeric thermal insulation such as "Self Seal Armaflex 2000".
- C. Elastomeric products shall be supplied in a pre-slit tubular form with a pressure sensitive adhesive system for closure and vapor sealing of the longitudinal joint.
 - 1. All elastomeric insulating products shall be guaranteed not to react with copper piping.
- D. Valves shall be insulated with mitered pipe covering with voids filled with glass fiber blanket insulation.
- E. Valves and fittings shall be vapor sealed with a water base asphaltic emulsion.
- F. Fittings on concealed insulation shall be built up to the thickness of adjacent insulation with glass fiber fitting wrap and shall be finished with Glasfab tape embedded in vapor barrier emulsion.
- G. Exposed fitting insulation shall be built up to same thickness as adjoining pipe insulation with one coat cement and after drying shall be finished with a white vapor seal and canvas jacket secured with "Arabol" adhesive and be suitable for painting.
- H. Seams in jacket shall be placed in the least noticeable locations.
 - 1. Where seams, joint or fittings are rough they shall be covered with an application of insulating cement troweled on smoothly before the canvas is applied with Arabol adhesive.
 - 2. The canvas must be free of wrinkles and have a smooth, neat appearance.
- I. All hot water piping systems shall be insulated as specified above for cold water, and the insulation thickness shall be 1 inch thick.
- J. The only hot and cold water piping that will not require insulation are the exposed runouts under non-handicap plumbing fixtures. Where pipe chases are tight, adequate provision shall be made at the rough

in stage utilizing offset fittings or other means (except springing the pipe) to insure that insulation can be applied throughout the length of the pipe.

2.2 ROOF DRAIN PIPING

- A. All roof drain piping and all horizontal runs in the building, and the bottom of all roof drains shall be insulated as specified for domestic cold water.
- B. Vertical roof drain piping inside the building shall not be insulated.

2.3 FIRE PROTECTION PIPING

- A. Fire protection piping, exposed or concealed, subject to freezing temperatures, shall be insulated with 7-1/2 lb. density fiberglass UL rated noncombustible pipe insulating system using sectional
 - 1. pipe covering, jacketed with a factory applied vapor barrier laminate of aluminum foil and glass cloth. Exposed piping shall be sized for painting. Thickness shall be as follows:

<u>Pipe Size (inches)</u>	<u>Insulation Thickness (inches)</u>
2 and smaller	2
2-1/2 and larger	2-1/2

2.4 SANITARY DRAIN PIPING

- A. All sanitary drain piping within 25 feet of a floor sink receiving cold condensate discharge and discharge and drain body shall be insulated as specified for domestic cold water.

2.5 INSULATION TYPES

- A. Type A: Fiberglass
 - 1. Manufacturers:
 - a. Owens Corning Corporation.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Insulation:
 - a. Glass fiber insulation piping insulation with a "K" factor of 0.23 BTU-In/Hr.-degree F at 75°F and 0.32 BTU-In/Hr.-degree F at 250°.
 - b. Rated maximum service temperature of 850°F.
 - c. Maximum density of 3.5-5.5 lbs/ft³.
 - d. Compressive strength of 28.5 psi minimum when tested in accordance with ASTM C165.
 - e. Rated as 25 flame spread and 50 smoke developed when tested in accordance with ASTM E84, UL 723, CAN/ULC-S102-M88 or NFPA 255.
 - f. Certified to meet the requirements of ASTM C795 for use over stainless steel.
 - g. Rated as noncombustible when tested in accordance with ASTM E136.
 - h. Insulation treated with water resistant resin on the surface and within each layer of the insulation.
- B. Type B: Closed Cell Elastomeric
 - 1. Manufacturers:
 - a. Armacell.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Insulation:
 - a. Closed cell elastomeric piping insulation with a "K" factor of 0.25 BTU-In/Hr.-degree F.
 - b. Rated maximum service temperature of 220°F.
 - c. Rated as 25 flame spread and 50 smoke developed when tested in accordance with ASTM E84, UL 723, CAN/ULC-S102-M88 or NFPA 255.
 - d. Certified to meet the requirements of ASTM C795 for use over stainless steel.
 - e. Rated as noncombustible when tested in accordance with ASTM E136.

2.6 PROTECTIVE JACKETING

- A. General:
 - 1. All jacketing shall be installed with the seam located along the bottom.
 - 2. At valves and special fittings, provide removable jackets to nearest flange in both direction for maintenance and removal of fittings.
- B. PVC Jacketing:
 - 1. Manufacturers:
 - a. Johns Manville Corporation; _____.

- b. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. PVC jacketing and fitting covers.
 - a. Material shall have 25/50 rating and shall be limited to piping systems operating at 140 degrees or below.
 - b. Thickness: 10 mil, 0.010 inch (0.25 mm).
 - 3. PVC color jacketing is required on all piping and shall match color requirements in Section 22 05 53 - Plumbing Identification.
- C. Canvas Jacket: UL listed 6 oz/sq yd (220 g/sq m) plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
 - 1. Lagging Adhesive: Compatible with insulation.
 - a. Manufacturers:
 - 1) Vimasco Corporation; _____.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. On exposed piping, locate insulation and cover seams in least visible locations, but not higher than at the side of the pipe at the "90°" position, with the seam lapped such that the lap is directed down.
- C. Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:
 - 1. Provide vapor barrier jackets, factory applied or field applied.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe.
 - 3. Finish with glass cloth and vapor barrier adhesive.
 - 4. PVC fitting covers shall not be used.
 - 5. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
 - 6. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- D. For insulated pipes conveying fluids above ambient temperature:
 - 1. Provide specified jackets, with or without vapor barrier, factory applied or field applied.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
 - 3. Finish with glass cloth and adhesive.
 - 4. PVC fitting covers shall not be used.
 - 5. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
 - 6. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions, including those at equipment, but label the insulation to indicate a concealed flange or union.
- E. Inserts and Shields:
 - 1. Application: Piping 2 inches diameter or larger.
 - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - 3. Insert Location: Between support shield and piping and under the finish jacket.
 - 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - 5. Insert Material: Heavy density insulating material suitable for the planned temperature range, and the weight of the pipe.
- F. Finish insulation at supports, protrusions, and interruptions.
- G. All piping and equipment shall be insulated as indicated on the Drawings, as specified herein, and as required for a complete system. In each case, the insulation shall be equal to that specified and materials applied and finished as described in these Specifications.
- H. All insulation shall be applied by mechanics skilled in this particular work and regularly engaged in such occupation. All insulation shall be applied in strict accordance with these Specifications and with factory printed recommendations on items not herein mentioned. Unskillfully, inadequate, or sloppy work will not

be acceptable, and all such work shall be removed and replaced as many times as necessary to achieve an acceptable installation.

- I. All insulation, jacket, adhesives, mastics, sealers, etc., utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50 smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application, and is stated as an exception to this requirement. Certificates to this effect shall be submitted along with Contractor's submittal data for this section of the Specifications. No material may be used that, when tested by the ASTM E84 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.
- J. All surfaces to be insulated shall be clean and dry before applying the insulation. All sections of molded pipe covering shall be firmly butted together. Where an insulation covering is applied, it shall lap the adjoining section of insulation by at least 3 inches. Where insulation terminates, it shall be neatly beveled and finished. No insulation shall be applied until the pipe, duct, etc., have been pressure tested and found tight. Piping, flexible connections, flanges, valves, strainers, and unions shall be covered unless specifically noted otherwise. Flexible connections on duct shall not be covered. All materials used shall be fire retardant or nonflammable. Refer to Section 22 00 10 - Basic Plumbing Requirements.
- K. Where vapor barriers are required, the vapor barrier shall be on the outside. Extreme care shall be taken that the vapor barrier is unbroken. Joints, etc., shall be sealed. Where insulation with a vapor barrier terminates, it shall be sealed off with the vapor barrier being continuous to the surface being insulated. Ends shall not be left raw.
- L. Where specified, aluminum bands shall be used on piping insulation. The bands shall be applied three (3) to a section of pipe. Fittings, valves, etc., shall have bands on each side.
- M. Where canvas finish is specified, use Arabol lagging adhesive to prevent mildew in securing canvas. Do not use wheat paste. In addition, cover all canvas insulation with a fire retardant coating.
- N. For purpose of definition in this Specification: "concealed" areas are those areas which cannot be seen by the building occupants, and "exposed" areas are all areas which are exposed to view by the building occupants, including under counter and inside cabinet areas, plus all mechanical rooms.
- O. The handling and installation of all insulation materials shall be performed in strict accordance with the manufacturers recommendations.

3.3 INSULATION "K" VALUE SCHEDULE

<u>Service</u>	<u>Oper Temperature Degrees F</u>	<u>"K" Mean Temp Degrees F</u>
Hot	105-140	.26 @ 100
Cold	40-55	.25 @ 75
(1) Fire line freeze protection (2) Domestic Cold Water; Storm		
Minimum "K" does not consider water vapor transmission and condensation. Additional insulation and/or vapor retarders may be required to limit water vapor transmission and condensation under extreme conditions.		
A minus 15 percent tolerance, on the insulation performance listed shall be permitted for manufacturers' standard insulation systems.		

END OF SECTION 22 07 19

SECTION 22 08 00

COMMISSIONING OF PLUMBING SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Commissioning process requirements for Plumbing systems, assemblies, controls, and equipment.
 - 1. This project will have selected building systems commissioned. The equipment and systems to be commissioned are specified in Section 01 91 00 - General Commissioning Requirements.

1.3 RELATED REQUIREMENTS

- A. Section 01 91 00 - General Commissioning Requirements.
- B. Section 23 08 00 - Commissioning of HVAC Systems.
- C. Section 26 08 00 - Commissioning of Electrical Systems.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 DEFINITIONS

- A. Refer to Section 01 91 00 - General Commissioning Requirements.

1.6 SUBMITTALS

- A. Certificate of Readiness, signed by the Contractor, certifying that systems, assemblies, equipment, components, and associated controls are ready for testing.
- B. Manufacturer's completed start-up reports for equipment and systems.

1.7 CONTRACTOR'S RESPONSIBILITIES

- A. Reference Project Specification Section 01 91 00 - General Commissioning Requirements for details of Plumbing contractor's responsibilities related to commissioning.
- B. Perform commissioning tests at the direction of the CxA.
- C. Attend commissioning meetings.
- D. Provide information requested by the CxA for functional testing and for final commissioning documentation.
- E. 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.
- F. Functional testing of systems will be carried out solely by Plumbing contractor's personnel, under the direction of CxA. Provide experienced personnel, familiar with the systems being installed under this project.

1.8 COMMISSIONING AGENT RESPONSIBILITIES

- A. Reference Project Specification Section 01 91 00 - General Commissioning Requirements.
- B. CxA will direct commissioning testing.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 GENERAL TESTING REQUIREMENTS

- A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in Division 22 Sections. Provide submittals, test data, inspector record, and certification to the CxA.
- B. Reference Project Specification Section 01 91 00 - General Commissioning Requirements for detailed requirements of commissioning of Plumbing systems.
- C. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

- D. 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.
 - E. Tests will be performed using design conditions whenever possible.
- 3.2 SYSTEM START-UP
- A. Contractor is solely responsible for system start-up. CxA may, at their discretion, witness start up procedures, but will not perform any Functional Testing of systems until Contractor has completed start-up and resolved all operating deficiencies, and has so certified.
- 3.3 TESTING PREPARATION
- A. Certify that Plumbing systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
 - B. Certify that testing, adjusting, and balancing procedures for Plumbing systems have been completed and submitted, discrepancies corrected, and corrective work approved.
 - C. Set 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).
 - D. Inspect and verify the position of each device and interlock identified on checklists.
 - E. Check safety cutouts, alarms, and interlocks with life-safety systems during each mode of operation.
- 3.4 FUNCTIONAL TESTING / GENERAL
- A. Reference Project Specification Section 01 91 00 - General Commissioning Requirements for detailed requirements of commissioning of Plumbing systems.
 - B. Provide measuring instruments to record test data as directed by the CxA.
- 3.5 PIPING SYSTEMS
- A. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Division 22 piping Sections.
 - B. Plumbing Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan.
 - C. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA.
 - D. Include sequence of testing and testing procedures, description of equipment for flushing operations, drawings for each pipe sector, showing the physical location of each designated pipe test section, minimum flushing water velocity, and chemical treatment plan.
- 3.6 DEFERRED TESTING
- A. Initial commissioning will be done to comply with 01 91 00 - General Commissioning Requirements.
 - B. If adequate load may be artificially placed upon heating or cooling equipment, CxA, at his discretion, may perform functional testing during non-peak load periods. If testing cannot be carried out under these conditions to adequately verify system performance, testing will be deferred until such time as conditions are more satisfactory.
 - 1. Contractor is to provide services of personnel and participate in deferred or seasonal testing process in the same manner as he would in non-seasonal testing.
 - 2. 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.
- 3.7 RE-TESTING
- A. Reference Project Specification Section 01 91 00 - General Commissioning Requirements for detailed requirements of re-testing of Plumbing systems.
- 3.8 SYSTEMS TO BE COMMISSIONED
- A. Reference Project Specification Section 01 91 00 - General Commissioning Requirements for list of Plumbing systems to be commissioned.

END OF SECTION 22 08 00

SECTION 22 11 16

PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Wall, Floor, and Ceiling Plates.
- B. Sleeves, Inserts, and Fastenings.
- C. Valves.
- D. Unions.
- E. Flanges.
- F. Sanitary Drainage System
- G. Backflow Preventers
- H. Interior Domestic Water Piping System.
- I. Welded Piping
- J. Natural Gas Distribution System.

1.3 RELATED REQUIREMENTS

- A. Section 22 00 10 - Basic Plumbing Requirements.
- B. Section 22 20 00 - Piping, Valves, and Fittings.

1.4 REFERENCE STANDARDS

- A. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings.
- B. ASME B31.1 - Power Piping.
- C. ASME B31.3 - Process Piping.
- D. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- E. MSS SP-25 - Standard Marking System for Valves, Fittings, Flanges and Unions.
- F. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. AGA - American Gas Association.
- H. ASME 31.1 - Power Piping.
- I. ASME 31.2 - Fuel Gas Piping.
- J. ASME 31.4 - Liquid Petroleum Transportation Piping Systems.
- K. ASME B31.9 - Building Service Piping.
- L. ASME BPVC - Boiler and Pressure Vessel Code.
- M. ASME BPVC-IX - Welding and Brazing Qualifications.
- N. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.
- O. ASME B16.3 - Malleable Iron Threaded Fittings.
- P. ASME B16.4 - Cast Iron Threaded Fittings Class 125 and 250.
- Q. ASME B16.18 - Cast Bronze Solder-Joint Pressure fittings.
- R. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings
- S. ASME B16.23 - Cast Copper Alloy Solder-Joint Drainage Fittings DWV.
- T. ASME B16.26 - Cast Bronze Fittings for Flared Copper Tubes.
- U. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings DWV.
- V. ASTM A47/A47M - Ferritic Malleable Iron Castings.
- W. ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- X. ASTM A74 - Cast Iron Soil Pipe and Fittings.

- Y. ASTM A234/A234M - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
 - Z. ASTM B32 - Solder Metal.
 - AA. ASTM B42 - Seamless Copper Pipe.
 - BB. ASTM B43 - Seamless Red Brass Pipe.
 - CC. ASTM B75/B75M - Seamless Copper Tube.
 - DD. ASTM B88 - Seamless Copper Water Tube.
 - EE. ASTM B251/B251M - Wrought Seamless Copper and Copper-Alloy Tube.
 - FF. ASTM B302 - Threadless Copper Pipe (TP).
 - GG. ASTM B306 - Copper Drainage Tube (DWV).
 - HH. ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
 - II. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
 - JJ. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 - KK. ASTM D2235 - Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
 - LL. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).
 - MM. ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - NN. ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing and Fittings.
 - OO. ASTM D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
 - PP. ASTM D2680 - Acrylonitrile-Butadiene-Styrene (ABS) Composite-Sewer Piping.
 - QQ. ASTM D2683 - Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe.
 - RR. ASTM D2729 - Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - SS. ASTM D2846/D2846M - Chlorinated Polyvinyl Chloride (CPVC) Pipe, Fittings, Solvent Cements and Adhesives for Potable Hot Water Systems.
 - TT. ASTM D2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
 - UU. ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - VV. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 - WW. ASTM F493 - Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
 - XX. AWS A5.8/A5.8M - Brazing Filler Metal. BA. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
 - YY. AWWA C110/A21.10 - Ductile - Iron and Gray - Iron Fittings 3 in. through 48 in., for Water and Other Liquids.
 - ZZ. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings.
 - AAA. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
 - BBB. AWWA C651 - Disinfecting Water Mains.
 - CCC. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.
 - DDD. CISPI 310 - Joints for Hubless Cast Iron Sanitary Systems.
 - EEE. MSS SP-45 - Bypass and Drain Connections.
 - FFF. NCPWB (SPS) - Procedure Specifications for Pipe Welding.
 - GGG. NFPA 54 - National Fuel Gas Code.
 - HHH. NFPA 58 - Storage and Handling of Liquefied Petroleum Gases.
 - III. TDH - Texas Department of Health, Water System Regulations
- 1.5 SUBMITTALS
- A. Submit under provisions of Division 01 and Section 22 00 10 - Basic Plumbing Requirements.
 - B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
 - C. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.
- 1.6 PROJECT RECORD DOCUMENTS
- A. Submit under provisions of Division 01 and Section 22 00 10 - Basic Plumbing Requirements.
 - B. Record actual locations of valves, etc.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 01 and Section 22 00 10 - Basic Plumbing Requirements.
- B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.8 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- C. Welders Certification: In accordance with ASME BPVC-IX.
- D. Maintain one copy of each document on site.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing the work of this section with minimum of three years documented experience.

1.10 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with International Plumbing Code.
- B. Conform to applicable code for installation of backflow prevention devices.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 01 and Section 22 00 10 - Basic Plumbing Requirements.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.12 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.13 ATTIC STOCK

- A. Furnish under provisions of Division 01 and Section 22 00 10 - Basic Plumbing Requirements.
- B. Provide two repacking kits for each size valve.

PART 2 - PRODUCTS

2.1 WALL, FLOOR AND CEILING PLATES

- A. Except as otherwise noted, provide C.P. (Chrome plated) brass floor and ceiling plates around all pipes, conduits, etc., passing exposed through walls, floors, or ceilings, in any spaces except underfloor and attic spaces.
 - 1. Plates shall be sized to fit snugly against the outside of the pipe or against the insulation on lines which are insulated and positively secured to such pipe or insulation.
 - 2. Plates will not be required for piping where pipe sleeves extend 3/4 inch above finished floor.
 - 3. Equipment rooms are classified as finished areas.
 - 4. Round and rectangular ducts shall have closure plates (NOT chrome plated) made to fit accurately at all floor, wall and ceiling penetrations.

2.2 SLEEVES, INSERTS, AND FASTENINGS

- A. General: Openings through all floors, walls, and roofs, etc., regardless of material for the passage of piping, ductwork, conduit, cable trays, etc., shall be sleeved.
 - 1. Penetrations must pass through sleeves except soil pipe installed under concrete slabs on fill.
 - 2. Sleeves shall be set in new construction before concrete is poured, as cutting holes through any part of the concrete will not be permitted unless acceptable to the Architect/Engineer.
 - 3. If a penetration is cored into an existing concrete, masonry or stone structure, then the installation of a sleeve will not be necessary.

- B. The minimum clearance between horizontal penetrations including insulation where applicable, and sleeve shall be 1/4-inch, except that the minimum clearance shall accommodate a Thunderline Linkseal closure where piping exits the building, or penetrates a wall below ground level.
 - 1. Contractor shall be responsible for the accurate location of penetrations in the slab for his pipe, duct, etc.
 - 2. Penetrations shall be of ample size to accommodate the pipe, duct, etc. plus any specified insulation.
 - 3. Sleeve materials shall be rigid metal of adequate strength.
 - 4. Void between sleeve and pipe shall be filled with Nelson Flameseal Firestop or approved equal caulk or putty.
- C. Installation of sleeves in walls shall be the same as for floors.
 - 1. Refer to the details on the project drawings.
 - 2. Where the details differ from these specifications, the drawings take precedence.
- D. Sleeves for penetrations passing through walls or floors on or below grade shall be removed, if practical, and after the pipes have been installed, the void space around the pipe shall be caulked with a suitable material to effect a waterproof penetration.
- E. Inserts:
 - 1. Suitable concrete inserts for pipe and equipment hangers shall be set and properly located for all pipe and equipment to be suspended from concrete construction.
 - 2. Drilled anchors in concrete or masonry shall be submitted for the approval by the Owner.
- F. Fasteners:
 - 1. Fastening of pipes, conduits, etc., in the building shall be as follows: To wood members by wood screws; to masonry by threaded metal inserts, metal expansion screws, or toggle bolts, whichever is appropriate for the particular type of masonry; to steel machine screws or welding (when specifically permitted or directed), or bolts, and to concrete by suitable inserts anchored to reinforcing steel, and poured in place unless other means are indicated on the plans. Power actuated fasteners (shooting) will not be acceptable under any circumstances. If it is necessary to install a method of fastening a hanger after the structure has been installed, then only clamps or drilled anchors shall be used.
 - 2. Note: Under no circumstances will the use of plastic anchors or plastic expansion shields be permitted for any purpose whatsoever.
- G. Rat-proofing: The open space around all ductwork, piping, etc., passing through the ground floor and/or exterior walls shall be rat-proofed in a manner acceptable to the Architect/Engineer.
- H. Weatherproofing:
 - 1. The annular space between a pipe and its sleeve in exterior walls or through floor to below grade shall be filled with polyurethane foam rods 50 percent greater in diameter than the space as backing and fill material and made watertight with a permanent elastic polysulfide compound.
 - 2. Seal both surfaces of wall or floor.
- I. Air Plenums: The space around piping, ductwork, etc., passing through air plenums shall be made airtight in a manner acceptable to the Architect/Engineer.
- J. Fireproofing:
 - 1. Each mechanical and electrical contractor shall seal all cable trays, pipe, conduit, duct, etc., penetrations through roof, fire rated walls and floors with a foam or sealant as described below, that will form a watertight, vermin-tight barrier that is capable of containing smoke and fire up to 2000 degrees F for two hours.
 - 2. Sealing of cable trays, and conduits that extend through rated walls from ends of cable tray shall be done after conductors have been installed.
 - 3. Refer to Section 07 84 13 - Penetration Firestopping, Section 07 84 43 - Joint Firestopping, and Section 07 84 13 - Penetration Firestopping.

2.3 VALVES

- A. Valves shall be located such that the removal of their bonnets is possible.
- B. Flanged valves shown in horizontal lines with the valve stem in a horizontal position shall be positioned so that the valve stem is inclined one bolt hole above the horizontal position.
- C. Screw pattern valves placed in horizontal lines shall be installed with their valve stems inclined at an angle of a minimum of 30 degrees above the horizontal position.

- D. Valves must be true and straight at the time the system is tested and inspected for final acceptance.
- E. Valves shall be installed as nearly as possible to the locations indicated in the Construction Drawings.
 - 1. Any change in valve location must be so indicated on the Record Drawings.
- F. Valves must be of threaded or flanged type.
- G. No solder connected or grooved fitting valves shall be used on this project.
- H. Bronze and iron body gate and globe valves shall be the product of one manufacture for each project.
 - 1. Manufacturers of other types may not be mixed on the same project; i.e., all butterfly valves shall be of the same manufacture, all ball valves shall be of the same manufacture, etc.
- I. Valves used in circulating systems, plumbing, and steam systems (low and medium pressure) shall be correlated to existing system requirements. Class 150 SWP.
 - 1. Class 200 valves shall be constructed of all ASTM B61 composition.
 - 2. All gate, globe and angle valves shall be union or screw-over-bonnet design.
 - 3. Metal used in the stems of all bronze gate, globe and angle valves shall conform to ASTM B371/B371M Alloy 694, ASTM B99 Alloy 651, or other corrosion resistant equivalents.
 - 4. Written approvals must be secured for the use of alternative materials.
- J. Valves shall be re-packable, under pressure, with the valve in the full open position.
- K. Packing for all valves shall be free of asbestos fibers and selected for the pressure-temperature service of the valve.
 - 1. It is incumbent upon the manufacturer to select the best quality, standard packing for the intended valve service. At the end of one year, period spot checks will be made, and should the packing show signs of hardening or causing stem corrosion then all valves supplied by the manufacturer shall be repacked by the Contractor, at no expense to the Owner, with a packing material selected by the Owner.
- L. Valves located with stem in horizontal position shall be drilled and tapped in accordance with MSS SP-45 at Boss G to accommodate a drain valve.
- M. Balancing and/or Shutoff Valves for Water Systems:
 - 1. Two inches and smaller, three-piece bronze body, bronze or stainless steel ball and stem, Teflon seats, packing and gasket, bronze gland follower, adjustable stuffing box, steel lever type handle, with plastic operating handle, quarter turn stops, and shall be Class 150.
 - 2. Manufacturer shall certify ball valves for use in throttling service.
 - 3. Stem extensions shall be furnished for use in insulated lines.
 - 4. Valves 2-1/2 inches and larger shall be tapped full lug butterfly valves with aluminum bronze discs of Alloy C955 and 316, 416, or 420 stainless steel shafts.
 - 5. Design must incorporate bushing between shafts and body of material suitable to provide a bearing surface to eliminate seizing or galling.
 - 6. Valve must be capable of providing a bubble tight seal at 200 psi for valves up to 12 inches (150 psi for larger valves) when used for end of line service without requiring the installation of a blind flange on the downstream side.
 - 7. Liners shall be resilient material suitable for 225°F temperature and bodies of ductile iron.
 - 8. Butterfly valves 8 inches and larger and butterfly valves used for balancing service, regardless of size, shall have heavy duty weather proof encased gear operators, with malleable iron handwheel.
 - 9. Valves 2-1/2 inches through 6 inches shall have lever handles which can be set in interim positions between full open and full closed.
 - 10. All butterfly valves shall be absolutely tight against a pressure differential of 150 psi.

2.4 UNIONS

- A. Provide and install unions at proper points to permit removal of pipe and various equipment and machinery items without injury to other parts of the system.
 - 1. No unions will be required in welded lines or lines assembled with solder joint fittings except at equipment items, machinery items and other special pieces of apparatus.
 - 2. Unions in 2 inches and smaller in ferrous lines shall be Class 300 AAR malleable iron unions with iron to brass seats, and 2-1/2 inches and larger shall be ground flange unions.
 - 3. Unions in copper lines shall be Class 125 ground joint brass unions or Class 150 brass flanges if required by the mating item of equipment.
 - 4. Companion flanges on lines at various items of equipment, machines and pieces of apparatus shall serve as unions to permit removal of the particular items.

- 5. See particular Specifications for special fittings and pressure.
- B. Unions connecting ferrous pipe to copper or brass pipe shall be dielectric type equal to Epco.
- C. In all domestic water lines where the material of the pipe is changed from ferrous to copper or brass, a dielectric coupling shall be used at the transition.

2.5 FLANGES

- A. Slip on flanges shall not be used.
- B. Bolts used shall be carbon steel or stainless steel bolts with semi-finished hexagon nuts of American Standard Heavy dimensions.
- C. All thread rods will not be an acceptable for flange bolts.
- D. Flat faced flanges shall be furnished where required to match flanges on pumps, check valves, strainers, etc.
- E. All flanges shall be gasketed.
 - 1. Place gasket between flanges of flanged joints.
 - 2. Gaskets shall fit within the bolt circle on raised face flanges and shall be full face on flat face flanges.
 - 3. Gaskets shall be cut from 1/16" thick, non metallic, non asbestos gasket material suitable for operating temperatures from 150°F to +750°F, Klingerseal C-4400, Manville Style 60 service sheet packing, or equal.

2.6 SANITARY DRAINAGE SYSTEM

- A. Sanitary drainage system shall be installed as indicated on the Drawings complete with all fixtures, drains, traps and required connections.
- B. Fixtures and drains shall be properly vented and trapped.
- C. The Contractor shall complete the installation of the sanitary drainage system by making approved connections as indicated on the Drawings and shall be responsible for any and all connection charges.
- D. Underground storm and sanitary waste piping, of all sizes, shall be cast iron hub and spigot type, with Tyseal (or approved equal) neoprene gaskets. Hubless piping systems shall not be used in a directly buried, underground application.

2.7 BACKFLOW PREVENTERS

- A. A BFP shall be installed to isolate all non-potable water requirements from the building domestic water system. All BFP's shall be installed within the building.

2.8 INTERIOR DOMESTIC WATER PIPING SYSTEMS

- A. ALL piping within confines of building walls shall be a part of the interior water piping system.
- B. Interior Domestic Water Control Valves
 - 1. Control valves shall be installed where indicated on Drawings and/or wherever necessary for controlling the several sections of the domestic water system.
 - 2. Valves shall be provided on all inlet (and outlet where applicable) connections to all kinds of apparatuses, all risers, and all groups of fixtures.
 - a. Groups of fixtures shall be arranged to have their group valves in one location.
 - b. Access shall be provided to all concealed valves by means of an access door.
 - c. Coordinate the location of valves with the architectural features of the building in order that the access doors will be located symmetrically with other features.
 - 3. The hot and/or cold water supply lines to each and every fixture hereinafter specified shall be equipped with stop valves which shall be chromium plated where exposed chrome plated pipe is used.
- C. Interior Domestic Water Headers
 - 1. Provide headers as detailed on the drawings for cold water and hot water syste
- D. Cross Connections
 - 1. Care shall be exercised in fabricating plumbing lines to avoid all cross connections and to construct the piping systems in a manner which eliminates the possibility of water contamination.
 - 2. The piping systems have been designed in every case to avoid the possibility of reverse flow or back siphoning. Care shall be exercised in constructing plumbing lines to make certain that not only the letter, but the spirit, of these safety precautions is carried out to the fullest possible extent.
- E. Requirements of Interior Water Piping Systems

1. All piping shall have reducing fittings used for reducing or increasing where any change in the pipe sizes occurs. No bushing of any nature shall be allowed in piping.
2. All exposed chrome plated, polished or enameled connections from fixtures shall be put up with special care, showing no tool marks or threads at fittings, and supported by neat racks or hangers with round head screws of same material and finish.

2.9 WELDED PIPING

A. Scope:

1. This section applies to all piping systems providing for welded piping, fittings, and other appurtenances.
2. Specific systems requiring welded piping include, but are not limited to: chilled water, steam, steam condensate, and fire protection systems.

2.10 NATURAL GAS DISTRIBUTION SYSTEM

- A. The gas distribution system shall be installed as indicated on the Drawings, complete with all valves, regulators, meters and other required items.
- B. The Contractor shall make all arrangements and pay for all services and material which are required to have the gas company extend its gas main to the property line and to install the regulator and/or meter required for this project.
 1. This Contractor shall, moreover, pay all fees and deposits which are required to have the meter "set" by the Gas Company.
 - a. This Contractor shall then extend the gas service into the buildings.
 - b. This Contractor shall make all arrangements and pay all fees which are required for odorizing the entire gas distribution system.
 2. At every entrance of gas piping into a building, the piping shall first rise above grade on the building exterior to prevent upstream gas leaks from following the piping inside the building.
 3. Provide wrench operated shutoff valve in the horizontal portion of this exterior piping at each location.
- C. Verify and coordinate, with the actual various users on the site, all the times and timing involved with modification, additions to, or alterations thereof, of gas piping serving these users.
- D. Natural Gas Valves
 1. The gas regulator bypass globe valve shall be sized to pass only a slightly larger maximum flow rate than the gas regulator. It shall include provision for locking shut with a large padlock.
- E. Natural Gas Cutoffs
 1. On the inlet and discharge side of the meter and pressure regulators and at building entrance, install a wrench operated plug cock valve.
 2. The flanges of this stop valve shall be dimensioned, drilled, faced and spot faced to conform to the Class 125 American Standard for Cast Iron Flanges ASME B16.1 .
 3. Install zone valves on each floor accessible to occupants for shutting off areas of the building under emergency conditions.
 4. Gas piping shall be welded up to these zone valves.
- F. Natural Gas Piping
 1. All gas piping within the building shall be installed exposed to view.
 2. Gas piping systems installed underground shall utilize a factory applied protective coating system .
 3. Under no circumstances shall any backfilling operations begin until these pipe protection operations have been completed.
- G. Natural Gas Fittings
 1. Unless otherwise specifically shown or called for, gas piping systems installed throughout the building shall be fabricated by a fusion welding process making use of welding fittings.
 2. These fittings shall be fittings as specified in other sections.
 3. In no case shall the wall thickness of a fitting incorporated in a gas piping system be less than that of the pipe to which it is jointed.
 4. All screwed pattern fittings specifically called for shall be Class 150 malleable iron fittings of Crane Company or Walworth Company manufacture (300 lb. for unions).
- H. Natural Gas Flanges:

1. In all instances in which flanges are required for the installation of flanged fittings for gas lines, the Contractor shall provide Crane or Walworth weld neck pattern, Class 150 forged steel flanges.
 2. These flanges shall be dimensioned, faced grinded and spot faced to conform to the Class 150 ASME B16.9.
 3. See piping section for additional requirements for flanges.
- I. Natural Gas Headers
1. The gas distribution header installed by this Contractor in the building shall be fabricated of Schedule 40 steel pipe conforming in all details to Standard Specifications for WELDED AND SEAMLESS STEEL PIPE, ASTM A53/A53M Grade B, Type E or S, latest revision.
 2. The header shall be dimensioned to conform to details shown on the Drawings. The pipe and welding materials for this header shall be carefully selected, and the welding operations shall be carefully supervised.
 3. Welding nipples neatly aligned shall be provided for the outlets of the header. After the header has been completely fabricated, it shall be temporarily sealed and subjected to a pneumatic test pressure of 100 pounds per square inch.
 - a. While the header is subjected to this pressure, all welded joints shall be given an application of soapy water for the purpose of detecting minute leaks which might not otherwise be observed.
 - 1) These leaks shall not be repaired by any peening operations.
 - 2) Such leaks shall be remedied by chipping and re-welding until the header is devoid of leaks at that pressure.
 - b. The header shall then be subjected to a hydrostatic test pressure of 200 pounds per square inch.
 - 1) Under these circumstances, the test pressure of the water confined in the header shall not decrease in a four-hour period of observation.
 - 2) If leaks are encountered, they shall be eliminated in the manner prescribed by the Owner's duly authorized representative.
 4. The header shall be provided with a 1/2 inch drain connection "taken off" the bottom of the header and terminated in a suitable stop cock.
 - a. This 1/2 inch drain connection shall have its origin in a 2 inches x 1/2 inch welding reducer having its 2 inch end so welded to the header as to completely drain that member. Each outgoing branch from the header shall be provided with a cock. The nature of the outgoing welding nipples shall be such that these cocks shall be lined up in a neat horizontal line.
 - b. Each outgoing branch from the header shall be provided with a cock.
 - c. The nature of the outgoing welding nipples shall be such that these cocks shall be lined up in a neat horizontal line.
- J. Natural Gas Cocks
1. Near the point at which each outgoing line leaves the gas header, the Contractor shall install a stop valve or cock. These wrench operated valves shall each be provided with an appropriate wrench.
 2. Cocks of the same type shall, moreover, be installed at each other point indicated on the Drawings.
- K. Natural Gas Drip Pipes
1. Drip pipes shall be provided throughout the gas piping systems for the purpose of accumulating moisture and condensate.
 2. They shall be sized no smaller than the gas piping to which they are connected in each instance.
 3. These drip pipes shall be U-shaped providing an effective water seal of no less than 12 inches of water.
 4. The extremity of each U-shaped drip pipe shall be threaded and capped with a suitably sized, screwed pattern, black, standard weight, malleable iron cap.
 5. All drip pipes shall be located in an accessible position so that the condensate may either be pumped from the system or so that a water seal shall be provided in the event that the water forming the seal evaporates.

2.11 POLYPROPYLENE PIPE

- A. Locations and use as approved in writing by UTSW FM.
- B. Installation per manufacturer's instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. After completion, fill, clean, and treat systems. Refer to Section 22 00 10 - Basic Plumbing Requirements.

3.3 INSTALLATION

- A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Route piping in orderly manner and maintain gradient.
- C. Install piping to conserve building space and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16 - Piping Expansion Compensation.
- F. Provide clearance for installation of insulation and access to valves and fittings.
- G. Provide access where valves and fittings are not exposed. Coordinate access door location with architectural features.
- H. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- I. Establish elevations of buried piping outside the building to ensure a minimum of cover.
- J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- K. Provide support for utility meters in accordance with requirements of utility companies.
- L. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting. Refer to Section 09 96 00 - High-Performance Coatings.
- M. Excavate in accordance with Section 22 00 10 - Basic Plumbing Requirements for work of this Section.
- N. Backfill in accordance with Section 22 00 10 - Basic Plumbing Requirements for work of this Section.
- O. Install bell and spigot pipe with bell end upstream.
- P. Install valves with stems upright or horizontal, not inverted.
- Q. Locate valves in readily accessible areas and where valve operation will not damage other components, materials, or devices.
- R. Provide one plug valve wrench for every ten plug valves sized 2 inches and smaller, minimum of one. Provide each plug valve sized 2-1/2 inches and larger with a wrench with set screw.
- S. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.
- T. Shock Arrestors:
 - 1. Install shock arrestors at each quick closing valve, solenoid type valve, and flush valve. Size shock arrestors in accordance with manufacturer's instructions.
 - 2. Install shock arrestors within five feet of valve, provide all access panel as required.
 - 3. Test and certify shock arrestors by Plumbing and Drainage Institute in accordance with ANSI/ASSE 1010.
- U. Inline Automatic Flow Controllers:
 - 1. Install in accordance with manufacturer's instructions and in accordance with details on Drawings.
 - 2. Provide valves, strainers, and PT ports NSF approved for potable water systems.

3.4 FABRICATION OF PIPE

- A. All the various piping systems shall be made up straight and true and run at proper grades to permit proper flow of the contained material. Lines shall also be graded for proper drainage.
- B. Piping shall follow as closely as possible the routes shown on Drawings which take into consideration conditions to be met at the site.
- C. Should any unforeseen conditions arise, lines shall be changed or rerouted as required after proper approval has been obtained.

- D. All piping shall be installed with due regard to expansion and contraction and so as to prevent excessive strain and stress in the piping, in connections, and in equipment to which the lines are connected.
- E. All piping shall be clean when it is installed. Before installation it shall be checked, upended, swabbed, if necessary, and all rust or dirt from storage or from laying on the ground shall be removed.
- F. Procedure of Assembling Screw Pipe Fittings: All screw joints shall be made with taper threads properly cut. Joints shall be made tight with Teflon applied to the pipe threads only and not to fittings. When threads are cut on pipes, the ends shall be carefully reamed to remove any burrs. Before installing pipe that has been cut and threaded, the lengths of pipe shall be upended and hammered to remove all shavings and foreign material.
- G. Procedure for Assembling Other Joints: Procedures for assembling joints in cast iron and copper lines have been set forth elsewhere in these Specifications. For any special materials, consult the manufacturers for the recommended procedures in assembling the joints.

3.5 INSTALLATION OF SANITARY DRAINAGE PIPING:

- A. Piping shall be run in the most direct manner. Horizontal pipes shall have a grade of 1/4 inch per foot, wherever possible, and not less in any case than 1/8 inch per foot, unless otherwise noted on Drawings.
- B. Joints in hub and spigot cast iron pipe shall be made water and gas tight with Tyseal neoprene gaskets. Lead and Oakum may be used only under special conditions, with prior written permission from the Resident Construction Manager.
 - 1. Joints in hubless cast iron soil pipe and fittings shall be made by the use of a neoprene sleeve and stainless steel shield made tight with a torque wrench and torqued to the manufacturer's specifications.
 - 2. Each clamp shall consist of a neoprene gasket with a stainless steel outer band which effectively captures the gasket material.
 - 3. Each clamp shall bear the FM and UPC stamp, and shall be approved to Class I of Factory Mutual Standard #1680, and be a Heavy Duty No Hub Coupling, minimum 4 bands.
 - 4. Materials used in the clamp shall be stainless steel.
 - 5. Elbows and tees shall be braced against thrust loads which might result in joint separation due to dynamic forces caused by sudden, heavy rainfall conditions.
 - 6. Where roof drains are 50 or more feet above the horizontal runout at grade level, the downspout piping system shall be constructed of Schedule 40 black steel pipe with weld fittings.
- C. Provide cleanouts at the bottom of each downspout, at each change of direction and at intervals not exceeding 95 feet in horizontal runs.
 - 1. Interior cleanouts shall be brass caulked into the lines, and where they occur in walls or floors of finished areas, shall be provided with nickel-bronze tops or access plates.
 - 2. Interior cleanouts shall be of the same size as the pipe served up to 4 inches size and 4 inches for all larger lines.
- D. Exterior cleanouts shall consist of a concrete encased wye in the line with sewer pipe extending upward therefrom and terminating in a concrete slab below grade.
 - 1. A standard cast iron cleanout casting shall be set on this slab in such manner as to be flush with finished grade and to provide access through its cover to the cleanout.
 - 2. A removable concrete stopper shall be set in the open top of the cleanout pipe.
- E. Horizontal runs of storm drainage piping within the building, except in crawl space shall be insulated as specified.
- F. Flashings:
 - 1. Vent pipes passing through the roof shall be provided with lead roof flashings constructed of 2-1/2# sheet lead with bases extending no less than 10 inches on each side of the pipe.
 - 2. The vertical portion of the flashing shall extend upward the entire length of the pipe and be turned inside the pipe at least 2 inches.
 - 3. Lead flashings shall be fabricated and furnished by Mechanical Contractor and turned over to Roofing Contractor who will install them.

3.6 SANITARY DRAINAGE TESTING:

- A. After the vertical lines of soil pipe, waste, and other parts of the sanitary system have been set from the basement to the top of the building, all outlets shall be temporarily "plugged up", except as are required for testing as described herein.

1. One floor level of the building shall be tested at a time.
 2. Each floor shall be tested from a level below the structure of the floor, or the outlet of the building in the case of the lowest level, to a level of 12 inches above the floor immediately above the floor being tested, or the top of the highest vent in the case of the highest building level.
 3. The pipes for the level being tested shall be filled with water to a verifiable and visible level as described above and be allowed to remain so for 24 hours.
 4. If after 24 hours the level of the water has been lowered by leakage, the leaks must be found and stopped, and the water level shall again be raised to the level described, and the test repeated until, after a 24-hour retention period, there shall be no perceptible lowering of the water level in the system being tested.
- B. A final test shall be conducted after all vertical and horizontal pipes and "rough-ins" have been complete but before the sewer connection is made.
1. The test procedure shall be identical with that described above except that the entire plumbing system, i.e., the vertical and horizontal pipe and "rough-in", shall be subjected to water under the head imposed by filling the system to the top of the building. After all testing operations have been completed, all waste lines shall be cleaned.
- C. Should the completion of these tests leave any reasonable question of a doubt relative to the integrity of the installation, additional tests or measures shall be performed to demonstrate the reliability of these systems to the complete satisfaction of the Owner's duly authorized representative. Such tests shall be conducted and completed before any joints in plumbing are concealed or made inaccessible.
1. Such tests shall be conducted and completed before any joints in plumbing are concealed or made inaccessible.

3.7 INTERIOR DOMESTIC WATER SYSTEM:

- A. Interior Domestic Water Piping Fabrication
1. All piping shall have reducing fittings used for reducing or increasing where any change in the pipe sizes occurs. No bushing of any nature shall be allowed in piping.
 2. All exposed chrome plated, polished or enameled connections from fixtures shall be put up with special care, showing no tool marks or threads at fittings, and supported by neat racks or hangers with round head screws of same material and finish.
 3. Wade Shokstop, or approved equal, sealed air chambers shall be provided in all water branches to fixtures, sized in accordance with manufacturer's recommendations, concealed, accessible, and located so as to protect each group of plumbing fixtures.
 4. The fabrication of copper pipe and fittings shall in every detail conform to the recommendations and instructions of the fitting manufacturer. The tools used shall be the tools adapted to that specific purpose.
 5. Refer to other parts of this Section for other information concerning installation of piping.
- B. Interior Domestic Water Piping - Testing and Sterilization
1. All water piping systems shall be properly tested to assure their being absolutely tight. In the case of pipes which are to be insulated, these tests shall be completed and the piping system proven to be absolutely tight before any insulation is applied.
 - a. Wherever pipes are placed so that they will ultimately be concealed, these tests shall be conducted and the absolute tightness of each piping system shall be demonstrated before the system is concealed.
 2. The procedure of these tests shall consist of subjecting a piping system to a hydrostatic pressure of 150 percent of the normal operating pressure or 125 psi, whichever is greater for a period of no less than twenty-four hours.
 - a. During this testing period, all pipe, fittings, and accessories in the particular piping system which is being tested shall be carefully inspected.
 - b. If leaks are detected, such leaks shall be stopped by means designated by the Owner's duly authorized representative and the hydrostatic test shall again be applied.
 - c. This procedure shall be repeated until, for an entire twenty-four hour period, no leaks can be found while the system being tested is subjected to the pressure mentioned above.
 3. Wherever conditions permit, each piping system shall thereafter be subjected to its normal operating pressure and temperature for a period of no less than five (5) days.

- a. During that period, it shall be kept under the most careful observation. The piping systems must demonstrate the propriety of their installation by remaining absolutely tight during this period.
 - b. Even though the completion of these tests is satisfactory, there is a continuing responsibility for the ultimate, proper, and satisfactory operation of such piping systems and their accessories.
4. After completion of the testing, the entire cold and hot water piping systems, with attached equipment, shall be thoroughly sterilized with a solution containing not less than 50 parts per million of available chlorine.
 - a. The chlorinating materials shall be either liquid chlorine conforming to U. S. Army Specification No. 4-1 or calcium hypochlorite or chlorinated lime conforming to the requirements of Federal Specification OC114.
 - b. The sterilizing solution shall be allowed to remain in the system for a period of eight (8) hours during which time all valves and faucets shall be opened and closed several times.
 - c. After sterilization, the solution shall be flushed from the system with clean water until the residual chlorine content is not greater than 0.2 parts per million.
 5. The sterilization process shall be conducted as required by the Health Department of the City in which the project is locate and the specifications above, and upon completion of the process, the Health Department shall test and certify the cleanliness of the water piping system.
 6. The Mechanical Subcontractor shall pay all costs and charges incidental to this test and certification.
- 3.8 WELDED PIPING FABRICATION:
- A. Piping and fittings shall be welded and fabricated in accordance with the latest editions of ASME B31.1 for all systems, and ASME B31.3 for Steam and Condensate systems, from the Code for Pressure Piping.
 1. Machine beveling in shop is preferred.
 2. Field beveling may be done by flame cutting to recognized standards.
 - B. Ensure complete penetration of deposited metal with base metal.
 1. Provide filler metal suitable for use with base metal.
 2. Keep inside of fittings free from globules of weld metal.
 3. Welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process.
 4. Pipe shall have the ends beveled 37-1/2 degrees and all joints shall be aligned true before welding.
 5. Except as specified otherwise, all changes in direction, intersection of lines, reduction in pipe size and the like shall be made with factory-fabricated welding fittings.
 6. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction will not be permitted.
 - C. Align piping and equipment so that no part is offset more than 1/16 inch.
 1. Set all fittings and joints square and true, and preserve alignment during welding operation.
 2. Use of alignment rods inside pipe is prohibited.
 - D. Do not permit any weld to project within the pipe so as to restrict it.
 1. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.
 - E. Do not split, bend, flatten or otherwise damage piping before, during or after installation.
 - F. Remove dirt, scale and other foreign matter from the inside of piping, by swabbing or flushing, prior to the connection of other piping sections, fittings, valves or equipment.
 - G. In no cases shall Schedule 40 pipe be welded with less than three passes including one stringer/root, one filler and one lacer.
 - H. Schedule 80 pipe shall be welded with not less than four passes including one stringer/root, two filler and one lacer. In all cases, however, the weld must be filled before the cap weld is added.
- 3.9 WELDED PIPING TESTING:
- A. Welds are subject to inspection, visual and/or X-ray, for compliance with specifications.
 1. Owner will, at the Owner's option, provide employees or employ a testing laboratory for the purposes of performing said inspections and/or X-ray testing.
 - a. Initial visual and X-ray inspections will be provided by the Owner.

2. Contractor shall be responsible for labor, material and travel expenses involved in the re-inspection and retesting of any welds found to be unacceptable. In addition, the contractor shall be responsible for the costs involved in any and all additional testing required or recommended by ASME B31.1 B31.1 and ASME B31.3 due to the discovery of poor, unacceptable or rejected welds.
- B. Welds lacking penetration, containing excessive porosity or cracks, or are found to be unacceptable for any reason, must be removed and replaced with an original quality weld as specified herein. All qualifying tests, welding and stress relieving procedures shall, moreover, be in accord with Standard Qualification for Welding Procedures, Welders and Welding Operators, Appendix A, Section 6 of the Code, current edition.
- C. Weld fittings shall be USA factory made wrought carbon steel butt welding fittings conforming to ASTM A234/A234M and ASME B16.9 B16.9 as made by Grinnell, Tube Turn, Hackney, Taylor Forge, or Ladish Company.
1. Each fitting shall be stamped as specified by ASME B16.9 and, in addition, shall have the laboratory control number metal stenciled on each fitting for ready reference as to physical properties and chemical composition of the material.
 2. Complete test reports may be required for any fittings selected at random.
 3. Only one manufacturer of weld fittings will be approved for each project.
 4. Fittings which have been machined, remarked, printed or otherwise produced domestically from imported forgings or materials will not be acceptable.
 5. Each fitting shall have the manufacturer's trademark permanently identified in accordance with MSS SP-25.
 6. Markings shall be placed on the fittings at the farthest point from the edge to be welded to prevent disfiguring from the welding process.
 7. Submittal data for these fittings shall include a letter signed by an official of the manufacturing firm certifying compliance with these Specifications.

3.10 NATURAL GAS PIPING FABRICATION:

- A. All interior gas piping shall, wherever possible, be installed so as to grade back toward the gas header in the basement.
1. In all cases where such grading is impracticable and it is necessary to grade the house piping away from the inlet, drip pipes of adequate capacity must be installed where traps are formed by such changes in grade.
 2. Drip pipes shall terminate a screwed pattern, malleable iron black cap. No drip pipes shall be used as outlets for the attachment of any fixture or gas appliance.
 3. Drip pipes must, moreover, be placed at the bottom of all vertical pipes which rise from and connect to the end of any horizontal pipe.
- B. All house piping must be securely fastened in place in such a manner as to maintain its grading.
1. Under no circumstances shall extension bars be used for supporting gas piping.
 2. Under no circumstances shall any gas piping be used to support any weight other than its own weight.
- C. All branch outlet pipes shall be taken from the top or sides of running horizontal lines and not from the bottom.
1. No crosses shall be installed in any horizontal gas line.
 2. No unions, gas cocks, or valves shall be used in any concealed location.
 3. Every gas cock and valve shall be accessible for inspection and repair.
- D. The general arrangement of all gas piping shall be such that the number of threaded joints involved is reduced to an absolute minimum.
1. If obstructions are encountered, pipe shall not be bent to circumvent such obstructions. Welding fittings shall be used for this purpose in the case of welded lines, and if threaded lines are involved, screwed fittings shall be used.
 2. Wherever gas pipes run through outside brick, stone, or other walls, the opening around the pipe shall be securely and rigidly sealed.
 3. Gas pipe sizes shall be at least one pipe size larger than the inlet of the gas appliance which they supply.
 4. No bushings shall be used in conjunction with any gas piping.

3.11 NATURAL GAS PIPING TESTING

- A. Gas piping systems shall be very carefully tested by the Contractor.
 1. These piping systems shall first be subjected to a pneumatic test pressure of 100 pounds per square inch.
 2. Hydro and pneumatic tests shall be dead weighted, recorded, and countersigned by the project inspector.
 3. While the systems are subjected to this air pressure, all welded joints shall have a soapy water solution applied for the purpose of detecting minute, as well as larger leaks, and shall be witnessed by Owner.
 4. A final test shall be performed after casework and lab hook up are completed at 15 psi for a minimum of 4 hours.
 - a. If leaks are found, they shall be repaired by chipping and re-welding operations.
 5. Alternate testing and re-welding operations shall be repeated until gas piping systems are absolutely tight at the pneumatic test pressure indicated above.
 - a. If leaks occur in the case of threaded joints, such leaks shall be eliminated by legitimate means, i.e., either by replacing leaking fittings or by tightening them properly.
 - b. Leaking flanged joints shall have flange bolts appropriately tightened or have gaskets causing leaks replaced.
- B. Entire gas piping systems shall be subjected to a pneumatic test pressure of 100 pounds per square inch. Such gas piping systems must be demonstrated to be absolutely tight when subjected to this pressure for a period of twenty-four hours.
 1. In all instances in which leaks are then found, they shall be eliminated in the manner designated by the Owner's duly authorized representative.
 2. A 1/2 inch test connection and cap shall be provided in each branch of the gas piping system.
- C. After all pneumatic testing of the entire gas piping system has been completed and all leaks have been repaired and at a time deemed suitable by the Owner's duly authorized representative, the Contractor shall have the gas supply turned on and the gas odorant chemical added by a representative of the gas company.
 1. The Contractor shall then bleed gas from every riser and every runout until the odor is present in the proper quantity at every gas outlet.

3.12 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
- C. Install ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- D. Install globe or plug valves for throttling, bypass, or manual flow control services.
- E. Provide spring loaded check valves on discharge of water pumps.
- F. Provide plug valves in Natural gas systems for shut-off service.
- G. Provide flow controls in water recirculating systems where indicated.
- H. Use grooved mechanical couplings and fasteners only in accessible locations or within riser shafts.
- I. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- J. Install ball valves for throttling, bypass, or manual flow control services.
- K. Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.
- L. Use butterfly valves interchangeably with gate and globe valves.
- M. Use lug end butterfly valves to isolate equipment.
- N. Provide 3/4 inch (20 mm) ball drain valves at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

3.13 ERECTION TOLERANCES

- A. Establish invert elevations, slopes for drainage to 1/8 inch per foot (one percent) minimum. Maintain gradients through each joint of pipe and throughout system.
- B. Slope water piping and arrange to drain at low points.

3.14 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed and clean.

- B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651 .

3.15 EQUIPMENT CONNECTIONS

- A. Under this Section, water lines shall be run to and connected to the pumps, quick fills, and other items of equipment as indicated.
- B. Provide suitable shutoff valves, check valves, and, if required by the drawings, bypass valves at each and every such point of connection.

3.16 CONNECTIONS FOR GENERAL CONTRACTOR FURNISHED EQUIPMENT

- A. Route lines as indicated on the Drawings to serve various items of equipment specified under General Specification.
 - 1. Rough-in in accordance with detailed drawings furnished by the equipment supplier, and make final connections to the equipment when it is installed.
 - 2. Rough-in shall terminate where noted on Drawings.
 - 3. All pressure lines shall be provided with shutoff valves or cocks.
 - 4. Drain lines shall be provided where required.
 - 5. It shall be assumed that the equipment supplier will provide and install all valves and pipe specialties, etc., unless such items are specified herein or called for on the Drawings.
- B. Laboratory and/or other special equipment and trim are specified in another section under which the equipment shall be furnished and installed.
 - 1. Trim, sink strainers and tail pieces shall be furnished to Mechanical Contractor who shall receive, store and install them.
 - 2. Mechanical Contractor shall furnish the sink P-traps and all materials and labor to rough-in and final connect as shown on the Drawings.

3.17 CONNECTIONS FOR OWNER FURNISHED EQUIPMENT

- A. The Owner will be furnishing various pieces of equipment.
- B. The Contractor shall provide the rough-in indicated on the Drawings.
- C. Final connections are also included as part of this contract.

END OF SECTION 22 11 16

SECTION 22 11 19
PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Floor drains.
- B. Cleanouts.
- C. Strainers.
- D. Backflow preventers.

1.3 RELATED REQUIREMENTS

- A. Section 22 00 10 - Basic Plumbing Requirements
- B. Section 22 11 16 - Plumbing Piping
- C. Section 22 67 06 - Deionized Water System.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ASSE 1001 - Hose Connection Vacuum Breakers.
- C. ASSE 1012 - Backflow Preventers with Immediate Atmospheric Vent.
- D. ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.
- E. ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining Anti Backflow Types.
- F. ASME A112.6.3 - Floor and Trench Drains.
- G. ASTM C478 - Precast Reinforced Concrete Manhole Sections.
- H. AWWA C510 - Double Check Valve Backflow Prevention Assembly.
- I. AWWA C511 - Reduced-Pressure Principle Backflow Prevention Assembly
- J. PDI-WH 201 - Water Hammer Arresters.

1.5 SUBMITTALS

- A. Submit under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
- C. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- D. Manufacturer's Installation Instructions: Indicate assembly and support requirements.
- E. Manufacturer's Certificate: Certify that oil interceptors meet or exceed specified requirements.
- F. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Record actual locations of equipment, cleanouts, backflow preventers, etc.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Operation Data: Indicate frequency of treatment required for interceptors.
- C. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Accept specialties on site in original factory packaging. Inspect for damage.

1.9 ATTIC STOCK

- A. Furnish under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Provide two loose keys for each type of manhole cover and valve box.

PART 2 - PRODUCTS

2.1 FLOOR DRAINS

- A. Floor drains (FD) shall be sized to conform to the information indicated on the Drawings or contained elsewhere in these Specifications. Extreme care shall be used to set the elevation of the drain to meet the low point elevation of the finished floor. Each floor drain shall be provided with a P-trap unless noted otherwise. Note that a deep seal type trap may be required under other Sections of these Specifications.
- B. All floor drains will be furnished and installed with all accessories required for the particular construction in which they are to be mounted; and shall be as manufactured by Wade, Josam, Zurn, or approved equal.

2.2 CLEANOUTS

- A. At each change in direction, at the end of each continuous waste line, at the foot of each riser in the building and at 50 foot intervals in long horizontal runs, of lines of 4 inch size and smaller, and not more than 95 foot intervals for larger lines, cleanouts shall be placed in soil and waste lines.
- B. The size of the cleanouts shall be identical with the size of the soil or waste line in which they are placed for 4 inch and smaller lines.
- C. The size of cleanouts in lines larger than 4 inches shall be 6 inches in all cases. All cleanouts shall be placed to be easily accessible for servicing.
- D. Where they occur in pipe chases, they shall be placed above the floor in such a location so they will be easily accessible through access doors, or they shall be brought through the walls and be provided with covers.
- E. All horizontal soil and waste lines shall have a cleanout placed in the end of the line by the use of a wye and a 1/8 bend, or by a combination tee wye and made easily accessible by extending the cleanout through the wall and be covered as described above.
- F. Cleanouts shall be located at the end of all sanitary lines and above the flood level rim.
- G. The screw plug of all cleanouts shall be of cast brass.
- H. The bodies of floor cleanouts shall be tapped for iron pipe threads. The brass tap screws shall have flange caps with raised nuts.
- I. Wherever such cleanouts occur in finished floor slabs or terminate in finished walls, they shall be provided with scoriated nickel bronze cleanout covers of such a size as to make the plugs over which they are installed readily accessible. These cleanouts shall be cast iron floor cleanout with cut off ferrule, tapered brass plug with 8 inch round screwed brass access cover with three eighths inches (3/8 inch) diameter Allen Head Screw.
- J. Floor Cleanouts (All Areas): Wade W-8190 UT or Zurn ZN 1455 4-75-UT as described above.
- K. Final mounting of cleanout or cover shall be set flush with the finished surface the device is mounted in.

2.3 STRAINERS

- A. Strainers, 2 inch and smaller, bronze body, screwed ends, No. 10 mesh strainer, screwed cap with bronze blow-off valve (size to be determined by standard tap size in cap).
- B. Cast iron body, 2 1/2 inches and larger, isolating type flanged ends where installed in copper lines, No. 7 perforated monel strainer, flanged cap with bronze ball blow-off valve (size of blow off valve shall be determined by standard tap size in cap).
- C. Suction diffusers shall be Paco or approved equal, cast iron body and cover, steel diffuser, and stainless steel strainer, 125 pound ASA (flat face) flange for a working pressure of 175 psi and temperature of 300°F.

2.4 BACKFLOW PREVENTERS

- A. Backflow preventers (BFP) shall be reduced pressure type, Febco 825, or approved equal. A BFP shall be installed to isolate all non-potable water requirements from the building domestic water system. (All BFP's shall be installed within the building.)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate cutting and forming of roof and floor construction to receive drains to required invert elevations.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of threaded sealant. Ensure clearance at cleanout for rodding of drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Pipe relief from back flow preventer to nearest drain.
- E. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatories, sinks, and washing machine outlets.
- F. Lead: It is forbidden that lead in any form be used in any water system other than waste. If lead is used in the fabrication or installation of any water system other than waste, then ALL of the installed equipment and material, which may have come in contact with the lead, shall be marked with bright red or orange spray paint, and shall be removed from the project site. The system(s) shall then be restored and reinstalled using all new materials.

END OF SECTION 22 11 19

SECTION 22 13 16

STORM AND SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Sanitary waste and vent piping.
- B. Storm water piping.

1.3 RELATED REQUIREMENTS

- A. Section 22 00 10 - Basic Plumbing Requirements.
- B. Section 22 00 13 - UTSW Plumbing Design Requirements.
- C. Section 22 05 29 - Hangers for Plumbing Piping.
- D. Section 22 13 19 - Sanitary Waste Piping Specialties .
- E. Section 23 21 13 - Hydronic Piping.

1.4 REFERENCE REQUIREMENTS

- A. IPC International Plumbing Code - Current Version.
- B. ASME B31.9 - Building Service Piping.
- C. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.
- D. CISPI 310 - Joints for Hubless Cast Iron Sanitary Systems.
- E. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
- F. TDH - Texas Department of Health, Water System Regulations
- G. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 SUBMITTALS

- A. Submit under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Submit product data for review on piping and fittings in accordance with the requirements of Division 01. Submittal data shall include:
 - 1. Manufacturer of pipe.
 - 2. Tests or listing by recognized testing laboratory that certifies material composition is in accordance with ANSI/ASTM requirements.
 - 3. Product data for pipe and fittings to be used on each piping system.
 - 4. Identification of where each pipe type will be used.

1.6 QUALITY ASSURANCE

- A. Installation according to IPC requirements.
- B. Identify pipe with marking including size, ASTM material classification and ASTM specification.

1.7 DELIVERY, STORAGE AND PROTECTION

- A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work and isolating parts of the completed system.

PART 2 - PRODUCTS

2.1 CAST IRON PIPE AND FITTINGS

- A. Conform to ASTM A-74, A-888, and CISPI 301-12.
- B. Pipe and fittings shall be marked with the collective trademark of Cast Iron Soil Pipe Institute and be listed by NSF International.
- C. Standard weight pipe with drainage fittings for:
 - 1. Sanitary waste, vent, and drainage pipe 2 inch and larger above ground.
 - 2. Building storm drains.

3. Rainwater conductors inside building.
 4. Drain lines under buildings, and under exterior concrete or other paving. Extend cast iron piping at least 5 feet outside of building.
- D. Joints in Cast Iron Pipe:
1. Below grade: Bell and spigot with neoprene compression gaskets
 2. Above grade: No-Hub using stainless couplings, meeting CISPI 310-12. Provide 4-band, heavy duty couplings for piping 2 inch through 10 inch and 6-band heavy duty couplings for piping 12 inch and larger. Couplings shall comply with ASTM C 1540/ FM-1680 rated no hub bands for all cast iron piping material above slab on-grade.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation: For each installation, comply with requirements from 22 00 10 - Basic Plumbing Requirements.
- B. Cast Iron Pipe Joints:
1. Install compression gaskets and No-Hub bands in accordance with CISPI installation methods and manufacturer's instructions.
- C. Grading Pipes for Drainage:
1. Uniformly place storm drainage pipes and footing drain pipes at elevations and slopes indicated. If no elevations or slopes are indicated, slope pipes at not less than 1/8 inch per foot.
 2. Uniformly place sanitary sewer pipes at elevations and slopes required by the local codes
- D. Bracing Joints:
1. Provide braces and all-thread bridle rods as required to reinforce sanitary and storm piping joints at each change of direction within building and where otherwise not direct buried below ground.
 2. If mechanical lock type couplings are used, then prepare pipe ends and make joints in accordance with pipe coupling manufacturer's printed instructions.
 3. Where large pipes underground are subject to shock because of sudden changes in liquid flow rate, provide concrete "kicker" blocks at joints, fittings, and changes of pipe direction. Provide "kicker" blocks in accordance with applicable pipe industry trade or research organization recommendations.
- E. Clean inside of pipe before installation. Keep installed piping clean, and protect ends from foreign matter by capping or plugging them.
- F. Do not install piping above electrical equipment such as starters, variable frequency motor controllers, motor control center's, or disconnects. Maintain code required clearance above, below and to sides of electrical equipment.
- G. Do not install piping above or passing through any IT rooms, IDF rooms, or service entrance rooms.
- H. Run pipes in straight lines and square with building. Install risers plumb. Make offsets only where indicated and where necessary.
- I. Piping passing through or under grade beams or through foundation walls shall be provided with a schedule 40 steel pipe sleeve two sizes greater than the piping passing through the sleeve.
- J. Identify all storm, waste and vent piping in accordance with and as specified in Section 22 05 53.

3.2 INSPECTION AND TESTING

- A. Inspection and Testing: For each installation, comply with requirements from 22 00 10 - Basic Plumbing Requirements.

3.3 CLOSEOUT ACTIVITIES

- A. As part of project punch list requirements per Section 01 77 00 - Closeout Procedures and Submittals, include UTSW Utilities / Mechanical Shop, UTSW Controls / Utilities Operations, UTSW Plumbing Shop, UTSW Building Maintenance, UTSW PM, Commissioning Agent (if applicable), and other associated teams for mechanical focused review.
- B. Provide revised Operations and Maintenance Data including final installed components, schedule, maintenance manuals, and warranty documentation to UTSW PM and to UTSW Building Maintenance.

END OF SECTION 22 13 16

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. This section includes requirements for:
 - 1. Cleanouts
 - 2. Trap primers

1.3 RELATED REQUIREMENTS

- A. Section 22 00 10 - Basic Plumbing Requirements.
- B. Section 22 00 13 - UTSW Plumbing Design Requirements.
- C. Section 22 05 29 - Hangers for Plumbing Piping.
- D. Section 22 05 53 - Plumbing Identification.
- E. Section 22 11 16 - Plumbing Piping .
- F. Section 22 11 19 - Plumbing Specialties.
- G. Section 22 13 16 - Storm and Sanitary Waste and Vent Piping .
- H. Section 22 20 00 - Piping, Valves, and Fittings.

1.4 REFERENCE REQUIREMENTS

- A. IPC International Plumbing Code - Current Version.
- B. ASME B31.9 - Building Service Piping.
- C. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.
- D. CISPI 310 - Joints for Hubless Cast Iron Sanitary Systems.
- E. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
- F. TDH - Texas Department of Health, Water System Regulations
- G. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 SUBMITTALS

- A. Submit under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Submit product data for review on piping and fittings in accordance with the requirements of Division 01. Submittal data shall include:
 - 1. Manufacturer of pipe.
 - 2. Tests or listing by recognized testing laboratory that certifies material composition is in accordance with ANSI/ASTM requirements.
 - 3. Product data for pipe and fittings to be used on each piping system.
 - 4. Identification of where each pipe type will be used.

1.6 QUALITY ASSURANCE

- A. Installation according to IPC requirements.
- B. Identify pipe with marking including size, ASTM material classification and ASTM specification.

1.7 DELIVERY, STORAGE AND PROTECTION

- A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work and isolating parts of the completed system.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers are indicated in subsequent paragraphs.

2.2 CLEANOUTS

- A. Acceptable manufacturers:
 - 1. Zurn (Zurn model numbers are used below as Basis of Design).
 - 2. Josam.
 - 3. Wade.
 - 4. Jay R. Smith.
 - 5. Sioux Chief.
 - 6. Watts.
 - 7. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Exterior: Heavy duty cast iron cleanout housing with internal cleanout body and plug.
 - 1. Basis of Design: BaZ1400Z.
- C. Finished concrete floor: Cast iron body with round adjustable polished nickel bronze top, ABS plug and carpet marker where required.
 - 1. Basis of Design: ZN1400.
- D. Ceramic tile: Cast iron body, polished nickel bronze top, 1/2 inch terrazzo recess and closure plug.
 - 1. Basis of Design: ZN1400 Series.
- E. Vinyl tile floor: Cast iron body, round nickel bronze top, 1/8 inch tile recess and closure plug.
 - 1. Basis of Design: ZN1400-X.
- F. Carpet: Inside caulk round brass scoriated frame and cover and provide carpet marker.
 - 1. Basis of Design: ZN1400-CM.
- G. Wall: Cast iron caulking ferrule with stainless round access cover and screws.
 - 1. Basis of Design: Z1441.
- H. Access covers: Minimum size 12-inch x 12-inch located for access to valves, shock absorbers, trap primers, wall cleanouts, etc.
- I. Furnish cleanouts occurring in waterproof floors with clamping devices.

2.3 TRAP PRIMERS

- A. Acceptable manufacturers:
 - 1. Josam
 - 2. Zurn
 - 3. Wade
 - 4. Jay R. Smith
 - 5. Precision Plumbing Products
 - 6. Sioux Chief
 - 7. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Provide trap primer of brass construction, with removable operating parts, and integral vacuum breaker.
- C. See Plumbing fixture section for specifications.

PART 3 - EXECUTION

3.1 INSTALLATION, INSPECTION, AND TESTING

- A. Installation: For each installation, comply with requirements from 22 00 10 - Basic Plumbing Requirements.
- B. Cleanouts
 - 1. Provide line size cleanouts up to 4 inch; 4-inch cleanout for lines larger than 4 inch.
 - 2. Locate cleanouts at all changes in direction greater than 45 degrees and in straight runs as shown 100 feet outside the building on drawing or spaced not greater than required by applicable Plumbing Code.
 - 3. Extend inaccessible cleanouts up through floor and/or wall to provide easy accessibility.
- C. Trap Primers
 - 1. Install primers in accessible location or as shown on drawings.
 - 2. Trap primers shall be Plumbing and Drainage Institute approved.

3.2 CLOSEOUT ACTIVITIES

- A. As part of project punch list requirements per Section 01 77 00 - Closeout Procedures and Submittals, include UTSW Utilities / Mechanical Shop, UTSW Controls / Utilities Operations, UTSW Plumbing Shop, UTSW Building Maintenance, UTSW PM, Commissioning Agent (if applicable), and other associated teams for mechanical focused review.

- B. Provide revised Operations and Maintenance Data including final installed components, schedule, maintenance manuals, and warranty documentation to UTSW PM and to UTSW Building Maintenance.

END OF SECTION 22 13 19

SECTION 22 20 00

PIPING, VALVES, AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Piping.
- B. Pipe fittings.
- C. Valves.
- D. Strainers.
- E. Unions.
- F. Flanges.
- G. Backflow Preventers.

1.3 RELATED REQUIREMENTS

- A. Section 09 96 00 - High-Performance Coatings.
- B. Section 22 00 10 - Basic Plumbing Requirements.
- C. Section 22 05 16 - Piping Expansion Compensation.
- D. Section 22 05 29 - Supports and Anchors.
- E. Section 22 05 48 - Vibration Isolation.
- F. Section 22 05 53 - Plumbing Identification.
- G. Section 22 07 19 - Plumbing Insulation.
- H. Section 22 11 16 - Plumbing Piping for installation requirements.

1.4 REFERENCE STANDARDS

- A. AGA - American Gas Association.
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
- C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.
- D. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
- E. ASME B16.9 - Factory-Made Wrought Butt Welding Fittings.
- F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- G. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
- H. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings: DWV.
- I. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings—DWV.
- J. ASME B16.34 - Valves — Flanged, Threaded, and Welding End.
- K. ASME B31.1 - Power Piping.
- L. ASME B31.9 - Building Services Piping.
- M. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators.
- N. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- O. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
- P. ASTM A105/A105M - Standard Specification for Carbon Steel Forgings for Piping Applications.
- Q. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- R. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
- S. ASTM A182/A182M - Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
- T. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.

- U. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- V. ASTM A536 - Standard Specification for Ductile Iron Castings.
- W. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings.
- X. ASTM B99 - Standard Specification for Copper-Silicon Alloy Wire for General Applications.
- Y. ASTM B148 - Standard Specification for Aluminum-Bronze Sand Castings.
- Z. ASTM B371/B371M - Standard Specification for Copper-Zinc-Silicon Alloy Rod.
- AA. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- BB. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
- CC. ASTM D2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping.
- DD. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
- EE. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- FF. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
- GG. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
- HH. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- II. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
- JJ. MSS SP-25 - Standard Marking System for Valves, Fittings, Flanges and Unions.
- KK. MSS SP-45 - Drain and Bypass Connections.
- LL. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005.

1.5 SUBMITTALS

- A. Submit product data under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Include data on pipe fittings, valves, and accessories.
- C. Provide manufacturer's catalog information. Indicate valve rating and data.
- D. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.6 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Certificates, Materials and Procedures: Conform to ASME BPVC-IX and applicable state labor regulations.
 - 1. Welders Certification: In accordance with ASME BPVC-IX.
- C. Maintain one copy of the above listed documents on site for inspection.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Store and protect products under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- C. Deliver and store valves in shipping containers with labeling in place.

PART 2 - PRODUCTS

2.1 PIPING

- A. Sanitary Drainage Pipe and Fittings:
 - 1. Pipe used for interior, above ground sewer and drainage purposes, unless specifically shown to the contrary, shall be service weight cast iron soil pipe conforming to ASTM A74 and CISPI 301, hub and spigot for 10 inches and larger and hubless for 8 inches and smaller, each piece of pipe and each fitting shall have the manufacturer's mark or name cast on it.
 - 2. Pipe and fittings from the sump pumps and sewage ejectors shall be Schedule 80 PVC with PVC bolted flange connections at pump discharge and at each valve. PVC piping shall be run from the pumps to the exterior piping connection point within 6 inches of 5 feet outside of the building.

3. Galvanized or black steel pipe shall not be used in any waste connection to a fixture or in any section of the soil or waste piping system. (Use ball valves in lieu of gate valves.)
- B. Storm Water Pipe and Fittings:
1. Piping:
 - a. Storm Water piping shall be service weight cast iron soil pipe conforming to ASTM Specification A74 and CISPI 301, hub and spigot for pipe 10 inches and larger and hubless for 8 inches and smaller.
 - b. Each piece of pipe and each fitting shall be coated at the factory with asphaltum or coal tar pitch and with the manufacturer's mark or name cast on it.
 - c. Copper piping shall be Type DWV copper pipe with wrought copper sweat joints where indicated on the Drawings.
 - d. Where roof drains are 50 or more feet above the horizontal runout at grade level, the downspout piping system shall be constructed of Schedule 40 black steel pipe with weld fittings.
 - e. Underground storm and sanitary waste piping, of all sizes, shall be cast iron hub and spigot type, with Tyseal (or approved equal) neoprene gaskets, coated at the factory with asphaltum or coal tar pitch, and with the manufacturer's mark or name cast on it. Hubless piping systems shall not be used in a directly buried, underground application.
 2. Joints in hub and spigot cast iron pipe shall be made water and gas tight with Tyseal neoprene gaskets.
 - a. Lead and Oakum may be used only under special conditions, with prior written permission from the Resident Construction Manager.
 - b. Joints in hubless cast iron soil pipe and fittings shall be made by the use of a neoprene sleeve and 24 gage, Type 304 Stainless Steel shield made tight with a torque wrench and torqued to a minimum of 100 inch pounds.
 - c. Each clamp shall consist of a neoprene gasket with a stainless steel outer band which effectively captures the gasket material.
 - d. Each clamp shall bear the FM and UPC stamp, shall be approved to Class I of Factory Mutual Standard #1680, and shall be a Heavy Duty No Hub Coupling, minimum 4 bands.
 3. Cleanouts:
 - a. Interior cleanouts shall be brass caulked into the lines, and where they occur in walls or floors of finished areas, shall be provided with nickel-bronze tops or access plates.
 - b. Interior cleanouts shall be of the same size as the pipe served up to 4 inches size and four 4 inches for all larger lines.
- C. Interior Domestic Water Piping and Fittings
1. Interior domestic water piping larger than 6 inches shall be Schedule 40 galvanized steel pipe.
 2. This pipe shall conform in every detail to A.S.T.M. Standard Specifications for BLACK AND HOT-DIPPED ZINC-COATED GALVANIZED WELDED AND SEAMLESS STEEL PIPE ASTM A53/A53M latest revision, Type E or S.
 3. This threaded pipe shall be supplied with thread protectors on each end.
 4. All steel water pipe shall be hot-dipped galvanized pipe zinc coated both inside and outside.
 5. Materials within domestic water distribution systems that may come into contact with potable water delivered shall be UL classified in accordance with ANSI/NSF-61 for hot and cold potable water service and shall be certified to the low lead requirements of NSF-372.
 - a. Manufacturer must provide written documentation of compliance.
 6. Unless otherwise shown on Drawings, all interior domestic water piping 4 inches and smaller shall be fabricated from Type L, hard drawn, copper pipe made of deoxidized copper (99.9 percent pure). No pipe smaller than 3/4 inch shall be used except at local connections or as detailed for laboratory areas.
 7. Interior domestic copper water pipe shall preferably be joined using non-lead-bearing solder, such as 95.5 silver or antimony solder (95 percent tin, and 5 percent silver or antimony).
 8. Domestic copper couplings may be press couplings and shall be connected similar to Fittings below.
 9. Interior Domestic Water Fittings
 - a. All fittings for 6 inch and larger water lines shall be 125 lb., cast iron, flanged pattern fittings. These fittings shall be hot-dipped galvanized, after all machining operations have been completed. These fittings shall be of Crane Company, or approved equal, manufacture and

- their flanges shall be dimensioned, faced drilled and spot faced to conform to the Class 150 American Standard for Steel Pipe Flanges and Flanged Fittings.
- b. Copper fittings for 4 inches and smaller domestic copper water lines shall preferably be Streamline Solder Fittings manufactured by Streamline Pipe and Fittings Division, Mueller Brass Company, or approved equal.
 - 1) These wrought copper fittings shall be rigid and strong with openings machined to accurate capillary fit for the pipe.
 - c. Fittings for piping systems involving the use of domestic copper pipe shall preferably be fabricated with the use of Dunton`s 95-5 (95 percent tin and 5 percent antimony) solder manufactured by W. M. Dunton Company, or approved equal.
 - 1) Silver solder consisting of 95 percent tin and 5 percent silver is the only acceptable substitution.
 - d. Interior domestic copper water pipe ONLY may utilize copper press fittings when the following conditions are met:
 - 1) Written approval of the Owner`s Project Manager shall be obtained prior to bidding.
 - 2) Fittings shall be installed in portions of systems having an operating pressure that will not exceed 200 psig.
 - (a) Fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22 .
 - (b) Fittings shall comply with NSF 61 and NSF 372 utilizing EPDM, nontoxic, and synthetic rubber sealing elements.
 - (c) Approved Manufacturers:
 - (1) Viega.
 - (2) Substitutions: Other products as approved by UTSW Facilities Management, complying with 01 60 00 - Product Requirements.
 - (d) O-rings for domestic water copper press fittings shall be EPDM.
 - (e) Copper press fittings shall be rated at 200 psi working pressure and 250 degree working temperature.
 - 3) Installation tools shall be as recommended by the fittings manufacturer.
10. Interior Domestic Water Headers
- a. Provide headers as indicated on Drawings for the distribution of the cold water and hot water systems.
 - 1) Galvanized headers shall be fabricated by a welding process by the use of extra strong black steel pipe and pipe supplies of the same character.
 - 2) Stainless headers may be welded or threaded.
 - 3) Copper headers may be braized or soldered.
 - 4) All flanges used in the case of such headers shall be dimensioned, faced, drilled and spot faced to conform to the Class 150 American Standard for Steel Pipe Flanges and Flanged Fittings (B16e).
 - 5) The header outlets shall be effected by welding to the header full length welding couplings of the proper size. These steel members shall be carefully "lined up".
 - b. Upon completion, these headers shall be subjected to a hydrostatic test of 300 pounds per square inch gauge. All defects noted upon inspecting the headers thus tested shall be repaired by chipping, machining and burning out defects, and re-welding. After repairs have been made, the headers shall be retested as described above.
 - c. After the galvanized headers have been tested and found to be tight, they shall be galvanized by a "double-dip" process.
 - 1) The manufacturer shall be required to provide certificates assuring the fact that the headers were so "double-dipped".
 - 2) Both exterior and interior surfaces shall receive a heavy zinc coating by a hot dipping process.
 - 3) Galvanized steel nipples shall be used to extend the various header outlets to the gate valves placed in each outgoing water line near the header.
 - 4) These nipples shall be of such a length that the gate valves in the outgoing water lines are neatly lined up in a horizontal plane.

- 5) At a point just beyond these gate valves, a 3/4 inch valved drain line shall be installed in the case of each outgoing branch leaving the header.
 - 6) The purpose of such valve branches shall be to drain the system into which the flow of water is controlled by the gate valves previously mentioned.
 - 7) These 3/4 inch drain line valves from the various branches leaving the headers shall be likewise lined up in a straight horizontal line.
 - 8) These 3/4 inch drain lines shall terminate in a common "drain line".
 - 9) That 1 inch drain line shall be the header drain line.
 - 10)
- d. Shock Arrestors
- 1) Acceptable manufacturers:
 - (a) Josam.
 - (b) Wade.
 - (c) Jay R. Smith.
 - (d) Precision Products.
 - (e) Zurn.
 - (f) Sioux Chief.
 - 2) Arrestor shall be piston type, polycarbonate with two EPDM O-rings, lubricated with FDA-approved Dow Corning 111 silicone compound in Type K or L copper body, suitable for 200 psig minimum pressure at 200 degrees F.
 - 3) Arrestor shall be ANSI/ASSE 1010 certified and must be accessible.
- e. Inline Automatic Flow Controller
- 1) Provide automatic flow controllers at recirculating branches and at recirculating pump as scheduled and detailed on Drawings.
 - 2) Acceptable Manufacturers: FDI, Inc. Model ICCS
 - 3) Body: Series 300 Stainless Steel.
 - 4) Union Nut: Nickel plated brass.
 - 5) Flow Cartridge: Series 300 Stainless Steel wear surfaces.
 - (a) Accuracy: Flow rate plus or minus 5 Percent over 95 Percent of the control range.
 - (b) Certification: NSF/ANSI 61-G certified by NSF for potable water applications.
 - 6) Temperature rating: 180 degree F. Tested and approved for commercial hot water applications.
 - 7) Pressure Rating: 400 PSI static pressure.
 - 8) Provide portable meter kit including the following accessories:
 - (a) Hoses, fittings, and adapters as required for connection to pressure/temperature ports.
 - (b) 6-inch diameter face, 270 degree arc, beryllium diaphragm gauge.
 - (c) Provide with carrying case, calibration instructions, and capacity curves.
- D. Welded Piping
1. Weld fittings shall be USA factory made wrought carbon steel butt-welding fittings conforming to ASTM A234/A234M and ASME B16.9 latest edition, as made by Weld Bend, Tube Turn, Hackney, or Ladish Company.
 2. Each fitting shall be stamped as specified by ASME B16.9 and, in addition, shall have the laboratory control number metal stenciled on each fitting for ready reference as to physical properties required for any fittings selected at random.
 3. Only one manufacturer of weld fittings will be approved for the project.
 4. Fittings that have been machined, remarked, printed or otherwise produced domestically from non-domestic forgings or materials will not be acceptable.
 5. Provide each in accordance with MSS SP-25.
 6. Markings shall be placed on the fittings at the farthest point from the edge to be welded to prevent disfiguring from the welding process.
 7. Submittal data for these fittings shall include a letter signed by an official of the manufacturing firm certifying compliance with these specifications.
- E. Natural Gas Piping

1. All pipe used for the fabrication of gas piping systems shall be Schedule 40 black steel pipe that conforms in every detail to Standard Specifications for WELDED AND SEAMLESS STEEL PIPE, ASTM A53/A53M , Type E or S.
2. Unless otherwise specifically required, all steel pipe provided for gas piping systems shall be provided with plain ends and assembled with weld fittings on all pipe 1-1/4 inch and larger of 3/4 inch and larger if before the emergency shut off valve.
3. No pipe smaller than 3/4 inch, or as detailed for laboratory furniture, shall be used. From the emergency shutoff valve to the outlets the pipe shall be assembled with threaded fittings provided all joints are exposed or within the confines of the laboratory furniture.
4. From the emergency shutoff valve to the outlets the pipe shall be assembled with threaded fittings provided all joints are exposed or within the confines of the laboratory furniture.
5. All gas piping within the building shall be installed exposed to view.

2.2 VALVES

- A. Refer to Section 22 11 16 - Plumbing Piping for installation and examination.
- B. Any alternate valves or materials shall be approved in writing by UTSW FM.
- C. All bronze and iron body gate and globe valves shall be the product of one manufacture for each project.
 1. Manufacturers of other types may not be mixed on the same project; i.e., all butterfly valves shall be of the same manufacturer, all ball valves shall be of the same manufacturer, etc.
- D. Valves used in circulating systems, plumbing, and steam systems (low and medium pressure) shall be correlated to existing system requirements. Class 150 SWP.
 1. Class 300 valves shall be constructed of all ASTM B61 composition.
 2. All gate, globe and angle valves shall be union or screw over bonnet design.
 3. Metal used in the stems of all bronze gate, globe and angle valves shall conform to ASTM B371/B371M Alloy 694, ASTM B99 Alloy 651, or other corrosion resistant equivalents.
 4. Written approvals must be secured for the use of alternative materials by UTSW Facilities Management.
- E. All iron body valves shall have the pressure containing parts constructed of ASTM designated of 126 class B iron.
 1. Stem material shall meet ASME B16.1 Alloy 360 or ASTM B371/B371M Alloy 876 silicon bronze or its equivalent.
- F. Gates and globes shall be bolted bonnet with OS&Y (outside screw and yoke) and rising stem design. A lubrication fitting is preferred on yoke cap for maintenance lubrication of the yoke bushing.
- G. All cast steel body valves shall have the pressure containing parts constructed of ASTM A216/A216M - GR-WCB carbon steel.
 1. Gate and globe valves shall be bolted bonnet outside and screw and yoke design with pressure temperature rating conforming to ASME B16.34. vs ASME B16.34
 2. Stems shall meet ASTM designation A-186-F6 chromium stainless steel.
 3. Wedge (gate valves) may be solid or flexible type and shall meet ASTM A182/A182M -F6 chromium stainless steel on valves from 2 inches to 6 inches. Sizes 8 inches and larger may be A-216-WCB with forged rings or overlay equal to 182-F6.
 4. Seat ring shall be hard faced carbon steel or 13 percent chromium ASTM A182/A182M-F6 stainless.
 5. Handwheels shall be A47 Grade 35018 malleable iron or Ductile Iron ASTM A536.
- H. All forged steel body valves shall have the pressure containing parts constructed of ASTM A105/A105M, Grade 2 forged carbon steel.
 1. Seat and wedges shall meet ASTM A182/A182M -F6 chromium stainless steel.
 2. Seat rings shall be hard faced.
 3. Valves shall conform to ASME B16.34 pressure-temperature rating.
- I. All valves shall be repackable, under pressure, with the valve in the full open position.
- J. All gate valves, globe valves, angle valves and shutoff valves of every character shall have malleable iron hand wheels, except iron body valves 2-1/2 inches and larger which may have either malleable iron or ASTM A126 Class B, gray iron hand wheels.
- K. Packing for all valves shall be free of asbestos fibers and selected for the pressure temperature service of the valve.
 1. It is incumbent upon the manufacturer to select the best quality, standard packing for the intended valve service.

2. At the end of one year, period spot checks will be made, and should the packing show signs of hardening or causing stem corrosion then all valves supplied by the manufacturer shall be repacked by the Contractor, at no expense to the Owner, with a packing material selected by the Owner.
- L. Valves located with stem in horizontal position shall be drilled and tapped in accordance with MSS SP-45 at Boss G to accommodate a drain valve.
- M. Balancing and/or Shutoff Valves for Closed Water Circulating Systems:
1. 2 inches and smaller, three piece bronze body, bronze or stainless steel ball and stem, Teflon seats, packing and gasket, bronze gland follower, adjustable stuffing box, steel lever type handle, with plastic operating handle, quarter turn stops, and shall be Class 150.
 2. Manufacturer shall certify ball valves for use in throttling service.
 3. Stem extensions shall be furnished for use in insulated lines.
 4. Valves 2-1/2 inches and larger shall be tapped full lug butterfly valves with aluminum bronze discs of ASTM B148 Alloy C955 and 316, 416, or 420 stainless steel shafts.
 5. Design must incorporate bushing between shafts and body of material suitable to provide a bearing surface to eliminate seizing or galling.
 6. Valve must be capable of providing a bubble tight seal at 200 psi for valves up to 12 inches (150 psi for larger valves) when used for end of line service without requiring the installation of a blind flange on the downstream side.
 7. Liners shall be resilient material suitable for 225°F temperature and bodies of ductile iron.
 8. Butterfly valves 8 inches and larger and butterfly valves used for balancing service or control, regardless of size, shall have heavy duty weather proof encased gear operators, with malleable iron handwheel.
 9. Valves 2-1/2 inches through 6 inches shall have lever handles which can be set in interim positions between full open and full closed.
 10. All butterfly valves shall be absolutely tight against a pressure differential of 150 psi.
- N. Check Valves:
1. Bronze body, 2 inches and smaller, bronze body regrinding disc and seat with screw-in cap.
 2. Iron body, 2-1/2 inches and larger, bronze disc and seat or non slam wafer type with stainless pins and springs, and bronze plate.
 3. Forged steel lift check valves, 2 inches and smaller shall be bolted cap and body, screwed end connections and conform to ASME B16.34 and pressure temperature rating.
- O. Standards of Quality for Valves: Standard of Quality for Valves: (Compare Charts between Sections)

			<u>Milwaukee</u>	<u>Nibco</u>	<u>Stockham or as Noted</u>
2" and smaller	Ball Valve for shut off	Domestic Hot & Cold Water Plumbing Systems Recirculating	BA100A	T-585-70	Appollo 77-100, Kitz #68
2-1/2" & larger	Gate Valve	Plumbing	F-2885-M	F-617-0	G-623, Kitz #72
2-1/2" & larger	Globe, Angle & Balancing Valve	Plumbing	F-2981-M	F-718-B	G-514-T Kitz #76
2-1/2" & larger	Butterfly Valve for shutoff	Domestic Hot & Cold Water Pibg Systems; Heating Water	ML-123B 642BG	LD2000	**DeZurik 632,L,D,Rs66,6 Demco
2" and smaller	Check Valve	All Water Systems	510	T-433	B-345
2-1/2" & larger	Check Valve	All Water Systems	1400 Series	W-920-W	Stockham "Duo-Check"
2" & smaller	Globe Valve	Primary Hot Water	--	276AP	Kitz #175
2-1/2" & larger	Globe Valve	Primary Hot Water	F-2983-M	F-768-B	Kitz #7122E
2" to 12"	Hub End	(AWWA)	--	--	Mueller 2380-5
1-1/2" & smaller	Lubricated Gas Cock	Lab Gases	BB2-100	1795 with Wrench	Rockwell 142 & 1797 (with wrench)

2" and larger	Lubricated Gas Cock	Lab Gases		179F with Wrench	Rockwell 143
2" & smaller	Isolation Ball Valve	Lab Gases	--	--	Spirax Sarco Model 60

* Requires extended stem in insulated lines.
** Valves 8 inches and larger, and valves used for balancing service regardless of size, shall have heavy-duty weatherproof encased gear operators.
*** Requires ball drip assembly.
Contractor may submit request for equivalent valve. Must show torque ratings for substitute and equivalence to base spec.
Valve operators shall be rated for 2.5x the torque for full shutoff.

2.3 STRAINERS

A. Strainers,

1. 2 inches and smaller, bronze body, screwed ends, No. 10 mesh strainer, screwed cap with bronze blow-off valve (size to be determined by standard tap size in cap). Cast iron body,
2. 2-1/2 inches and larger, isolating type flanged ends where installed in copper lines, No. 7 perforated monel strainer, flanged cap with bronze ball blow-off valve (size of blow-off valve shall be determined by standard tap size in cap).
3. Special Note: All strainers 6 inches and larger shall have studs mounted in the body flange in lieu of bolts for removal of cap. Baskets for strainers 6 inches and larger shall have stainless steel reinforcing bands at ends to prevent collapsing.

- B. Suction diffusers shall be Paco or approved equal, cast iron body and cover, steel diffuser, and stainless steel strainer, 125 pound ASA (flat face) flange for a working pressure of 175 psi and temperature of 300°F.

2.4 UNIONS

- A. Provide and install unions at proper points to permit removal of pipe and various equipment and machinery items without injury to other parts of the system.
- B. No unions will be required in lines assembled with solder joint fittings except at equipment items, machinery items and other special pieces of apparatus.
- C. Unions in 2 inches and smaller in ferrous lines shall be Class 300 AAR malleable iron unions with iron to brass seats, and 2-1/2 inches and larger shall be ground flange unions.
- D. Unions in copper lines shall be Class 125 ground joint brass unions or Class 150 brass flanges if required by the mating item of equipment.
- E. Companion flanges on lines at various items of equipment, machines and pieces of apparatus shall serve as unions to permit removal of the particular items. See particular Specifications for special fittings and pressure.
- F. Unions connecting ferrous pipe to copper or brass pipe shall be dielectric type equal to Epco.
- G. In all domestic water lines where the material of the pipe is changed from ferrous to copper or brass, a dielectric coupling shall be used at the transition.

2.5 FLANGES

- A. All 150 lb. and 300 lb. ASME/ANSI flanges shall be weld neck and shall be domestically manufactured, forged carbon steel, conforming to ASME B16.5 and ASTM A181/A181M Grade I or II or A-105-71 as made by Tube Turn, Hackney or Ladish Company.
- B. Only one manufacturer of weld flanges will be approved for each project.
- C. Each fitting shall be stamped as specified by ASME B16.9 and, in addition, shall have the laboratory control number stenciled on each fitting for ready reference as to physical properties and chemical composition of the material.
- D. Complete test reports may be required for any fitting selected at random.
- E. Flanges which have been machined, remarked, painted or otherwise produced domestically from imported forges will not be acceptable.
- F. Flanges shall have the manufacturer's trademark permanently identified in accordance with MSS SP-25.
- G. Bolts used shall be carbon steel or stainless steel bolts with semi-finished hexagon nuts of American Standard Heavy dimensions.
- H. All-thread rods will not be an acceptable for flange bolts.

- I. Bolts shall have a tensile strength of 60,000 psi and an elastic limit of 30,000 psi.
- J. Flat faced flanges shall be furnished where required to match flanges on pumps, check valves, strainers, etc.
- K. All flanges shall be gasketed.
 - 1. Contractor shall place gasket between flanges of flanged joints.
 - 2. Gaskets shall fit within the bolt circle on raised face flanges and shall be full face on flat face flanges.
 - 3. Gaskets shall be cut from 1/16 inch thick, non metallic, non asbestos gasket material suitable for operating temperatures from -150°F to +750°F, Klingenseal C-4400, Manville Style 60 service sheet packing, or equal.

2.6 BACKFLOW PREVENTERS

- A. Backflow preventers (BFP) types:
 - 1. Reduced pressure type, Basis of Design Febco 825 or approved equal by UTSW FM.
 - 2. Spill-Proof Vacuum Breaker, Basis of Design by Watts.
 - 3. Regular Vacuum Breaker, Basis of Design by Watts.
 - 4. Double Check, Basis of Design by Watts.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. After completion, fill, clean, and treat systems. Refer to Section 22 00 10 - Basic Plumbing Requirements.

3.2 INSTALLATION

- A. Refer to Section 22 11 16 - Plumbing Piping for installation requirements.
- B. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space, and not interfere with use of space and other work.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16 - Piping Expansion Compensation.
- F. Provide clearance for installation of insulation, and access to valves and fittings.
- G. Provide access where valves and fittings are not exposed.
- H. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- J. Prepare pipe, fittings, supports, and accessories for finish painting. Refer to Section 09 96 00 - High-Performance Coatings.
- K. Install valves with stems upright or horizontal, not inverted.
- L. Locate valves in readily accessible areas and where valve operation will not damage other components, materials, or devices.

3.3 FABRICATION OF PIPE

- A. All the various piping systems shall be made up straight and true and run at proper grades to permit proper flow of the contained material. Lines shall also be graded for proper drainage.
- B. Piping shall follow as closely as possible the routes shown on Drawings which take into consideration conditions to be met at the site.
- C. Should any unforeseen conditions arise, lines shall be changed or rerouted as required after proper approval has been obtained.
- D. All piping shall be installed with due regard to expansion and contraction and so as to prevent excessive strain and stress in the piping, in connections, and in equipment to which the lines are connected.
- E. All piping shall be clean when it is installed. Before installation it shall be checked, upended, swabbed, if necessary, and all rust or dirt from storage or from laying on the ground shall be removed.

- F. Procedure of Assembling Screw Pipe Fittings: All screw joints shall be made with taper threads properly cut. Joints shall be made tight with Teflon applied to the pipe threads only and not to fittings. When threads are cut on pipes, the ends shall be carefully reamed to remove any burrs. Before installing pipe that has been cut and threaded, the lengths of pipe shall be upended and hammered to remove all shavings and foreign material.
- G. Procedure for Assembling Other Joints: Procedures for assembling joints in cast iron and copper lines have been set forth elsewhere in these Specifications. For any special materials, consult the manufacturers for the recommended procedures in assembling the joints.

3.4 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations or within riser shafts.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
- D. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- E. Install ball valves for throttling, bypass, or manual flow control services.
- F. Provide spring loaded check valves on discharge of pumps.
- G. Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.
- H. Use butterfly valves interchangeably with gate and globe valves.
- I. Use lug end butterfly valves to isolate equipment.
- J. Provide 3/4 inch (20 mm) ball drain valves at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

END OF SECTION 22 20 00

SECTION 22 40 00
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Emergency Fixtures.
- B. Vacuum Breakers.
- C. Trap Primers.

1.3 RELATED SECTIONS

- A. Section 01 25 00 - Substitution Procedures
- B. Section 07 92 00 - Joint Sealants
- C. Section 22 00 10 - Basic Plumbing Requirements
- D. Section 22 11 16 - Plumbing Piping
- E. Section 22 11 19 - Plumbing Specialties
- F. Section 22 33 50 - Domestic Water Heaters
- G. Section 23 05 29 - Supports and Anchors

1.4 ALLOWANCES

- A. Cash Allowance: Include under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Allowance includes purchase and delivery of owner selected fixtures. Installation is included in this section and is part of the Contract Sum/Price.

1.5 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
- C. ANSI Z358.1-2014 - American National Standard for Emergency Eyewash and Shower Equipment.
- D. ASME A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use.
- E. ASME A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.
- F. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures.
- G. ASME A112.19.1 - Enameled Cast Iron Plumbing Fixtures.
- H. ASME A112.19.2 - Vitreous China Plumbing Fixtures.
- I. ASME A112.19.3 - Stainless Steel Plumbing Fixtures.
- J. ASME A112.19.4M - Porcelain Enameled Formed Steel Plumbing Fixtures.
- K. ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals (Dimensional Standards).
- L. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices.
- M. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- N. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- O. ASTM C1822 - Standard Specification for Insulating Covers on Accessible Lavatory Piping.
- P. ASTM D570 - Standard Test Method for Water Absorption of Plastics.
- Q. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.
- R. ASTM D696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between - 30C and 30C with a Vitreous Silica Dilatometer.
- S. ASTM D785 - Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials.
- T. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

- U. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- V. ASHRAE Std 18 - Method of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration.
- W. ADA Standards - 2010 ADA Standards for Accessible Design.
- X. Texas Accessibility Standards (TAS).

1.6 SUBMITTALS

- A. Submit under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Product Data: Provide catalogue illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C. Manufacturer's Installation Instructions.
- D. Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- E. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Accept fixtures on site in factory packaging. Inspect for damage.
- C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.9 FIELD MEASUREMENTS

- A. Verify that field measurements are either as indicated on shop drawings or as instructed by the manufacturer, and designate in the submittal that it has been verified, and which measurements are the basis for construction.
- B. Confirm that millwork is constructed with adequate provision for the installation of countertop lavatories and sinks.

1.10 WARRANTY

- A. Provide five year warranty under provisions of Section 22 00 10 - Basic Plumbing Requirements.

1.11 ATTIC STOCK

- A. Furnish under provisions of Section 22 00 10 - Basic Plumbing Requirements.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Regulatory Requirements:
 - 1. Comply with applicable codes for installation of plumbing systems.
 - 2. Perform all work and provide products in compliance with requirements of ADA Standards, ANSI A117.1, and the Texas Accessibility Standards (TAS).
- B. Provide plumbing fixtures where indicated on the Drawings.
 - 1. These plumbing fixtures shall be standard products as manufactured by the following. Any substitution requests must be submitted according to the requirements of Section 01 25 00 - Substitution Procedures.
 - a. American Standard.
 - b. Kohler.
 - c. Crane.
 - d. Halsey-Taylor.
 - e. Eljer.
 - f. Sloan.

2. Plumbing accessories shall be standard products as manufactured by the following. Any substitution requests must be submitted according to the requirements of Section 01 25 00 - Substitution Procedures.
 - a. Bemis Manufacturing Co.
 - b. Brass Craft.
 - c. Chicago Faucets.
 - d. Fiat Products.
 - e. Halsey Taylor.
 - f. Jay R. Smith Mfg. Co.
 - g. McGuire Manufacturing Co. Inc.
 - h. Plumberex Specialty Products, Inc.
 - i. T&S Brass.
 - j. Watts.
 3. Emergency Fixtures shall be standard products as manufactured by the following. Any substitution requests must be submitted according to the requirements of Section 01 25 00 - Substitution Procedures.
 - a. Bradley.
 - b. Guardian
 - c. Encon.
 - d. Haws.
 - e. Acorn.
- C. Product Requirements:
1. Fixtures shall be free from mars or chips and shall be new, first quality and shall be furnished with sufficient supports in order to adequately hang each and every unit.
 2. Space between fixtures and masonry walls shall be grouted with white silicon grout, Basis of Design: General Electric.
 3. Space between fixtures and sheetrock or wood panel walls shall not be grouted but the fixture shall fit flat against the wall surface with no more than 1/16 inch gap.
 4. Faucets, fittings, supply stops, and similar devices shall be of one manufacturer unless otherwise specified.
 - a. Water faucets and valve bodies shall be cast brass with a minimum copper content of 85%.
 - b. All shall have standardized interchangeable operating units constructed of a removable and replaceable unit containing all parts subject to wear.
 - c. Water faucets shall contain an adjustable internal volume control unit.
 - d. Exposed parts shall be chromium plated.
 5. (At Cup Sinks Only) Polypropylene Fixtures:
 - a. Base:
 - 1) Orion Fittings.
 - b. Optional:
 - 1) Enfield Industrial.
 - 2) Town & Country Plastics.
- 6.

2.2 FITTINGS AND PIPES

- A. Fittings and piping shall be brass and, wherever exposed, shall be polished chrome plated. Provide tight fitting wall or floor escutcheons of chrome-plated brass wherever pipes pass through floors, walls or ceilings.
- B. Furnish and install all required water, waste, soil and vent connections to all plumbing fixtures, together with all fittings, supports, fastening devices, cocks, valves, traps, etc., leaving all in complete working order.
- C. Supplies for all lavatories and drinking fountains shall be loose key angle stops with 1/2 inch I.P.S. female inlets and shall include wall flanges, and 1/2 inch O.D. flexible risers with bull nose or flared end outlets.
 1. Components to be chrome plated.
 2. In all cases, all piping, tubing, fittings, and faucets shall be installed using a mechanical non-slip connection, such as bull nose, flared, flanged, ferrule, or threaded fittings.
 3. Fittings requiring a friction fit using slip-on or gasketed connections are not acceptable.

2.3 EMERGENCY FIXTURES

- A. All emergency fixtures must meet the requirements outlined in ANSI Z358.1-2014 and other applicable safety codes per project.
- B. Deck Mounted Eyewash / Drench Hose with Backflow Preventer
 - 1. Basis of Design: Guardian G5022 or equivalent product by acceptable manufacturer.
 - 2. Components: Deck mounted hand-held eye wash / drench hose, without bowl. Provide 2 polypropylene spray heads with integral flip-up dust covers, filters, mounted on chrome plated brass assembly, and flag style handle. Includes 1/2 inch stay open chrome-plated brass squeeze valve with replaceable stainless steel seat and locking clip, stainless steel squeeze handle with plastic cover, nylon handle, nylon deck flange with locator guide, and 8 foot PVC hose.
 - 3. Mounting: Right hand. Include hardware to secure to countertop.
 - 4. Thermostatic Mixing Valve: Mixing valve precisely blends hot and cold water to deliver tepid water to eyewash.
 - 5. Sign: Provide ANSI-compliant identification sign.
 - 6. Isolation Ball Valve - WOG rated valve, pressure rating to match floor requirements. Install in-line, readily accessible, and as close as possible prior to the unit installation. For above ceiling installation, indicate valve location with ceiling tack or additional signage.
 - 7. Visual or audible accessories (ex. Strobes or audible alarms) when a unit is activated shall not be installed, unless approved in writing by OSBC Chemical / Biological Safety team.

2.4 VACUUM BREAKERS

- A. All outlets with hose threads shall be provided with vacuum breakers.
- B. Where vacuum breakers have not been specified with fixture trim and on all hose faucets not associated with plumbing fixtures both inside and outside of buildings, contractor shall furnish and install 3/4 inch hose thread vacuum breakers attached to the hose outlet threads with tamper proof set screw.
- C. Vacuum breaker shall be as manufactured by Chicago Faucet or by Watts.

2.5 TRAP PRIMER

- A. Pressure principal activated, Multi-fixture device.
- B. Precision Plumbing Products or approved equal.
- C. Provide trap primers for all floor and hub drains in mechanical rooms even if not shown on Drawings.

2.6 SINKS - CUP

- A. Fixture:
 - 1. 6 inches diameter x 4 inches deep, Countertop mounted, polypropylene, single-bowl, 1-1/2 inches outlet, without faucet ledge, with stopper.
 - 2. Orion CS3.
- B. Faucet:
 - 1. Single-hole Countertop mounted, single-handle, single-temperature, 4-arm color-coded handle, 6 inches diameter fixed gooseneck, integral vacuum breaker, serrated hose nozzle.
 - a. Chicago Faucet 928.
- C. Trim:
 - 1. 1-1/2 inches tailpiece and P-trap of specified material for acid waste piping (see Section 22 11 16).

2.7

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available and of the correct characteristics.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Furnish and install all labor, materials, equipment, tools and services and perform all operations required in connection with or properly incidental to the installation of complete plumbing fixtures, as indicated on the Drawings, reasonably implied therefrom, or as specified herein, unless specifically excluded.
 - B. Plumbing fixtures shall be supplied, set and connected as listed herein and as shown on the Drawings. Fixtures shall be protected from damage during construction, and shall be thoroughly cleaned of all tape and adhesives prior to final acceptance.
 - C. Coordinate special mounting heights of plumbing fixtures with architectural details of each toilet area.
 - D. Install in accordance with manufacturer's instructions.
 - E. Install each fixture with trap, easily removable for servicing and cleaning.
 - F. Install components level and plumb.
 - G. Install and secure all fixtures in place with specified wall carriers and bolts.
 - H. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.
- 3.4 INTERFACE WITH OTHER PRODUCTS
- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.
- 3.5 ADJUSTING
- A. Adjust work under provisions of Section 22 00 10 - Basic Plumbing Requirements.
 - B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- 3.6 CLEANING
- A. Clean work under provisions of 22 00 10 - Basic Plumbing Requirements.
 - B. At completion clean plumbing fixtures and equipment.
- 3.7 PROTECTION OF FINISHED WORK
- A. Protect finished Work under provisions of Section 22 00 10 - Basic Plumbing Requirements.
 - B. Do not permit use of fixtures during construction, until after Substantial Completion has been announced by Owner.
- 3.8 FIXTURE HEIGHTS
- A. Fixture size, design and mounting height shall meet the requirements of ADA Standards, ANSI A117.1, and the Texas Accessibility Standards (TAS).
- 3.9 FIXTURE ROUGH-IN SCHEDULE

	<u>Hot Water</u>	<u>Cold Water</u>	<u>Waste</u>	<u>Vent</u>
Lavatory	1/2 inch	1/2 inch	2 inch	1-1/2 inch
Water Closet		1 inch	4 inch	2 inch
Urinal		3/4 inch	2 inch	1-1/2 inch
Shower (where applicable)	1/2 inch	1/2 inch	2 inch	2 inch

END OF SECTION 22 40 00

SECTION 22 61 10

LABORATORY COMPRESSED AIR SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Laboratory fittings.
- B. Piping.
- C. Valves.

1.3 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete
- B. Section 22 00 10 - Basic Plumbing Requirements
- C. Section 22 11 16 - Plumbing Piping
- D. Section 23 05 29 - Supports and Anchors
- E. Section 23 05 53 - Mechanical Identification
- F. Section 26 05 19 - Building Wire Cable and Connectors (600V and Below)
- G. Section 26 27 26 - Wiring Devices and Floor Boxes

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ASME - Boiler and Pressure Vessel Code.
- C. ASME B16.3 - Malleable Iron Threaded Fittings.
- D. ASME B16.18 - Cast Bronze Solder-Joint Pressure Fittings.
- E. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings.
- F. ASME B16.26 - Cast Bronze Fittings for Flared Copper Tubes.
- G. ASME B31.1 - Power Piping.
- H. ASME B31.9 - Building Services Piping.
- I. ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- J. ASTM A234/A234M - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- K. ASTM B32 - Solder Metal.
- L. ASTM B88 - Seamless Copper Water Tube.
- M. ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing and Fittings.
- N. ASTM D2683 - Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe.
- O. NFPA 70 - National Electrical Code.
- P. NFPA 99 - Health care Facilities Code.

1.5 SUBMITTALS

- A. Submit under provisions of Division 01 and Section 22 00 10 - Basic Plumbing Requirements.
- B. Shop Drawings: Indicate piping system schematic with electrical characteristics and connection requirements.
- C. Product Data: Provide manufacturers catalog literature with capacity, weight, and electrical characteristics and connection requirements.
- D. Test Reports: Submit inspector's certificate for air receiver for inclusion in Operating and Maintenance Manuals.
- E. Manufacturer's Installation Instructions: Indicate hoisting and setting requirements, starting procedures.
- F. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 01 and Section 22 00 10 - Basic Plumbing Requirements.
- B. Record actual locations of equipment and components. Modify shop drawings to indicate final locations.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 01 and Section 22 00 10 - Basic Plumbing Requirements.
- B. Operation Data: Submit for air compressor, air receiver and accessories, after cooler, refrigerated air dryer, and pressure reducing station.
- C. Maintenance Data: Submit for air compressor, air receiver and accessories, after cooler, air dryer, and pressure reducing station.

1.8 REGULATORY REQUIREMENTS

- A. Conform to ASME codes for installation of pressure vessels.
- B. Provide certificate of compliance from Factory Mutual indicating approval of air receiver.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters` Laboratories, In, as suitable for the purpose specified and indicated.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of 22 00 10 - Basic Plumbing Requirements.
- B. Accept air compressors, refrigerated air dryer on site in factory fabricated containers with shipping skids and plastic pipe end protectors in place. Inspect for damage.
- C. Protect piping and equipment from weather and construction traffic.

1.10 WARRANTY

- A. Provide five year warranty under provisions of Division 01 and Section 22 00 10 - Basic Plumbing Requirements.
- B. Warranty: Include coverage for reciprocating air compressors, motors, receivers, and controls.

1.11 ATTIC STOCK

- A. Provide maintenance materials under provisions of Division 01 and Section 22 00 10 - Basic Plumbing Requirements.
- B. Provide 4 quart containers of compressor oil.

PART 2 - PRODUCTS

2.1 LABORATORY FITTINGS

- A. Laboratory fittings will be furnished to the job site by the Laboratory Equipment Supplier, with necessary holes cut in the laboratory equipment. The Contractor shall receive, store, and install the fittings and make all necessary connections thereto.

2.2 PIPING

- A. Compressed air piping shall be ASTM B88, Type K, hard drawn, seamless copper tubing with wrought copper solder fittings. No ferrous piping will be permitted in the system. Where threaded nipples are required these shall be I.P.S. brass.
- B. All piping shall be pitched back so as to drain to the point shown on the Drawings. All branch air take-offs shall be made from the top of the mains.
- C. Piping shall be cleaned in accordance with CGA recommendations for piping for Oxygen Service.

2.3 VALVES

- A. Compressed air and laboratory or medical gas valves shall be Spirax Sarco Model 60, stainless steel ball valves, with screwed joint and Teflon seats.

2.4 TESTS

- A. Test air lines at 150 pounds per square inch and proved tight at this pressure. All tests shall be observed by a representative of the Architect before the tests are removed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment in accordance with manufacturer`s instructions.

- B. Install valved drip connections at low points of piping system.
- C. Install take offs to outlets from top of main, with shut off valve after take off. Slope take off piping to outlets.
- D. Install compressed air couplings, female quick connectors, and pressure gages where outlets are indicated.
- E. Install tees instead of elbows at changes in direction of piping. Fit open end of each tee with plug.
- F. Identify and label piping system and components. Refer to Section 23 05 53 - Mechanical Identification.
- G. Start-up assistance and in-service training to be provided by factory authorized personnel.

3.2 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 22 00 10 - Basic Plumbing Requirements and Section 22 11 16 - Plumbing Piping.
- B. Compressed Air Piping Leak Test: Prior to initial operation, clean and test compressed air piping in accordance with ASME B31.1 .
- C. Repair or replace compressed air piping as required to eliminate leaks, and retest to demonstrate compliance.
- D. Cap (seal) ends of piping when not connected to mechanical equipment.

END OF SECTION 22 61 10

SECTION 22 62 19

MEDICAL GAS AND VACUUM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Medical gas systems.

1.3 RELATED REQUIREMENTS

- A. Section 01 79 00 - Demonstration and Training
- B. Section 01 91 00 - General Commissioning Requirements
- C. Section 09 96 00 - High-Performance Coatings

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ASME B16.18 - Cast Copper Alloy Solder-Joint Pressure Fittings.
- C. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- D. ASME B40.100 - Pressure Gauges and Gauge Attachments.
- E. ASME - Boiler and Pressure Vessel Code.
- F. ASTM A269/A269M - Stainless and Welded Austenitic Stainless Steel Tubing for General Service.
- G. ASTM A403/A403M - Wrought Austenitic Stainless Steel Piping Fittings.
- H. ASTM B32 - Solder Metal
- I. ASTM B88 - Seamless Copper Water Tube.
- J. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration field Service.
- K. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- L. ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- M. ASTM D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- N. AWS A5.8/A5.8M - Brazing Filler Metal.
- O. CGA G-7 - Compressed Air for Human Respiration.
- P. CGA V-5 - Diameter Index Safety System Non-Interchangeable Low Pressure Connections for Medical Gas Applications.
- Q. FM (AG) - Factory Mutual System - Approval Guide.
- R. FS TT-P-645 - Primer, Paint, Zinc Chromate, Alkyd Type.
- S. FS W-C-596 - Electrical Power Connector, Plug, Receptacle, and Cable Outlet.
- T. FS WW-V-35C - Valve Ball.
- U. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture.
- V. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- W. NFPA 55 - Compressed Gases and Cryogenic Fluids Code.
- X. NFPA 99 - Standard for Health Care Facilities.

1.5 SUBMITTALS

- A. Shop Drawings: Indicate general assembly of components, mounting and installation details, and general layout of control and alarm panels. Submit detailed medical wall assembly drawings.
- B. Product Data: Provide manufacturers literature and illustrations for all components indicating size, dimensions and configuration.
- C. Independent Testing Agency Reports: Indicate systems are complete, zone valves installed, alarm systems functional, and pressure and cross connections tests performed. Document tests.
- D. Manufacturer's Installation Instruction: Indicate requirements for equipment and systems.

- E. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.
- 1.6 PROJECT RECORD DOCUMENTS
 - A. Submit 3 copies of as-built drawings, and provide electronic file in AutoCAD format.
 - B. Record actual locations of piping, valving, and outlets.
- 1.7 OPERATION AND MAINTENANCE DATA
 - A. Submit digital copy of operation and maintenance manuals complying with Section 01 77 00 - Closeout Procedures and Submittals.
 - B. Operation Data: Include installation instructions, assembly views, lubrication instructions, and assembly views.
 - C. Maintenance Data: Include maintenance and inspection data, replacement part numbers and availability, and service depot location and telephone.
- 1.8 QUALITY ASSURANCE
 - A. Perform Work in accordance with NFPA 99 .
 - B. Maintain one copy of each document on site.
- 1.9 QUALIFICATIONS
 - A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.
 - B. Installer: Company specializing in performing the work of this Section with minimum three years documented experience.
 - C. Testing Laboratory: Company specializing in performing the testing of this Section with minimum three years documented experience.
- 1.10 REGULATORY REQUIREMENTS
 - A. Conform with applicable codes for medical gas systems.
 - B. Provide certificate of compliance indicating approval of systems.
- 1.11 DELIVERY, STORAGE, AND HANDLING
 - A. Accept material on site in factory containers and packing. Inspect for damage.
 - B. Protect from damage and contamination by maintaining factory packaging and caps in place until installation.
- 1.12 SCHEDULING
 - A. Schedule Work to ensure equipment is installed and systems tested and certified prior to substantial completion.
- 1.13 SCOPE
 - A. Provide all labor, materials, equipment, tools and services and perform all operations required in connection with or properly incidental to the installation and testing of oxygen, nitrogen, nitrous oxide, compressed air and vacuum piping systems including fittings, valves, medical gas outlets, air compressors, nitrogen and nitrous oxide manifolds, vacuum pumps, alarms, etc. for complete operable systems.
 - B. The stock and model numbers of equipment listed hereinafter identify equipment manufactured by NCG Division of Chemetron Corp., Chicago, Ill. Equal equipment by approved manufacturers will be acceptable.

PART 2 - PRODUCTS

- 2.1 PIPING
 - A. Piping for vacuum and gases of every character shall be ASTM B88 Type L, hard drawn, seamless copper tubing with wrought copper solder fittings. No ferrous piping will be permitted in the system. Where threaded nipples are required, these shall be I.P.S. brass. All vacuum piping shall be purged with dry nitrogen while being soldered.
 - B. Piping shall be pitched back so as to drain to the point shown on the Drawings. All branch takeoffs shall be made from the top of the mains.

- C. Fittings for copper tube shall be wrought copper fittings and attached with silver solder alloy containing not less than 50 percent silver. All soldering shall be done with dry nitrogen flowing through the pipe to prevent oxidation and scale information.
- D. Before erection, all pipe, tubing, valves, and fittings (except those supplied expressly cleaned for oxygen, nitrogen, nitrous oxide, air-and-vacuum service by manufacturer) shall be thoroughly cleansed of all grease, oil and other combustible materials by washing in a hot solution of sodium carbonate or trisodium phosphate mixed in equal proportions of one pound to three gallons of water.
 - 1. Scrubbing and continuous agitation of the parts shall be employed where necessary to remove all deposits and to ensure complete cleansing.
 - 2. After washing, all materials shall be rinsed thoroughly in clean, hot water.
 - 3. After rinsing, great care must be exercised in the storage and handling of all materials and in the condition of tools used in cutting and reaming to prevent oil or grease being introduced into the tubing.
 - 4. Where such contamination is known to have occurred, the materials affected must be rewashed and then rinsed.
- E. Where screwed connections are required at equipment, suitable adapters shall be provided with threaded connections. A thin paste of litharge and glycerin shall be applied to the external threads only.
- F. After erection of pipe and tubing, but prior to installation of the service outlet valves, each system shall be blown clear of moisture and foreign matter by means of dry nitrogen or oil free air.
- G. After installing service outlet valves, each system shall be subjected to a test pressure of 150 psig by means of water-pumped (oil free) nitrogen or air. This test pressure shall be maintained until each joint has been thoroughly examined for leaks by means of soapy water. A soap solution mixed in the following proportions should be used: one ounce of castile or palm oil soap, eight ounces of water, and four ounces of glycerine. Dissolve the soap in the water, add the glycerin and mix thoroughly. Wipe joints clean after test. All leaks shall be properly repaired and the system retested.
- H. A final test shall be 24 hours standing pressure test with water pumped (oil free) air or dry nitrogen at 150 psig to check the completeness of prior joint pressure tests. If water pumped nitrogen is used, particular care must be exercised to assure that it is all flushed out with oxygen before placing the system in service.

2.2 SERVICE OUTLETS

- A. Wall type service outlets shall be installed where indicated on Drawings approximately 50 inches above finished floor unless otherwise directed.
- B. Outlets shall be modified NCG 378 D.I.S.S. series, quick release type as listed by Underwriter's Laboratories, designed for recessed piping.
- C. Each service shall be housed in a special designed back box, assembled complete with special stainless-steel cover plate, plaster flanges and tubing guards ready for rough wall mounting, and with an 8 inch of 1/4 inch nominal I.D. Type "K" copper tubing for completing the connection to the service line.
- D. Check Units shall be safety keyed to prevent interchangeability of services.
 - 1. They shall have a self sealing dust plug and a primary and secondary check, both of which shall seal simultaneously when equipment is not attached.
 - 2. The Check Units for each service shall be pressure tested at the factory and furnished completely assembled except for the stainless steel cover plates.
 - 3. A color-coded nameplate identifying the gas service shall be affixed to each Check Unit to minimize the possibility of interchanging gas services during installation.
 - 4. Check Units shall be furnished with a protective cover imprinted with installation instructions and covering the inlet to prevent plaster dust or other foreign matter from contaminating the internal parts of the unit during installation.
 - 5. Check Units shall be designed so as to be completely serviceable from the front including removal of the secondary check and the filter screen without the use of special tools.
 - 6. Check Units shall be so designed that attachment or removal of equipment is a one hand operation and release mechanism shall be such that inadvertent pushing or bumping of the attached equipment will not tend to release it.
 - 7. The outlet, when installed, shall have no projections beyond the finishing cover plate.
 - 8. Where more than one service is indicated at a single location, they shall be combined into a multiple unit under a single cover plate.

- E. See Drawings for details of special cover plates and for special service panels which combine gas service outlets and electrical items.
- F. Ceiling type recessed service outlets shall be installed where indicated on Drawings.
 - 1. Outlets shall be modified NCG 376 D.I.S.S. series and shall meet the requirement for wall type service outlets specified hereinbefore, including special cover plates, back boxes, pin indexing between fascia and matching, keyed slot in channel slot box saddle.
 - 2. Coupler for attachment of hose and adaptor connecting thereto, shall be threaded type meeting Compressed Gas Association (CGA) D.I.S.S. specifications.
 - 3. Hose shall be of plastic, conductive type, color coded for identity of service and terminating at a point 7 feet above finished floor, in quick release, color coded female couplers, safety keyed for gas service supplied. (Note: Ceilings in new addition at 10 foot, ceilings in remodel building at 9 foot.)
 - 4. Outlet back boxes shall be supported from overhead structure utilizing anti-sway bars as required to prevent movement of the outlets.
 - 5. Connect all ceiling outlets to an established common ground.
- G. High pressure ceiling or wall type recessed nitrogen outlets shall be installed where indicated on Drawings. Outlets shall be modified NCG 239590-64 and shall meet requirements for ceiling type recessed service outlets hereinbefore specified, including special cover plates, back boxes, etc. Outlet stations are to incorporate a quick disconnect valve mechanism functioning as follows:
 - 1. Service attachment without opening pressure.
 - 2. Pressure actuation in a succeeding mechanical function.
 - 3. Pressure shutoff and bleed of entrapped pressure while holding hose secure.
 - 4. Release of adapter and hose, a succeeding mechanical function, without high pressure entrapment. Provide a NCG No. 000606-63 nitrogen hose assembly with DynaCon male and female adapters. Length as required for termination at a point 7 feet above finished floor.

2.3 MEDICAL GAS VALVES

- A. Valves not in boxes shall be NCG bronze bodied, double seal, full flow ball type, with Teflon seat seals and O-ring packing designed for working pressures up to 300 psi with a chrome plated brass ball which seals in both directions.
 - 1. The valves shall be so designed that only a quarter turn of the lever type handle is necessary between the open and closed positions.
 - 2. Valves shall be supplied and properly washed for oxygen service.
 - 3. Gas service labels shall be provided for each service as required.
- B. Shutoff valves in recessed boxes shall be installed in boxes with back box constructed of 18-gauge Paintlok steel with a gray baked on semigloss finish and with plaster flanges on all four sides for securing to wall.
 - 1. The valves shall be bronze bodied, double seal, full flow ball type with Teflon seat seals, O-ring packing designed for working pressures up to 300 psi, chrome plated bronze balls which seal in both directions, and adjustable Teflon stem seals and bearings, self compensating to guard against leakage due to wear.
 - 2. Tubing extensions shall be factory soldered to the valve flanges for connection to piping outside the box.
 - 3. Valves and tubing extensions shall be chrome plated, preassembled, pressure tested and rigidly mounted to the box for ease of installation.
 - 4. The valves shall require only a quarter turn of the handle to completely open or close.
 - 5. A color-coded gas label shall be supplied with each valve, which can be marked to indicate the area controlled.
 - 6. The cover shall be of 18-gauge stainless-steel with No. 4 brushed finish, and shall incorporate an internal service identification cover and shield, providing shutoff directions.
 - 7. The combination internal and external fascia shall attach to the box assembly without the use of screws, and shall compensate for variations in plastic thickness.
 - 8. Mounted in the finishing frame shall be a clear, rigid, vinyl window for easy access to the valve.
 - a. Window shall contain a caution label reading: "CAUTION, CLOSE ONLY IN EMERGENCY" and "PULL RING TO BREAK WINDOW".

2.4 AIR AND VACUUM VALVES

- A. Stop valves at compressors, tanks, vacuum pumps, and in vacuum piping shall be Jenkins 32A bronze ball valves with screwed connections and Teflon seats.

2.5 FINAL CHECKING AND OPERATING INSTRUCTIONS

- A. A representative of the equipment manufacturer shall periodically check with the Contractor during initial installation of the pipeline systems equipment.
- B. Representative shall assist the Contractor in final check to make certain that all systems are in perfect operating condition.
- C. The equipment manufacturer's representative shall provide 8 hours of instruction to the hospital personnel in the use of the piping systems and the related equipment which is operated from those systems.

2.6 LABORATORY FITTINGS

- A. Laboratory fittings will be furnished to the job site by the laboratory equipment supplier, with necessary holes cut in the laboratory equipment.
- B. The Mechanical Contractor shall receive, store and install the fittings and make all necessary connections thereto.

2.7 STANDARDS AND CODES

- A. The recommendations of the National Fire Protection Association (NFPA) as set forth in Pamphlet No. 56, 565 and 566, and the "Standard for Medical/Surgical Vacuum Systems in Hospitals" as set forth in Compressed Gas Association (CGA) Pamphlet No. P-2.1, Second Edition 1967, shall apply to this installation and shall be adhered to in all respects.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in complete compliance with governing Codes and manufacturers instructions.
- B. Except for piping and pipe fittings, all components shall be supplied by a single manufacturer and shall be fully compatible with Owner's existing system and service devices.

3.2 TESTING

- A. Test in accordance with NFPA 99, Sections 4-3 through 4-10. Provide to Owner a notarized letter of certification from equipment manufacturer certifying the following:
 - 1. No cross connections exist.
 - 2. Alarm system is adjusted and performing to manufacturer's design.
 - 3. All components have been installed, adjusted and are functioning in accordance with manufacturer's recommendations.

3.3 COMPATIBILITY

- A. Verify compatibility of all new components with existing system and services.

END OF SECTION 22 62 19

SECTION 22 64 00

MEDICAL GASES STARTUP AND CERTIFICATION PROCEDURE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. The following requirements:
 - 1. Test, certify and startup the medical gas equipment and pipeline systems.
 - 2. The Certification of the medical gas pipeline system must be performed by a certifier technically competent and experienced in the field of medical gas pipeline testing. Certifiers shall be licensed to ASSE (American Society of Sanitary Engineering) Series #6030 (N.I.T.C. Level M-4 or equivalent). Testing shall be performed by a party other than the installing contractor.
- B. The air compressor and vacuum pump supplier shall be present at site for system startup to verify equipment is installed and operating properly as required by NFPA 99.

1.3 RELATED REQUIREMENTS

- A. Section 01 79 00 - Demonstration and Training
- B. Section 01 91 00 - General Commissioning Requirements
- C. Section 22 08 00 - Commissioning of Plumbing Systems.
- D. Section 22 61 10 - Laboratory Compressed Air System.
- E. Section 22 62 19 - Medical Gas and Vacuum Systems.
- F. Division 26: Electrical
 - 1. Under Division 26, provide wiring for vacuum pumps and air compressors
 - 2. Under Division 22, provide local and remote wiring to alarm panels in accordance with NFPA 99 . Provide conductors and raceways as specified in Division 26.

1.4 REFERENCE STANDARDS

- A. NFPA 99 - Health Care Facilities Code.
- B. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005.

1.5 SUBMITTALS

- A. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CERTIFICATION PROCEDURE

- A. Perform mechanical check of all medical gas outlets prior to the certification inspection. Any necessary repairs or rework shall be done prior to system certification inspection. Check to include:
 - 1. Outlets properly supported.
 - 2. Installation complete.
 - 3. Appropriate adapters fit and securely lock in place.
- B. The Owner is responsible for ensuring that bulk tank and/or cylinder supplies are installed, connected, and filled (or partially filled) prior to system certification inspection.
- C. Medical gas system suppliers and/or Certification Company and Plumbing Contractor sign Medical Gas Pipeline Inspection Agreement describing service to be performed by the medical gas system supplier, services not performed by the medical gas system supplier, price quotation, and exceptions affecting quoted price.
- D. The Contractor shall provide a qualified certifier to perform pipeline certification inspection and to provide report and certification in accordance with previously signed agreement.

1. Any discrepancies discovered during the inspection shall be noted, corrected, and any and all portions of the system affected by corrective action shall be retested and findings recorded after retest.
- E. Provide representative who shall serve as customer contact person and who shall witness the certification inspection and certify that all outlets have been checked and are in accordance with inspection procedure and findings as witnessed.
- F. Hospital Maintenance Department to provide representative who shall witness the certification and certify that all spaces and the outlets have been checked in accordance with inspection procedure.
- G. All air, oxygen, nitrous oxide and carbon dioxide outlets shall be tested to deliver 3.5 SCFM at 50 psi with a maximum pressure drop of 5 psi. All instrument air outlets shall be tested to deliver 5 SCFM at 160 psi with a maximum pressure drop of 5 psi. Medical surgical vacuum inlets shall draw 3.0 SCFM without reducing the vacuum pressure below 12" gauge HV at any adjacent station inlet. These tests shall be performed with oil-free, dry nitrogen.
- H. Each medical gas outlet shall be purge tested to verify that a minimum of 35 cubic feet of oil free dry nitrogen shall be filtered through a clean white 0.45 micron filter at a minimum flow of 3.5 SCFM. Filter shall not accrue more than 0.1 mg of matter. This test shall be performed at twenty- five percent of the zones for each gas type. Samples taken within each zone shall be taken at the outlet farthest from the zone valve.
- I. For clinical air, oxygen, instrument air, nitrous oxide and carbon dioxide systems measure and record the dewpoint, total hydrocarbons, and halogenated hydrocarbons. The maximum allowable variation for each parameter shall be:
 1. Dewpoint: .5 degrees C @ 50 PSI
 2. Total hydrocarbons: 1.0 PPM
 3. Halogenated hydrocarbons: 2.0 PPM
 4. Tests shall be performed on the outlet most remote from the source and compared with source gas tests. The two tests shall not exceed the measurements outlined above. These tests shall be performed with oil-free dry nitrogen.
- J. The valves shall be tested to verify proper operation and rooms or areas of control. Each valve shall be labeled for the rooms or area they control. Verify room names with owner's representative, prior to labeling valves.
- K. The alarm panels wiring shall be tested to ensure that all components are functioning properly. The alarm panels shall be tested per NFPA 99.
- L. The certifier shall furnish copies of Medical Gas Pipeline Inspection Report and Medical Gas Pipeline Certification. Transmit a copy of the report and certification to each of the following parties:
 1. Contractor.
 2. Owner's Construction Manager.
 3. Architect.
 4. Consulting Engineer.
 5. Hospital.
 6. UTSW Facilities Management.
- M. The following procedure should be followed in addition to the above on extensions to existing systems:
 1. Architect shall, with adequate advance notice, request that certifier or inspection team is on-site when old piping is cut-in for installation of new lines.
 2. Architect or Contractor shall arrange to have certifier or inspection team on-site when the existing piping is cut into for installation of new lines.
 3. Main line shut-off valves shall be installed in new piping as close as possible to point to cut-in to previously installed piping.
 4. After verification of proper labeling, pressure and proper gas distribution of previously installed piping and after cut-in procedure, the aforementioned valves shall be considered the service valve of supply for the new piping.
 5. Before connection to the existing system and before system is put into service, the system shall be pressure tested, purged, outlet flow, tested, and gases analyzed per NFPA 99.
 6. After re-establishing pressure in each previously installed supply line after "cut-in", the previously installed outlets immediately upstream for each gas and for each cut-in point shall be opened to

ensure that the proper gas is being delivered. Gas should be bled to atmosphere prior to analyzation to ensure purging from point of cut-in to test point.

- N. The presence of the desired gas shall be confirmed with the combined use of an analyzer designed to measure the specific gas dispensed, and a pressure gauge attached to an appropriate adaptor with results tabulated below:
 - 1. Oxygen: 99-100 percent Oxygen, Pressure: 50 psi, plus or minus 5 psi
 - 2. Nitrous Oxide: 99-100 percent Nitrous Oxide, Pressure: 50 psi plus or minus 5 psi
 - 3. Vacuum: Pressure-Negative
 - 4. Carbon Dioxide: plus or minus 1 percent Oxygen; Temporarily reduce pressure at source to 30 psi. Outlet pressure shall be 30 psi, plus or minus 5 psi
 - 5. Medical Air: 19.5-23.5 percent oxygen, Pressure: 50 psi, plus or minus 5 psi
- O. After a new medical air compressor is installed, tests shall be performed at the sample port and results shall not exceed the following parameters:
 - 1. Dewpoint: 39 deg. F @ 50 psi
 - 2. Carbon monoxide: 10 PPM
 - 3. Carbon dioxide - Air: 500 PPM
 - 4. Gaseous hydrocarbons - Air: 25 PPM (as Methane)
 - 5. Halogenated hydrocarbons-Air: 2 PPM

3.2 CROSS CONNECTION TESTING AND CERTIFICATION

- A. Cross connection testing and certification of the medical gas system must be performed by party technically competent and experienced in the field of medical gas pipeline testing.
- B. Medical gas system shall be tested in accordance with NFPA 99 and Section 22 62 19 - Medical Gas and Vacuum Systems.
- C. In addition to cross connection testing, this specification shall require the technical certifier to test each individual pipeline systems component for performance to design specifications and make any necessary adjustments to ensure a complete and working system.
- D. The system shall be tested for cross connection in one of the following methods:
 - 1. Test one pipeline system at a time at 50 psi while the others are at atmospheric pressure including the vacuum system.
 - 2. Reduce the pressure in all medical gas systems to atmospheric pressure. Increase the test pressure to the piping to the following pressures:
 - a. Gas Mixtures: 20 psi
 - b. Nitrous Oxide: 40 psi
 - c. Oxygen: 50 psi
 - d. Compressed Air: 60
 - e. Any medical-surgical vacuum system shall be in operation at same time that medical gases are tested.
- E. Obtain and present to the Owner a complete bond report of pipeline certification from the equipment manufacturer. This letter of certification shall indicate:
 - 1. That the system is free of crossed connections.

END OF SECTION 22 64 00

SECTION 22 66 00
LAB WASTE SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Acid waste piping system (non Glass).

1.3 RELATED REQUIREMENTS

- A. Section 22 00 10 - Basic Plumbing Requirements

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
- C. ASTM D1599 - Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings.
- D. ASTM D2122 - Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
- E. ASTM D3311 - Standard Specification for Drain, Waste, and Vent (DWV).
- F. ASTM D4101 - Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials.
- G. ASTM F1290 - Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings.
- H. ASTM F1412 - Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems.
- I. IAPMO (UPC) - Uniform Plumbing Code

1.5 SUBMITTALS

- A. Submit under provisions 22 00 10 - Basic Plumbing Requirements.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- C. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Record actual locations of drain piping.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.8 QUALITY ASSURANCE

- A. Maintain one copy of each document on site.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing the work of this section with minimum three years documented experience.

1.10 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with Uniform Plumbing Code IAPMO (UPC)
- B. Conform to applicable code for installation of piping.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Accept materials on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protection for all materials from the elements and corrosive nature of the environment.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.12 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.13 ATTIC STOCK

- A. Furnish under provisions of Section 22 00 10 - Basic Plumbing Requirements.

PART 2 -PRODUCTS

2.1 WALL, FLOOR AND CEILING PLATES:

- A. Except as otherwise noted, provide C.P. (Chrome plated) brass floor and ceiling plates around all pipes, conduits, etc., passing exposed through walls, floors, or ceilings, in any spaces except underfloor and attic spaces.
- B. Plates shall be sized to fit snugly against the outside of the pipe or against the insulation on lines which are insulated and positively secured to such pipe or insulation.
- C. Plates will not be required for piping where pipe sleeves extend 3/4 inch above finished floor.
- D. All equipment rooms are classified as finished areas. Round and rectangular ducts shall have closure plates (NOT chrome plated) made to fit accurately at all floor, wall and ceiling penetrations.

2.2 SLEEVES, INSERTS, AND FASTENINGS:

- A. General:
 - 1. All openings through all floors, walls, and roofs, etc., regardless of material for the passage of piping, ductwork, conduit, cable trays, etc., shall be sleeved.
 - 2. All penetrations must pass through sleeves except soil pipe installed under concrete slabs on fill.
 - 3. Sleeves shall be set in new construction before concrete is poured, as cutting holes through any part of the concrete will not be permitted unless acceptable to the Architect/Engineer.
 - 4. If a penetration is cored into an existing concrete, masonry or stone structure, then the installation of a sleeve will not be necessary.
- B. The minimum clearance between horizontal penetrations including insulation where applicable, and sleeve shall be 1/4 inch, except that the minimum clearance shall accommodate a Linkseal closure, by Garlock, An Enpro Company, where piping exits the building, or penetrates a wall below ground level.
 - 1. Contractor shall be responsible for the accurate location of penetrations in the slab for his pipe, duct, etc.
 - 2. All penetrations shall be of ample size to accommodate the pipe, duct, etc. plus any specified insulation.
 - 3. Sleeve materials shall be rigid metal of adequate strength. Void between sleeve and pipe shall be filled with Nelson Flameseal Firestop or approved equal caulk or putty.
- C. Installation of sleeves in walls shall be the same as for floors.
 - 1. Refer to the details on the project drawings.
 - 2. Where the details differ from these specifications, the drawings take precedence.
- D. Sleeves for penetrations passing through walls or floors on or below grade shall be removed, if practical, and after the pipes have been installed, the void space around the pipe shall be caulked with a suitable material to effect a waterproof penetration. Note that the practicality of the removal of the sleeve shall be the decision of the Construction Inspector. The decision of the Inspector shall be final.
- E. Inserts:
 - 1. Suitable concrete inserts for pipe and equipment hangers shall be set and properly located for all pipe and equipment to be suspended from concrete construction.
 - 2. If the inserts are later found not to be in the proper location for the placement of hangers, then drilled anchors shall be installed.

3. Drilled anchors in concrete or masonry shall be submitted for the approval by the Owner.
- F. Fasteners: Fastening of pipes, conduits, etc., in the building shall be as follows:
 1. Wood members by wood screws.
 2. Masonry by threaded metal inserts, metal expansion screws, or toggle bolts, whichever is appropriate for the particular type of masonry.
 3. Steel machine screws or welding (when specifically permitted or directed), or bolts.
 4. Concrete by suitable inserts anchored to reinforcing steel, and poured in place unless other means are indicated on the plans. Power-actuated fasteners (shooting) will not be acceptable under any circumstances.
 5. If it is necessary to install a method of fastening a hanger after the structure has been installed, then only clamps or drilled anchors shall be used.
 6. Note: Under no circumstances will the use of plastic anchors or plastic expansion shields be permitted for any purpose whatsoever.
- G. Rat-proofing: The open space around all ductwork, piping, etc., passing through the ground floor and/or exterior walls shall be rat-proofed in a manner acceptable to the Architect/Engineer.
- H. Weatherproofing: The annular space between a pipe and its sleeve in exterior walls or through floor to below grade shall be filled with polyurethane foam rods 50 percent greater in diameter than the space as backing and fill material and made watertight with a permanent elastic polysulfide compound. Seal both surfaces of wall or floor.
- I. Air Plenums: The space around piping, ductwork, etc., passing through air plenums shall be made airtight in a manner acceptable to the Architect/Engineer.
- J. Fireproofing:
 1. Each mechanical and electrical contractor shall seal all cable trays, pipe, conduit, duct, etc., penetrations through roof, fire rated walls and floors with a foam or sealant as described below, that will form a watertight, vermin-tight barrier that is capable of containing smoke and fire up to 2000 degrees F for two hours.
 2. Sealing of cable trays, and conduits that extend through rated walls from ends of cable tray shall be done after conductors have been installed.
 3. Refer to fireproofing and firestopping specifications in Division 07 for product requirements.

2.3 HANGERS

- A. Entire system shall be installed free of stress.
- B. Horizontal lines shall allow for lateral movement of pipe and shall be supported by a padded hanger every 4 to 6 feet.
- C. Vertical lines shall be supported by a padded riser clamp under bottom most coupling in the stack. This riser clamp shall restrict sideward as well as downward movement.
- D. Three-inch and larger diameter stacks shall be supported at each floor by a riser clamp on the pipe O.D., smaller diameter stacks shall be supported at every other floor. All riser clamps shall be padded with 1/4 inch thick solid neoprene or buna N rubber.

2.4 LAB WASTE AND VENT PIPE AND FITTINGS (ABOVE SLAB ONLY, INCLUDING CRAWL SPACES)

- A. Polypropylene Pipe Schedule 40 joined by the coil electrofusion method. Pipe shall be manufactured of flame retardant homopolymer polypropylene. Flammability requirements are based on ASTM D635 "Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self Supporting Plastics in a Horizontal Position"
- B. Flame Retardant Polypropylene fittings shall be manufactured to Schedule 40 wall thickness dimensions.
- C. Fittings shall be joined to the polypropylene pipe by means of coil fusion method. Fittings shall meet the same flammability requirements as described for pipe above. Fittings to be same manufacturer as pipe. Fittings joined by mechanical means are not allowed.
- D. All components of the system shall conform to the following applicable ASTM Standards, ASTM D4101, ASTM D3311, ASTM D1599, ASTM D2122, ASTM F1290 and ASTM F1412. All pipe shall be marked with manufacturers name, pipe size, schedule, type, quality control mark and ASTM information. All fittings shall be legibly marked showing manufacturer trademark, fitting size, manufacturer part number, and symbol indicating the material.
- E. Shall be Fuseal pipe and fittings as manufactured by GF Piping Systems LLC (Little Rock, Arkansas), or approved equal by the Owner or A-E.

2.5 LAB WASTE AND VENT PIPE AND FITTINGS ABOVE GRADE (RETURN AIR PLENUMS)

- A. Polypropylene Pipe Schedule 40 joined by the coil electrofusion method. Pipe shall be manufactured of flame retardant homopolymer polypropylene. Flammability requirements are based on ASTM D635 "Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self Supporting Plastics in a Horizontal Position"
- B. Flame Retardant Polypropylene fittings shall be manufactured to Schedule 40 wall thickness dimensions.
- C. Fittings shall be joined to the polypropylene pipe by means of coil fusion method. Fittings shall meet the same flammability requirements as described for pipe above. Fittings to be same manufacturer as pipe. Fittings joined by mechanical means are not allowed.
- D. All components of the system shall conform to the following applicable ASTM Standards, ASTM D4101 , ASTM D3311, ASTM D1599, ASTM D2122, ASTM F1290 and ASTM F1412. All pipe shall be marked with manufacturers name, pipe size, schedule, type, quality control mark and ASTM information. All fittings shall be legibly marked showing manufacturer trademark, fitting size, manufacturer part number, and symbol indicating the material.
- E. Pipe shall be covered and wrapped with 3M Fire Barrier Plenum Wrap 5A. Install according to the manufacturer's specifications.
- F. Shall be Fuseal pipe and fittings as manufactured by GF Piping Systems LLC Little Rock, Arkansas), or approved equal by the Owner or A-E.

2.6 LAB WASTE PIPE AND VENT PIPE AND FITTINGS ABOVE SLAB (UNDER BENCH)

- A. Polypropylene Pipe Schedule 40 joined by the coil electrofusion method. Pipe shall be manufactured of flame retardant homopolymer polypropylene. Flammability requirements are based on ASTM D635 "Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self Supporting Plastics in a Horizontal Position"
- B. Flame Retardant Polypropylene fittings shall be manufactured to Schedule 40 dimensions.
- C. Fittings shall be joined to the polypropylene pipe by means of coil fusion method. Fittings shall meet the same flammability requirements as described for pipe above. Fittings to be same manufacturer as pipe. Fittings joined by mechanical means are not allowed.
- D. All components of the system shall conform to the following applicable ASTM Standards, ASTM D4101, ASTM D3311, ASTM D1599, ASTM D2122, ASTM F1290 and ASTM F1412 . All pipe shall be marked with manufacturers name, pipe size, schedule, type, quality control mark and ASTM information. All fittings shall be legibly marked showing manufacturer trademark, fitting size, manufacturer part number, and symbol indicating the material.
- E. Laboratory sink and cup sink tailpieces and p-traps shall be flame retardant polypropylene with heat fused socket joints and DWV pattern fittings. Mechanical connections at laboratory sink are not allowed.
- F. Any laboratory sink fused p-trap will have tap at bottom for cleanout.
- G. Shall be Fuseal pipe and fittings as manufactured by GF Piping Systems LLC, or approved equal by the Owner or A-E.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify excavations under provisions of Section 22 00 10 - Basic Plumbing Requirements.

3.2 INSTALLATION

- A. Pipe and fittings shall be installed according to current installation instructions as delivered or documented on-line by the manufacturer.
 - 1. On-site installation seminar shall be conducted by the manufacturer, by manufacturer's personnel who are certified to conduct said seminar.
 - 2. Seminar topics shall include all aspects of product installation (storage, set-up, support spacing, fusion process, testing procedures, etc).
 - 3. At the conclusion of the installation seminar, all installers will be given a certification test and, upon successful completion of said test, will be issued a certification card verifying they have met the requirements of the manufacturer with regards to knowledge of proper product installation and testing methods.
- B. All the various piping systems shall be made up straight and true and run at proper grades to permit proper flow of the contained material. Lines shall also be graded for proper drainage.

- C. Piping shall follow as closely as possible the routes shown on Drawings that take into consideration conditions to be met at the site.
- D. Should any unforeseen conditions arise, lines shall be changed or rerouted as required after proper approval has been obtained.
- E. All piping shall be installed with due regard to expansion and contraction and so as to prevent excessive strain and stress in the piping, in connections, and in equipment to which the lines are connected.
- F. All piping shall be clean when it is installed. Before installation it shall be checked, upended, swabbed, if necessary, and all dirt from storage or from laying on the ground shall be removed.
- G. Pipes passing through walls and floors shall be fitted with pipe sleeves a minimum of 2" greater diameter than the pipe. Caulk the annular space between the pipe and the sleeve. Piping shall be protected against weld splatter.
- H. Installer shall then waterproof floor penetrations with Metallic Oxide grout.

3.3 TESTS

- A. The system shall be tested in accordance with all local Plumbing Codes and tested as specified for sanitary waste system, except as follows:
- B. Test sections of the piping system with a maximum of 30-foot head of water (approx. 15 PSI).
- C. Under no circumstances should the system be tested with air or any other gas.
- D. Joints may be leak tested 10 minutes after the fusion cycle is completed.

END OF SECTION 22 66 00

SECTION 22 67 06

DEIONIZED WATER SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Labor, materials, equipment, tools and services to perform all operations required in connection with or properly incidental to the construction of a deionized water distribution system as shown on the drawings, reasonably implied therefrom, or as specified herein unless specifically excluded.
- B. Includes systems for production and distribution of Reverse Osmosis Water (RO) and Deionized Water (DI).
- C. Work consists of a distribution system as shown on the Drawings.
 - 1. Work shall include testing, disinfection, adjusting and balancing the flow and pressures for the entire system.

1.3 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 22 00 10 - Basic Plumbing Requirements.
- C. Section 22 05 29 - Hangers for Plumbing Piping
- D. Section 22 05 53 - Plumbing Identification.
- E. Section 22 11 16 - Plumbing Piping.
- F. Section 22 11 19 - Plumbing Specialties.
- G. Section 26 05 19 - Building Wire Cable and Connectors (600V and Below).
- H. Section 26 27 26 - Wiring Devices and Floor Boxes.

1.4 REFERENCE STANDARDS

- A. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
- D. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
- E. ASME B31.9 - Building Services Piping.
- F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- G. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- H. ASTM B32 - Standard Specification for Solder Metal.
- I. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- J. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
- K. ASTM D3222 - Standard Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.
- L. AWWA B604 - Granular Activated Carbon.
- M. NEMA 12 - Enclosures.
- N. NFPA 70 - National Electrical Code.
- O. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005.

1.5 SUBMITTALS

- A. Submit under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Shop Drawings: Indicate piping system schematic with electrical characteristics and connection requirements.

- C. Product Data: Provide manufacturers catalog literature with capacity, weight, and electrical characteristics and connection requirements.
 - D. Test Reports: Submit inspector's certificate for air receiver for inclusion in Operating and Maintenance Manuals.
 - E. Certification: Provide Water Quality Association Certification and TNRCC Level III Certification as a Water Specialist for supervising agent.
 - F. Manufacturer's Installation Instructions: Indicate hoisting and setting requirements, starting procedures.
 - G. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.
- 1.6 PROJECT RECORD DOCUMENTS
- A. Submit under provisions of Section 22 00 10 - Basic Plumbing Requirements.
 - B. Record actual locations of equipment and components. Modify shop drawings to indicate final locations.
- 1.7 OPERATION AND MAINTENANCE DATA
- A. Submit under provisions of Section 22 00 10 - Basic Plumbing Requirements.
 - B. Operation Data: Submit for back washable carbon filters, particulate prefilters, twin water softening system, UV sterilizers, RO unit, pumps, DI Mixed beds, and all instruments and controls.
 - C. Maintenance Data: Submit for back washable carbon filters, particulate prefilters, twin water softening system, UV sterilizers, RO unit, pumps, DI Mixed beds, and all instruments and controls.
- 1.8 REGULATORY REQUIREMENTS
- A. Conform with applicable ASME codes for installation of pressure vessels.
 - B. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.
- 1.9 DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, protect and handle products to site under provisions of Section 22 00 10 - Basic Plumbing Requirements.
 - B. Accept delivery of packaged deionized water equipment, storage vessel, etc., on site in factory fabricated containers with shipping skids and pipe end protectors in place. Inspect for damage.
 - C. Protect piping and equipment from dirt and debris, weather, and construction traffic.
- 1.10 WARRANTY
- A. Provide five year warranty under provisions of Section 22 00 10 - Basic Plumbing Requirements.
 - B. Warranty: Include coverage for deionized water system, storage tank, controls.
 - C. System supplier shall guarantee that under actual operating conditions the effluent from the system shall meet the purity parameters as given on the drawings for a minimum of one year.
 - D. Manufacturer shall guarantee defective workmanship and materials of mechanical equipment for one (1) year from date without charge to the Owner or Contractor.
- 1.11 ATTIC STOCK
- A. Provide maintenance materials under provisions of Section 22 00 10 - Basic Plumbing Requirements.

PART 2 - PRODUCTS

2.1 SEDIMENT PREFILTERS

- A. Cartridge filter in polypropylene housing.
- B. Provide FDA approved materials.

2.2 ACTIVATED CARBON FILTERS

- A. Activated Carbon Automatic Backwash Water Filter. Tank of fiberglass wrapped one piece thermoplastic inner liner, NSF and UL listed. Fully automatic backwash with top mounted control valve and electro-mechanical controller. Activated Carbon media to meet FDA Codex and AWWA B604 standards, NSF certified.

2.3 WATER SOFTENING SYSTEM:

- A. Refer to project drawings for system design requirements. Existing system shall be tested to meet the requirements of new equipment being installed. Non-compliance shall be reported to EOR and water quality provider.

- B. For the conventional system, the regeneration sequence shall be in this order: Backwash, brine, slow rinse, fast down flow flush, and return to service.
 - C. Piping: Provide CPVC schedule 80 piping within softener system.
 - D. Tank:
 - 1. Softener tank shall be a FRP one-piece seamless molded vessel, 150-psi working pressure and 120 degrees F design.
 - a. Tank shall be FRP with cover and plastic overflow adapter.
 - b. Both the Water Quality Association and NSF shall list the tanks or materials used in their construction.
 - c. Tanks shall be warranted for 5 years from the date of substantial completion.
 - 2. Lower distribution system shall consist of a full flow non-clogging CPVC Schedule 80 slotted distributor tube.
 - a. Brining system shall be wet salt storage type, adjustable between minimum and maximum salting levels without removing the brine valve.
 - b. Shall be suitable for storage of sufficient salt for at least six (6) regenerations at maximum brining.
 - c. Provide with heavy duty brine well to house the heavy duty, fully repairable, plastic brine valve that includes diaphragm type air shut off system.
 - E. Main operating valve on each softener shall be 5-cycle, automatic hydraulically balanced piston, seal and spacer type to independently pilot service flow and regeneration.
 - 1. Valve body shall be of solid lead-free brass.
 - 2. Maximum hydrostatic pressure: 300 PSIG
 - 3. Working pressure: 125 PSIG at a temperature range of 34-110 degrees F.
 - 4. System shall have soft water and inlet water pressure gauges and sample cocks.
 - F. The water softening control shall be programmable to operate in conjunction with a flow-sensing device located in the outlet piping of each tank in the system provide for demand regeneration.
 - 1. Enclosure shall be NEMA 3R equivalent, water resistant, rain tight, corrosion resistant and UV stable.
 - G. Provide flow meter packages.
 - 1. These are used as input devices for the water treatment equipment controller for the measurement of treated water flow. Flow data is used to repeatedly measure and deliver a specified volume of treated water at a minimum accuracy range of +/- 5 percent.
 - 2. Meter shall be made of lead-free brass or Noryl and shall register even during power outages.
 - H. Flow controls for backwash, brine, slow rinse, and flush shall be fully automatic, requiring no field adjustment.
 - I. Water testing set shall be furnished for each system, shall be ASTM test type complete with container and instructions.
- 2.4 UV STERILIZERS

- A. Ultraviolet Sterilizer: Stainless steel with fused quartz sleeves for lamp installation. Shortwave, low pressure mercury vapor discharge tubes, with Monitor, elapsed time indicator, sight port plug.
- B. Ultraviolet Lights:
 - 1. In-line Ultraviolet Lights.
 - 2. Acceptable Manufacturers:
 - a. Neotech.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - 3. Materials:
 - a. Wetted Surfaces: 316L stainless steel electropolished to a surface finish of 15 RA and passivated.
 - 4. Connections: Provide flanged.
 - 5. Accessories:
 - a. "S" Pattern light traps - Located on inlet and outlet.
 - 6. Instrumentation:
 - a. Temperature sensor with shut down interlock, local alarm, dry contacts.
 - b. UT intensity meter with local alarm and dry contacts.
 - c. LED operating indicators for each UV lamp.

- d. Elapsed running time meter.
 - e. Remote start/stop capability.
 - 7. Electrical: 120 VAC, single phase, 60 HZ.
- 2.5 REVERSE OSMOSIS SYSTEM
- A. Refer to project drawings for system design requirements. Existing system shall be tested to meet the requirements of new equipment being installed. Non-compliance shall be reported to EOR and water quality provider.
 - B. Reverse Osmosis system, Single pass, complete skid-mounted package with prefilter, pump, pressure vessel, thin film composite membranes, piping, wiring, and controls. Suitable for continuous operation in semi-conditioned space. System shall have the following components:
 - 1. Thin Film Composite Membranes.
 - 2. Stainless Steel multi-stage pump.
 - 3. PLC Controls.
 - 4. Heavy duty FRP vessels.
 - 5. Painted Steel Frame.
 - 6. 5 micron prefilter with polypropylene housing.
 - 7. Product TDS monitor.
 - 8. Permeate/Concentrate Flowmeters.
 - 9. High and Low pressure protection.
 - 10. Pre and Post flush Operations.
 - 11. Panel mounted instruments and indicator lamps.
 - 12. NEMA 12 4X Control Panel.
 - 13. Pump discharge and Reject Throttle valves.
 - 14. 316 Stainless Steel High Pressure plumbing piping.
 - 15. TDS Rejection monitor.
 - 16. Reject recirculation loop with flow meter.
- 2.6 STORAGE TANK
- A. Polyethylene, dome top, bottom cone, with stand.
 - B. Provide level sensor for high level alarm, low level alert, and low level alarms.
- 2.7 DI WATER PUMPS
- A. Vertical, multi-stage, centrifugal pumps.
 - B. Material: 316L Stainless Steel wetted parts.
 - C. Mechanical shaft seal.
 - D. Provide taps for gauges.
 - E. High efficiency, continuous service, inverter duty ODP motor.
- 2.8 DI MIXED BEDS
- A. Fiberglass vessels, virgin mixed bed exchange resins.
- 2.9 FINAL FILTERS
- A. Multistack cartridge filters with housing. Housing all wetted parts 316L Electropolished stainless steel.
- 2.10 INSTRUMENTATION MANIFOLD
- A. The instrumentation manifold shall have as a minimum the following instruments:
 - 1. PH and conductivity.
 - 2. TOC/Resistivity.
 - 3. Particulates.
 - 4. Flow Rate, GPM.
 - 5. Temperature.
 - 6. Pressure.
 - 7. Sampling Valves.
 - B. The following alerts and alarms must be transmitted to CDAS:
 - 1. Tank High Level Alarm.
 - 2. Tank Low Level Alert.
 - 3. Tank Low Level Alarm.
 - 4. Low Supply Pressure.

2.11 PIPING, VALVES AND FITTINGS (PVDF - POLYVINYLIDENE FLUORIDE)

- A. Pipe valves and fittings for purified water service shall be:
 - 1.
 - 2. Type: Schedule 80, virgin, polyvinylidene fluoride per ASTM D3222 Type 1, Grade 2.
 - 3. All pipe, fittings, and valves shall be tested and approved for potable water by National Sanitation Foundation (NSF).
 - a. Provide hallmarks for compliance on each component.
 - 4. All system piping components shall be the products of one manufacturer.
- B. Manufacturers:
 - 1. Asahi.
 - 2. Georg Fischer.
 - 3. Sani-Tecch
 - 4. Simtech.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Installation practices shall comply with manufacturer's instructions, including support spacing and joint fusion including infared butt fusion by a trained and certified technician.
- D. Sleeves: Provide sleeves in return air plenums.
 - 1. Provide a sleeved system through the installation of grooved Schedule 10 galvanized piping and couplings.
 - 2. Provide sleeve piping no less than 2 inches greater diameter than the polyvinylidene fluoride piping contained within it.
 - 3. Provide only rolled groove piping.
 - a. The Victaulic "Fit" fittings and piping system, or any similar set screw type fitting system is specifically prohibited. Vic-Let and Vic-O-Well or similar type fittings are **specifically prohibited** for use on this project.
 - 4. Where a reduced tee fitting is required, then a reducing tee or regular tee with bell reducer shall be used.
 - 5. **If any of the above described prohibited materials or installation methods are used, then the material or installation method shall be corrected at the contractor's expense.**
- E. Valves shall be ball valve type and shall be manufactured of the same virgin, unpigmented molding compound as the fittings to assure compatibility.
- F. All ball valves shall have Viton seals, and PTFE seats.
 - 1. Pressure rating: 150 psi at a minimum of 68F.
 - 2. Basis of Design: PVDF Manufactured by: GF Piping Systems.
- G. The Contractor shall supply a fusion welding machine to the owner prior to completion of the project.
 - 1. Furnish training for a minimum of two of the Owner's personnel on the operation of the fusion machine, installation of the piping and fittings, and the maintenance required for the machine and piping systems.
 - a. Minimum of 4 hours at Owner's premises at the Physical Plant of the institution where this project is constructed.
 - b. The training shall instruct maintenance and installation personnel, including hands-on training to ensure proper use of equipment to follow manufacturer requirements.

2.12 PIPING, VALVES AND FITTINGS (CPVC SCHEDULE 80) (DI RETURN ONLY)

- A. Pipe and Fitting Type: Schedule 80, virgin, CPVC per ASTM D2846/D2846M Type 1, Grade 2.
 - 1. Design Stress: 1,360 psi at 73 degrees, maximum service temperature 280 degrees F.
- B. All pipe, fittings, and valves shall be tested and approved for potable water by National Sanitation Foundation (NSF).
 - 1. Provide hallmarks for compliance on each component.
- C. All system piping components shall be the products of one manufacturer.
- D. Pipe Manufacturers:
 - 1. Basis of Design: GF Piping Systems.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Fitting Manufacturers:
 - 1. Basis of Design: GF Piping Systems.

2. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Manual Valves: Stainless steel ball type with Teflon seats, packing and gasket,
 1. Manufacturers:
 - a. Basis of Design: GF Piping Systems-
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- G. Solenoid Valves: Designed for pure water service.
 1. Material: Body is stainless steel with ethylene propylene elastomers.
 2. Manufacturers:
 - a. Basis of Design: GF Piping Systems.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- H. Installation practices, including support spacing and joint threading, shall be in compliance with manufacturer's printed recommendations.
 1. Socket weld joints are preferred over threaded joints.
- I. all system piping components shall be the products of one manufacturer.
- J. Sleeves: Provide sleeves in return air plenums.
 1. Provide a sleeved system through the installation of grooved Schedule 10 galvanized piping and couplings.
 2. Provide sleeve piping no less than 2 inches greater diameter than the polyvinylidene fluoride piping contained within it.
 3. Provide only rolled groove piping.
 - a. The Victaulic "Fit" fittings and piping system, or any similar set screw type fitting system is specifically prohibited. Vic-Let and Vic-O-Well or similar type fittings are **specifically prohibited** for use on this project.
 - b. Where a reduced tee fitting is required, then a reducing tee or regular tee with bell reducer shall be used.
 - c. **If any of the above described prohibited materials or installation methods are used, then the material or installation method shall be corrected at the contractor's expense.**

2.13 FLOW CONTROL VALVES

- A. The Mechanical Contractor shall furnish and install a 3/8-inch PVC flow control valve in each and every deionized water fixture return tap that limits the flow to 1/2 GPM. The Contractor shall supply and install a 2 GPM a natural polypropylene flow control valve in each deionized water connection to washers.
- B. Flow control valves shall maintain a constant flow regardless of inlet pressure changes between 15 and 100 psig. No metal shall be in contact with the liquid.
- C. PVDF:
 1. Diaphragm Valves.
 - a. Basis of Design: GF Piping Systems.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Ball Valves:
 - a. Basis of Design: GF Piping Systems.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 3. Sampling Valves:
 - a. Basis of Design: GF Piping Systems.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 4. Check Valves:
 - a. Basis of Design: GF Piping Systems.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 5. Self-Contained Pressure Regulating Valves:
 - a. Basis of Design: GF Piping Systems.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Actuators:
 1. Basis of Design: GF Piping Systems.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Flow Control Valves:,
 1. Basis of Design: GF Piping Systems.
 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.14 PRESSURE REGULATING VALVES

- A. Contractor shall supply and install, where shown on the drawings, socket fusion natural, virgin, unpigmented polypropylene pressure regulating valves.
- B. Valves shall accurately reduce and regulate steady or varying inlet pressures and maintain a constant predetermined outlet pressure.
- C. Pressure regulating valves shall be Series "PR", as manufactured by Plastomatic Valves, Inc., or approved equal.

2.15 PRESSURE GAGES

- A. Pressure Gages shall be 2-1/2-inch diameter, dual calibrated for 0 to 100 psi and SI units, having 316 stainless steel bourdon tube. The gauges supplied and/or installed for the service specified shall be manufactured by Ashcroft, Fig. No. 1079-S or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. PVDF Joint Fabrication:
 - 1. Install and perform joining in accordance with manufacturer's instructions and recommended procedures.
 - a. Fabricate in clean area with ventilation from areas with grinding or welding.
 - b. Clean components thoroughly and in compliance with manufacturer's instructions.
 - c. Jointing shall be made with equipment as indicated by manufacturer.
 - d. Label joints and record operating conditions.
 - e. Scratched pipe must be replaced.
 - f. Provide joints as indicated on drawings and where to connect with accessories and equipment. Install according to manufacturer's instructions.
 - 1) Provide ANSI flanged joints for connecting to equipment at locations where other types have not been indicated.
 - 2) Threaded joints are not acceptable.
- B. Configuration:
 - 1. Support all piping according to manufacturer's recommendations including at pump discharge locations.
 - 2. Provide continuous support for horizontal runs.
 - 3. Locate valves to ensure complete drainage per manufacturer's recommendations.
 - 4. System shall include low point drains and high point vents as indicated on drawings and as noted in submittal reviews by Architect.
 - 5. Ensure pipe is protected from contact with rough or sharp items, to prevent damage.
 - 6. Locate check valves and orifice plates in vertical sections. Provide eccentric valves or plates for horizontal installation with correct orientation.
 - 7. Install piping without spring or force and ensure equipment connections are without stress.
 - 8. Minimize all dead legs. Distance from sealing point on branch to inside of main line wall to be less than four branch line diameters.
 - 9. Ensure installation accommodates thermal expansion of system with both piping and supports.
 - 10. Install all in-line items to ensure access for maintenance, calibration, replacement of components, and sampling.
 - 11. Orient all gauges to the main pathway of the space.
- C. Equipment:
 - 1. Install equipment on concrete housekeeping pad. Refer to Section 22 00 10 - Basic Plumbing Requirements.
 - 2. Install line size isolation and check valves on circulation pump discharge.
 - 3. Install valved bypass around purification equipment.
 - 4. Install manual air vent valves at all high points of piping system, including piping direction changes from horizontal to vertical drops (ells only).
 - 5. Install take offs to outlets with shut off valve after take off. Slope take off piping to outlets.
- D. Identify piping system and components. Refer to Section 23 05 53 - Mechanical Identification.

3.2 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Repair or replace piping as required to eliminate leaks, and retest to demonstrate compliance.
- C. Cap (seal) ends of piping when not connected to mechanical equipment.

3.3 INSTRUCTIONS AND START-UP – DI SYSTEM

- A. At the time of delivery of equipment to the job site, the DI Water system shall be supplied with six complete sets of bound instructions covering installation, operating and maintenance.
- B. Contractor shall provide for the service of a competent supervising agent from the DI system manufacturer/supplier to inspect the completed installation, start the system into operation, and acquaint the operators with the proper operation and maintenance of the equipment. As proof of competency, the supervising agent shall carry both Water Quality Association Certification and TNRCC Level III Certification as a Water Specialist.
- C. At the time of start-up of equipment, the supplier of equipment shall provide all media fill including activated carbon, an initial brine maker full of 99 percent pure pellet salt for each softener system, and mixed bed ion exchange media.

3.4 INSTRUCTIONS AND START-UP – DI PIPING SYSTEM

- A. Entire piping system shall be cleaned, pressure tested, and sanitized. Submit cleaning, testing, and sanitization procedures for approval.
- B. Recommended Cleaning Procedures:
 - 1. Preliminary flush with potable water.
 - 2. Provide temporary bypass of DI equipment to create. Fill loop with solution of DI water and Alconox at 25 grams per gallon or equivalent solution. Circulate solution for minimum 60 minutes. Bleed minimum 1/2 gallon from each end connection valve during process.
 - 3. Flush system with DI water, minimum 5 line volumes.
 - 4. Refill with DI Water and Hydrogen peroxide to a 3 percent hydrogen peroxide solution. Let stand 1 hour. Recirculate minimum 1 hour, bleed minimum 1/2 gallon from each end connection during process.
 - 5. Flush system with DI water until potassium permanganate test indicates negative for H₂O₂. Check resistivity and continue flush with DI water until resistivity reaches point equal to DI water source.

3.5 TESTING

- A. Inspection:
 - 1. Visually inspect all joints and verify that they comply with manufacturer's criteria for a properly formed joint.
 - 2. For joints fused by machines that generate labels, verify that each joint has label.
 - 3. Check diaphragm valve bonnet bolts for correct torque.
- B. Hydrotest:
 - 1. Execute all pressure testing safely.
 - a. Do not pressurize plastic piping with gas.
 - b. Isolate equipment or instrumentation that cannot to be exposed to test pressure.
 - c. Notify personnel with access to system that testing is to take place. Tag each use point to indicate that valve is not to be used.
 - d. Ensure that air is completely vented from system to avoid a hazardous condition.
 - e. Pressurize system gradually.
 - f. Provide controls to prevent pressure from exceeding specified test pressure.
 - 2. Ensure that cleanliness of system is not compromised.
 - a. Provide water for testing and flushing that has quality equal to or better than service water.
 - b. When performing preliminary testing of sections of system, after test is complete flush all water out of system and ensure that it drains completely. Close all openings in system after draining.
 - 3. Execute final acceptance test on completed piping system.
 - a. Do not insulate or conceal piping until testing is complete.
 - b. Test system in sections or as a whole, but all joints need to be covered in test.
 - c. Ensure that air is completely vented from system.
 - d. Pressurize gradually and hold system at 100 psig for 4 hours. An initial pressure decrease will occur due to pipe elongation after pressurization. After 4 hours, pressure loss will stabilize, and

pressure must then hold at test pressure without a loss of 1% over period of one hour to pass test.

- e. Monitor pressure with gauge located near bottom of system that is readable to at least plus or minus 1 psi.
 - f. Note if pressure drops more than 1% over test period and determine source of leakage.
 - 1) Cut out and reinstall defective joints.
 - 2) Hand tighten wing nuts on sanitary clamps if required. If leakage continues, install new gasket. Do not tighten using tools.
 - 3) Retest.
4. Provide written certification that includes identification of portion of system tested, date, time, test criteria, test medium and pressure, duration, and name and title of person responsible for test.

3.6 CLOSEOUT ACTIVITIES

- A. As part of project punch list requirements per Section 01 77 00 - Closeout Procedures and Submittals, include UTSW Utilities, UTSW Plumbing Shop, UTSW Building Maintenance, UTSW PM, and other associated teams for plumbing focused review.
- B. Provide revised Operation and Maintenance Data including final installed components schedule, maintenance manuals, and warranty documentation to UTSW PM and to UTSW Building Maintenance.

END OF SECTION 22 67 06



DIVISION 23

HEATING, VENTILATING, AND AIR
CONDITIONING (HVAC)



SECTION 23 00 00

UTSW MECHANICAL DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Basic Mechanical Requirements specifically applicable to Division 23 Sections, in addition to Division 01 General Requirements.
- B. This document address design criterion not specifically covered by the Mechanical Code (UMC), American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) or set requirements that may exceed the minimum requirements of both.

1.3 APPLICABILITY

- A. This Specification applies to all HVAC projects designed and constructed by facilities management personnel, outside Architect/Engineering (A/E) firms, and all construction contractors.
- B. No deviations to the standard are acceptable without the written authorization of the Owner or Owner's Representative.
- C. UNIFORM GENERAL CONDITIONS, SUPPLEMENTARY GENERAL CONDITIONS, and DIVISION 1 of the Specifications apply to the work specified in this Section.
- D. Work covered by this Section of these Specifications shall be accomplished in accordance with all applicable provisions of the Contract Documents and any addenda or directives which may be issued herewith, or otherwise.

1.4 GENERAL

- A. The Contractor shall execute all work hereinafter specified or indicated on accompanying Drawings .
- B. Contractor shall provide all equipment necessary and usually furnished in connection with such work and systems whether or not mentioned specifically herein or on the Drawings.
- C. The Contractor shall be responsible for fitting material and apparatus into the building and shall carefully lay out the work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation, and to provide an integrated, satisfactory operating installation.
- D. The mechanical, electrical, and plumbing Drawings are necessarily diagrammatic by their nature, and are not intended to show every connection in detail or every pipe or conduit in its exact location. These details are subject to the requirements of standards referenced elsewhere in these specifications, and structural and architectural conditions
- E. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work
 - 1. Work shall be organized and laid out so that it will be concealed in furred chases and suspended ceilings, etc , in finished portions of the building, unless specifically noted otherwise.
 - 2. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- F. When the mechanical, electrical, and plumbing Drawings do not give exact details as to the elevation of pipe, conduit and ducts, the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with proper grades for the functioning of the system involved.
- G. Piping, exposed conduit and the duct systems are generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat manner.
 - 1. The drawings do not show all required offsets, control lines, pilot lines and other location details.
 - 2. Work shall be concealed in all finished areas.

1.5 TERMS AND DEFINITIONS

- A. General Requirements: The provisions of requirements of other Division 01 Sections apply to entire work of Contract and, where so indicated, to other elements that are included in Project. Basis Contract definitions are included in the General Conditions.
- B. Indicated: The term "indicated" is a cross reference to graphic representations, notes or schedules on drawings, to other paragraphs or schedules in the specifications, and to similar means of recording requirements on contract documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated," it is for the purpose of helping reader locate the cross reference, and no limitation of location is intended except as specifically noted.
- C. Directed, requested, etc.: Where not otherwise explained, terms such as "directed," "requested," "authorized," "selected," "approved," "required," "accepted," and "permitted" mean "directed by Architect/Engineer," "requested by Architect/Engineer" and similar phrases. However, no such implied meaning will be interpreted to extend Architect's/Engineer's responsibility into Contractor's area of construction supervision and job safety.
- D. Approve: Where used in conjunction with Architect's/Engineer's response to submittals, requests, applications, inquiries, reports and claims by Contractor, the meaning of term "approved" will be held to limitations to Architect's/Engineer's responsibilities and duties as specified in General and Supplementary Conditions. In no case will "approval" by Architect/Engineer be interpreted as a release of Contractor from responsibilities to fulfill requirements of contract documents or to extend Architect's/Engineer's responsibility into Contractor's area of construction supervision and job safety.
- E. As required: Where "as required" is used in these specifications or on the drawings, it shall mean "that situations exist that are not necessarily described in detail or indicated that may cause the contractor certain complications in performing the work described or indicated. These complications entail the normal coordination activities expected of the Contractor where multiple trades are involved and new or existing construction causes deviations to otherwise simplistic approaches to the work to be performed. The term shall not be interpreted to permit an option on the part of the Contractor to achieve the end result."
- F. Furnish: The term "furnish" is used to mean "supply and deliver to project site, ready for unloading, unpacking, assemble, installation, and similar operations. Where "furnish" applies to work for which the installation is not otherwise specified, "furnish" in such case shall mean "furnish and install."
- G. Install: The term "install" is used to describe operations at Project Site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use.
- I. CDAS – Central Data Acquisition System (CDAS) is the campus-wide central monitoring station, which is located in the Facilities Management Office (P Building).
- J. Dry Lab – Laboratories, which are not equipped with multiple utilities, but require a greater degree of electrical power and HVAC than an office area.
- K. Engineer – UTSW Engineer, Owner, or Owner's designated representative.
- L. Gas Cylinder Room – Any room that contains carbon dioxide, nitrogen, or argon cylinders in excess of 50 Lbs capacity.
- M. Wet Lab – Any laboratory equipped with sinks, fume hoods, biological safety cabinets, or other equipment, which requires multiple utilities (such as gas, air or vacuum), and a greater degree of HVAC than a dry lab.
- N. Concealed: Areas which cannot be seen by the building occupants.
- O. Exposed: Areas which are exposed to view by the building occupants, including under counters, inside cabinets and closets, plus all mechanical rooms.

1.6 RELATED REQUIREMENTS

- A. Section 01 77 00 - Closeout Procedures and Submittals.
- B. Section 01 79 00 - Demonstration and Training.
- C. Section 01 91 00 - General Commissioning Requirements.
- D. Section 09 96 00 - High-Performance Coatings.
- E. Section 23 00 00 - UTSW Mechanical Design Requirements.
- F. Section 23 05 53 - Mechanical Identification.
- G. Section 23 08 00 - Commissioning of HVAC Systems.

1.7 PERMITS, UTILITY CONNECTIONS AND INSPECTIONS

- A. General: Refer to Division 01 for construction phasing and time increments.
- B. Fees and Costs:
 - 1. If, during the course of the construction, a need arises to buy utilities, the Contractor shall pay all fees attendant thereto.
 - 2. If City or privately owned utility piping or electrical cable needs to be extended, relocated, or terminated, the Contractor will pay all permits and construction/inspection fees associated with that particular work.
- C. All work performed on this project is under the authority of the State of Texas, therefore no local construction fees or construction permits will be required except as may be required for new service taps, or new or modified connections to City controlled services.
 - 1. If inspections by City personnel are specifically required by this document, then the Contractor is responsible for any fees or permits in connection to those requirements.
- D. Compliance:
 - 1. The Contractor shall comply in every respect with all requirements of National Fire Protection Association, local Fire Department regulations, and utility company requirements.
 - 2. In no case does this relieve the Contractor of the responsibility of complying with these Specifications and Drawings where specified conditions are of higher quality than the requirements of the above specified authorities.
 - 3. Where requirements of the Specifications and Drawings are more lenient than the requirements of the above authorities having jurisdiction, the Contractor shall make installations in compliance with the requirements of the above authorities with no extra compensation.

1.8 CONTRACT DOCUMENTS

- A. All dimensional information related to new structures shall be taken from the appropriate Drawings.
 - 1. All dimensional information related to existing facilities shall be taken from actual measurements made by the Contractor on the site.
- B. The interrelation of the Specifications, the Drawings, and the schedules are as follows:
 - 1. The Specifications determine the nature and setting of the several materials.
 - 2. The Drawings establish the quantities, dimensions, and details.
 - 3. The schedules give the performance characteristics.
 - 4. If the Contractor requires additional clarification, the request shall follow the contractually prescribed information flow requirements.
- C. Should the Drawings or Specifications conflict within themselves or with each other, the better quality, or greater size or quantity of work or materials shall be performed or furnished except where directed otherwise in writing by the design professional.

1.9 OWNER FURNISHED PRODUCTS

- A. Products furnished to the site and paid for by Owner will be indicated as a Cash Allowance. Refer to Division 01 of the Construction Documents for information and requirements.

1.10 FUTURE WORK

- A. Future work will be noted on the Drawings.

1.11 ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at the Owner's option.
 - 1. Accepted Alternates will be identified in Owner Contractor Agreement.
- B. Coordinate related work and modify surrounding work as required.
- C. Schedule of Alternates: See "Special Conditions" and Bid Form.
- D. Any Alternate Proposals are summarized in Division 01 of the Specifications.
- E. The Contractor is directed to refer to all Sections of the Specifications and Drawings for this project to determine the exact extent and scope of the various Alternate Proposals as each pertains to the work of all trades.

1.12 SUBMITTALS

- A. Refer to Division 01, UGC, and supplemental UGC's for specification requirements pertaining to timeliness of submission and review, quantity, and format.

- B. Each specification section describes the content of the submittals and any submittals which must be approved prior to submission of others.
- C. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.
- D. Submit shop drawings for OSBC review and approval where any equipment or components must coordinate with life safety elements.
 - 1. Submit shop drawings showing locations of smoke detectors installed in line with humidifiers to be approved by OSBC.
- E. Mark dimensions and values in units to match those specified.
- F. Submit Fabrication Drawings when:
 - 1. Equipment proposed varies in physical size and arrangement from that indicated on the Drawings, thus causing rearrangement of equipment space.
 - 2. Where tight spaces require extreme coordination between ductwork, piping, conduit, and other equipment.
 - 3. Where called for elsewhere in these Specifications.
 - 4. Where specifically requested by the Architect/Engineer.
- G. Fabrication Drawings shall be made at no additional charge to the Owner or the Architect/Engineer.
 - 1. All required Fabrication Drawings, except as noted otherwise, shall be prepared at a scale of not less than 1/4 inch = 1 foot.
 - 2. Fabrication Drawings for ductwork, air handling units, and sections in Mechanical Rooms shall be drawn at a minimum scale of 3/8 inch = 1 foot.
 - 3. Submit Fabrication Drawing to the Architect/Engineer and UTSW Facilities Management for review in the quantity and format as specified in Division 1. The Architect/Engineer and UTSW will review the fabrication drawings and return with comments.
- H. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.13 SUBSTITUTION OF MATERIALS AND EQUIPMENT

- A. Refer to General Conditions for substitution of materials and equipment.
- B. Should a substitution be accepted, and should the substitute material prove defective, or otherwise unsatisfactory for the service intended within the guarantee period, material or equipment shall be replaced with the material or equipment specified at no additional cost to Owner.
- C. General:
 - 1. Within thirty days after the date of contract award or work order, whichever is later, and before purchasing or starting installation of materials or equipment, the Contractor shall submit for review, a complete list of suppliers, contractors, and manufacturers for all materials and equipment which will be submitted for incorporation into the project.
 - 2. The list shall be arranged in accordance with the organization of the Specifications:
 - a. This initial list shall include the manufacturer's name and type or catalog number as required to identify the quality of material or equipment proposed.
 - b. This list will be reviewed by the Engineer and the Owner and will be returned to the Contractor with comments as to which items are acceptable without further submittal data and which items will require detailed submittal data for further review and subsequent approval.
 - c. The initial list shall be submitted as herein specified Materials and equipment requiring detailed submittal data shall be submitted with sufficient data to indicate that all requirements of these Specifications have been met and samples shall be furnished when requested.
 - d. All manufacturers' data used as part of the submittal shall have all inapplicable features crossed out or deleted in a manner that will clearly indicate exactly what is to be furnished.
- D. It is not the intent of the Drawings and/or Specifications to limit products to any particular manufacturer or to discriminate against an "APPROVED EQUAL" product as produced by another manufacturer.
 - 1. Some proprietary products are mentioned to set a definite standard for acceptance and to serve as a reference in comparison with other products.
 - 2. When a manufacturer's name appears in these Specifications, it is not to be construed that the manufacturer is unconditionally acceptable as a provider of equipment for this project.
 - 3. The successful manufacturer or supplier shall meet all of the provisions of the appropriate specification(s).

4. The specified products have been used in preparing the Drawings and Specifications and thus establish minimum qualities with which substitutes must at least equal to be considered acceptable.
 5. The burden of proof of equality rests with the Contractor.
 6. The decision of the designer is final.
- E. When requested by the Architect/Engineer, the Contractor shall provide a sample of the proposed substitute item. In some cases, samples of both the specified item and the proposed item shall be provided for comparison purposes.
- F. Timeliness:
1. The burden of timeliness in the complete cycle of submittal data, shop Drawings, and sample processing is on the Contractor.
 2. The Contractor shall allow a minimum of 6 weeks time frame for review of each submission by the office of the design discipline involved after receipt of such submissions by that design discipline.
 3. The Contractor is responsible for allowing sufficient time in the construction schedule to cover the aforementioned cycles of data processing, including time for all re-submittal cycles on unacceptable materials, equipment, etc covered by the data submitted.
 4. Construction delays and/or lack of timeliness in the above regard are the responsibility of the Contractor and will not be considered in any request for scheduled construction time extensions and/or additional costs to the Owner.
- G. All equipment installed on this project shall have local representation; local factory authorized service, and a local stock of repair parts.
- H. Acceptance of materials and equipment:
1. This is based on the manufacturer's published data and will be tentative subject to the submission of complete shop Drawings indicating compliance with the contract documents and that adequate and acceptable clearances for entry, servicing, and maintenance will exist.
 2. Acceptance of materials and equipment under this provision shall not be construed as authorizing any deviations from the Specifications, unless the attention of the Architect/Engineer has been directed in writing to the specific deviations.
 3. Data submitted shall not contain unrelated information unless all pertinent information is properly identified.
- I. Certification: The Contractor shall carefully examine all data forwarded for approval and shall sign a certificate to the effect that the data has been carefully checked, found to be correct with respect to dimensions and available space, that the equipment complies with all requirements of the Specifications, and that the product is suitable for its intended use on this project.
- J. Physical Size of Equipment: Space is critical; therefore, equipment of larger sizes than shown, even though of specified manufacturer, will not be acceptable unless it can be demonstrated that ample space exists for proper installation, operation, and maintenance.
- K. Materials and Equipment Lists:
1. Provide digital copies of the list of materials and equipment, the name of manufacturer, trade name, type, and catalog number shall be submitted to the Architect/Engineer in quantity and format as described in Division 01.
 2. The lists shall be accompanied by digital sets of pictorial and descriptive data derived from the manufacturers' catalogs, sales literature, or incorporated in the Shop Drawings.
 3. Should a substitution be accepted, and should the substitute material prove defective, or otherwise unsatisfactory for the service intended within the guarantee period, this material or equipment shall be replaced with the material or equipment specified at no additional cost to the Owner.

1.14 MATERIALS AND WORKMANSHIP

- A. All materials, unless otherwise specified, shall be new, free from all defects, suitable for the intended use, and of the best quality of their respective kinds.
1. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved.
 2. All work shall be executed by mechanics skilled in their respective trades, and the installations shall provide a neat, precise appearance.
 3. Materials and/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 materials and/or equipment.

- B. The responsibility for the furnishing of the proper equipment and/or material and seeing that it is installed as intended by the manufacturer rests entirely upon the Contractor who shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.

1.15 FLAME SPREAD PROPERTIES OF MATERIALS

- A. Materials and adhesives incorporated in this project shall conform to NFPA .
- B. The classification shall not exceed a flame spread rating of 25 for all materials, adhesives, finishes, etc , specified for each system, and shall not exceed a smoke developed rating of 50.

1.16 REGULATORY REQUIREMENTS

- A. The "Authority Having Jurisdiction" for Fire and Life Safety related compliance in accordance with the rules and regulations promulgated by the Texas State Fire Marshal as an Agency of the State of Texas is UT Southwestern Medical Center Office of Safety and Business Continuity.
- B. Plan reviews, installations, inspections, and approvals shall be done as a function of the Fire and Occupational Safety program under the direction of the Director of Fire and Occupational Safety (University Fire Marshal).
- C. It is required that the installation shall meet the minimum standards prescribed in the latest editions of the following listed codes and standards identified in Section 01 41 00 - Regulatory Requirements and listed in other Specification sections. Additional requirements include but not limited to:
 - 1. All referenced codes and standards shall be those current at the date of issue of the design documents.
 - 2. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - 3. National Fire Protection Association Standards (NFPA): Currently accepted edition.
 - 4. ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - 5. ASHRAE Std 62.1 Ventilation and Acceptable Indoor Air Quality.
 - 6. American Gas Association Publications (AGA): Directory of Approved Gas Appliances and Tested Accessories.
 - 7. American Society of Mechanical Engineers (ASME): Boiler and Pressure Vessel Codes.
 - 8. Air Conditioning and Refrigeration Institute Standards (ARI): All standards related to refrigeration and air conditioning equipment and piping furnished under these Specifications.
 - 9. Sheet Metal and Air Conditioning Contractors National Association, Inc (SMACNA): All current editions of applicable manuals and standards (See Sections 23 31 00 - Ductwork and 23 33 00 - Ductwork Accessories).
 - 10. Air Moving and Conditioning Association (AMCA): All current editions of applicable manuals and standards.
 - 11. American Society of Testing Materials (ASTM): All current editions of applicable manuals and standards.
 - 12. American Water Works Association (AWWA): All current editions of applicable manuals and standards.
 - 13. National Electrical Manufacturers` Association (NEMA): All current editions of applicable manuals and standards.
 - 14. International Codes, current edition or as listed elsewhere in the contract.
 - 15. Texas Occupational Safety Act: All applicable safety standards.
 - 16. Occupational Safety and Health Act (OSHA).
 - 17. TAS, ADA, and ANSI Standards: All work shall be in accord with all regulations and requirements of the Standards and Specifications for Handicapped and Disabled for the Construction of Public Buildings and Facilities in the State of Texas Usable by Physically Handicapped and Disabled persons, ANSI Standards, and the requirements of the American Disabilities Act.
 - 18. All materials and workmanship shall comply with all applicable state and national codes, Specifications, and industry standards
 - a. In all cases where Underwriters` Laboratories, Inc has established standards for a particular type material, such material shall comply with these standards
 - b. Evidence of compliance shall be the UL "label" or "listing" under Reexamination Service.
 - 19. The Contract Documents are intended to comply with the aforementioned rules and regulations; however, some discrepancies may occur.

- a. Where such discrepancies occur, the Contractor shall immediately notify the Architect/Engineer in writing of said discrepancies and apply for an interpretation.
- b. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with said regulations shall be paid for as covered by Division 1 of these Contract Documents, providing no work of fabrication of materials has been accomplished in a manner of noncompliance.
- c. Should the Contractor fabricate and/or install materials and/or workmanship in such a manner that does not comply with the applicable codes, rules and regulations, the Contractor who performed such work shall bear all costs arising in correcting these deficiencies to comply with said rules and regulations.

1.17 COMMISSIONING

- A. Comply with project requirements for commissioning. Refer to Section 01 91 00 - General Commissioning Requirements and associated sections.

1.18 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

- A. Storage at Site: The Contractor shall not receive material or equipment at the job site until there is suitable space provided to properly protect equipment from rust, water, weather, humidity, dust damage, and vandalism.
- B. Capacities shall be not less than those indicated but shall be such that no component or system becomes inoperative or is damaged because of startup or other overload conditions.
- C. Conformance with Agency Requirements:
 - 1. Where materials or equipment are specified to be approved, listed, tested, or labeled by the Underwriters` Laboratories, Inc , or constructed and/or tested in accordance with the standards of the American Society of Mechanical Engineers or the Air Moving and Conditioning Association, the Contractor shall submit proof that the items furnished under this Section of the Specifications conform to such requirements.
 - a. The label of the Underwriters Laboratories, Inc , applied to the item will be acceptable as sufficient evidence that the items conform to such requirements.
 - b. The ASME stamp or the AMCA label will be acceptable as sufficient evidence that the items conform to the respective requirements.
- D. Nameplates:
 - 1. Refer to Section 23 05 53 - Mechanical Identification for requirements.
 - 2. Each major component of equipment shall have the manufacturer`s name, address, and catalog number on a plate securely attached to the item of equipment. Attachment shall be appropriate to the type of surface to ensure longevity of attachment.
 - 3. All data on nameplates shall be legible at the time of Final Inspection.
- E. Prevention of Rust:
 - 1. Standard factory finish will be acceptable on equipment specified by model number; otherwise, surfaces of ferrous metal shall be given a rust inhibiting coating.
 - 2. The treatment shall withstand 200 hours in salt spray fog test, in accordance with Method 6061 of Federal Standard No 141.
 - 3. Immediately after completion of the test, the specimen shall show no signs of wrinkling or cracking and no signs of rust creep beyond 1/8 inch on either side of the scratch mark.
 - 4. Where rust inhibitor coating is specified hereinafter, any treatment that will pass the above test is acceptable unless a specific coating is specified except that coal tar or asphalt type coating will not be acceptable unless so stated for a specific item.
 - 5. Where steel is specified to be hot-dip galvanized, mill-galvanized sheet steel may be used provided all raw edges are painted with a zinc-pigmented paint conforming to Military Specification MIL-P-26915.
- F. Protection from Moving Parts:
 - 1. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts shall be fully enclosed or properly guarded for personnel protection.
 - 2. Guards shall be compliant with OSHA requirements.
- G. Verification of Dimensions:
 - 1. The Contractor shall be responsible for the coordination and proper relation of the work to the building structure and to the work of all trades.

2. The Contractor shall visit the premises and become thoroughly familiar with all details of the work and working conditions, to verify all dimensions in the field, and to advise the Architect/Engineer of any discrepancy before performing any work.
3. Adjustments to the work required in order to facilitate a coordinated installation shall be made at no additional cost to the Owner or the Architect/Engineer.

1.19 WALL, FLOOR AND CEILING PLATES

- A. Except as otherwise noted, provide C P (Chrome plated) brass floor and ceiling plates around all pipes, ducts, conduits, etc , passing exposed through walls, floors, or ceilings, in any finished spaces except underfloor and attic spaces.
 1. Plates shall be sized to fit snugly against the outside of the pipe or against the insulation on lines which are insulated and positively secured to such pipe or insulation.
 2. Plates will not be required for piping where pipe sleeves extend 3/4 inch above finished floor.
 3. All equipment rooms are classified as finished areas.
 4. Round and rectangular ducts shall have closure plates (NOT chrome plated) made to fit accurately at all floor, wall and ceiling penetrations.

1.20 SLEEVES, INSERTS, AND FASTENINGS

- A. General:
 1. All openings through all floors, walls, and roofs, etc , regardless of material for the passage of piping, ductwork, conduit, cable trays, etc , shall be sleeved.
 2. All penetrations must pass through sleeves except soil pipe installed under concrete slabs on fill.
 3. Sleeves shall be set in new construction before concrete is poured, as cutting holes through any part of the concrete will not be permitted unless acceptable to the Architect/Engineer in writing.
 - a. If a penetration is cored into an existing solid concrete or stone structure, then the installation of a sleeve will not be necessary.
 4. Sleeves set in floors shall extend 4-inches above finished floor elevation and be sealed water tight to the floor.
- B. The minimum clearance between horizontal penetrations including insulation where applicable, and sleeve shall be 1/4 inch, except that the minimum clearance shall accommodate a Link-seal by Garlock, an Enpro Company, or approved equal product, closure where piping exits the building, or penetrates a wall below ground level.
- C. Contractor shall be responsible for the accurate location of penetrations in the slab for pipe, duct, etc.
 1. All penetrations shall be of ample size to accommodate the pipe, duct, etc plus any specified insulation.
 2. Sleeve materials shall be rigid metal of adequate strength.
 3. Void between sleeve and pipe shall be filled with Nelson Flameseal Firestop or approved equal caulk or putty.
- D. Sleeves:
 1. Installation of sleeves in walls shall be the same as for floors.
 2. Refer to the details on the project drawings.
 - a. Where the details differ from these specifications, the drawings take precedence.
 3. Sleeves for penetrations passing through walls or floors on or below grade shall be removed, if practical, and after the pipes have been installed, the void space around the pipe shall be caulked with a suitable material to effect a waterproof penetration.
 - a. Note that the practicality of the removal of the sleeve shall be the decision of the Construction Inspector. The decision of the Inspector shall be final.
- E. Inserts:
 1. Where the construction schedule allows, suitable concrete inserts for pipe and equipment hangers shall be set and properly located for all pipe and equipment to be suspended from concrete construction.
 2. If the inserts are later found not to be in the proper location for the placement of hangers or if the construction schedule does not allow inserts to be installed, then drilled anchors shall be installed.
 3. Drilled anchors in concrete or masonry shall be submitted for approval.
- F. Fasteners:
 1. Fastening of pipes, conduits, etc , in the building shall be as follows:
 - a. To wood members - by wood screws.

- b. To masonry - by threaded metal inserts, metal expansion screws, or toggle bolts, whichever is appropriate for the particular type of masonry.
 - c. To steel - machine screws or welding (when specifically permitted or directed), or bolts.
 - d. To concrete by suitable inserts anchored to reinforcing steel, and poured in place unless other means are indicated on the plans.
 - e. Power-actuated fasteners (shooting) will not be acceptable under any circumstances.
 - f. If it is necessary to install a method of fastening a hanger after the structure has been installed, then only clamps or drilled anchors with torque nuts and washes shall be used.
2. Note: The use of plastic anchors or plastic expansion shields is prohibited.
- G. Rat proofing: The open space around all ductwork, piping, etc , passing through the ground floor and/or exterior walls shall be rat proofed in a manner acceptable to the Architect/Engineer.
 - H. Weatherproofing: The annular space between a pipe and its sleeve in exterior walls or through floor to below grade shall be filled with polyurethane foam rods 50 percent greater in diameter than the space as backing and fill material and made watertight with a permanent elastic polysulfide compound.
 - 1. Seal both surfaces of wall or floor.
 - I. Air Plenums: The space around piping, ductwork, etc , passing through air plenums shall be made airtight in a manner acceptable to the Architect/Engineer.
 - J. Fireproofing:
 - 1. Each contractor shall seal duct, etc , penetrations through roof, fire rated walls, and floors with a foam or sealant as described below or in Division 7 that will form a watertight, vermin tight barrier that is capable of containing smoke and fire up to 2,000 degrees F for two hours.
 - 2. Refer to fireproofing and firestopping specifications in Division 07 for product requirements.
- 1.21 PROJECT/SITE CONDITIONS
- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.
 - B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections.
 - C. Obtain permission of Architect/Engineer in writing before proceeding.
 - D. In some cases the existing system(s) will be expanded or replaced.
 - 1. Contractor shall thoroughly familiarize themselves with the existing system(s) and bring to the attention of the Architect/Engineer any situations, which deviate from those, indicated in the Contract Documents.
- 1.22 MANUFACTURER`S RECOMMENDATIONS
- A. The manufacturer`s published directions shall be followed in the delivery, storage, protection, installation, piping, and wiring of all equipment and material.
 - 1. The Contractor shall promptly notify the Architect/Engineer, in writing, of any conflict between the requirements of the Contract Documents and the manufacturers` directions.
 - 2. The Contractor shall obtain the Architect/Engineer`s instructions before proceeding with the work.
 - 3. Should the Contractor perform any such work that does not comply with the manufacturers` directions or such instructions from the Architect/Engineer, the Contractor shall bear all costs arising in connection with the deficiencies.
- 1.23 SPACE AND EQUIPMENT ARRANGEMENT
- A. The size of mechanical and electrical equipment indicated on the Drawings is based on the dimensions of a particular manufacturer.
 - 1. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment proposed will fit in the space.
 - 2. Fabrication Drawings shall be prepared for approval when required by the Architect/Engineer or Owner to indicate a suitable arrangement.
 - B. All equipment shall be installed in a manner to permit access to all surfaces.
 - 1. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.
 - C. All equipment intended for floor mounting shall be installed on housekeeping pads or grouted bases that elevate the base away from damage.
 - 1. Housekeeping pads to be sealed to match floor waterproofing system.
 - 2. Housekeeping pad edges to be painted Safety Yellow.

3. Once equipment is set in place, seal around base perimeter per requirements of Section 07 92 00 - Joint Sealants.

1.24 LARGE APPARATUS

- A. Any large piece of apparatus which is to be installed in any space in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed.
- B. Following placement in the space, such apparatus shall be thoroughly and completely protected from damage as hereinafter specified.

1.25 PROTECTION

- A. The Contractor shall at all times take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of the work.
 1. This shall include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the cribbing of any items above the floor of the construction; and the covering of items in the incomplete building with tarpaulins or other protective covering; the installation of electric heaters in electrical switchgear and similar equipment to prevent moisture damage.
 2. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.
- B. Take particular care not to damage the building structure in performing work.
 1. All finished floors, step treads, and finished surfaces shall be covered to prevent any damage by workmen or their tools and equipment during the construction of the building.
- C. Equipment and materials shall be protected from rust both before and after installation.
 1. Any equipment or materials found in a rusty condition at the time of final inspection must be cleaned of rust and repainted as specified elsewhere in these Specifications.
- D. Storage of all equipment shall be per manufacturer's recommendations.
- E. All pumps, fans and motors shall be rotated by hand when received and when stored to maintain bearing lubrication.

1.26 COOPERATION BETWEEN TRADES AND WITH OTHER CONTRACTORS

- A. Each trade, subcontractor, and/or Contractor must work in harmony with the various other trades, subcontractors and/or Contractors on the job as may be required to facilitate the progress to the best advantage of the job as a whole.
- B. Each trade, subcontractor, and/or Contractor must pursue its work promptly and carefully so as not to delay the general progress of the job.
- C. This Contractor shall work in harmony with Contractors working under other contracts on the premises.

1.27 ELECTRICAL WIRING OF MOTORS AND EQUIPMENT

- A. The Contractor shall note that the electrical design and Drawings are based on the equipment scheduled and indicated on the Drawings, and should any mechanical equipment be provided requiring changes to the electrical design, the required electrical changes shall be made at no cost to the Owner.
- B. The Electrical Trades shall provide all interconnecting wiring for the installation of all power.
- C. The Electrical Trades shall provide all disconnect switches as required for proper operation, as indicated on the Drawings or required by applicable code.
 1. All combination starters, individual starters, and other motor starting apparatus not specifically scheduled or specified as provided by the equipment manufacturer under the scope of Division 23, shall be provided under the scope of Division 26 or as directed by the General Contractor.
- D. The Mechanical Trades shall provide complete wiring diagrams indicating power wiring and interlock wiring.
 1. Diagrams shall be submitted for review within 30) days after the submittals for equipment have been reviewed.
 2. Diagrams shall be based on accepted equipment and shall be complete full phase and interlock control Drawings, not a series of manufacturer`s individual diagrams.
 3. After these diagrams have been reviewed, copies shall be transmitted to the Electrical Trades by the Contractor.
 4. See Section 23 09 00 - Instrumentation and Control for HVAC for additional clarification.

1.28 SUPERVISION

- A. Each Contractor and subcontractor shall keep a competent superintendent or foreman on the job at all times (Refer to the Uniform General Conditions for additional information concerning supervision).
- B. It shall be the responsibility of each superintendent to study all Drawings and familiarize themselves with the work to be done by other trades.
- C. Coordinate with other trades and, before material is fabricated or installed, superintendent shall ensure that the work will not cause an interference with another trade.
- D. Where interferences are encountered, they shall be resolved at the job site by the superintendents involved.
- E. Where interferences cannot be resolved without major changes to the design, the matter shall be referred to the A/E for ruling.

1.29 SITE OBSERVATION

- A. Site observation by the Architect/Engineer is for the express purpose of verifying compliance by the Contractor with the Contract Documents, and shall not be construed as construction supervision nor indication of approval of the manner or location in which the work is being performed as being a safe practice or place.

1.30 PRECEDENCE OF MATERIALS

- A. The specifications determine the nature and setting of materials and equipment.
- B. The drawings establish quantities, dimensions, and details.
- C. The installation precedence of materials shall generally be as follows:
 - 1. Note that if interference is encountered, this shall guide the contractor in the determination of which trade shall be given the "Right-of-Way" This does not require elements with a lower preference to be relocated if such relocation is required to resolve interference or to provide better access.
 - a. Building lines.
 - b. Structural Members.
 - c. Soil and Drain Piping.
 - d. Vent Piping.
 - e. Supply, Return, and Outside Air Ductwork.
 - f. Exhaust Ductwork.
 - g. HVAC Water and Steam Piping.
 - h. Condensate Piping.
 - i. Fire Protection Piping.
 - j. Natural Gas Piping.
 - k. Domestic Water (Cold and Hot).
 - l. Refrigerant Piping.
 - m. Electrical Conduit.

1.31 RECORDS FOR OWNER

- A. Records shall comply with Section 01 77 00 - Closeout Procedures and Submittals and requirements described herein.
- B. The Contractor shall maintain a set of prints in the Field Office for the sole purpose of recording "installed" conditions.
 - 1. Daily note all changes made in these Drawings in connection with the final installation including exact dimensioned locations of all new underground utilities, services and systems and all uncovered existing active and inactive piping outside the building.
- C. At Contract completion, the Contractor shall provide a set of reproducible drawings and set of specifications electronic format (PDF).
 - 1. The contractor shall transfer the information from the prints maintained as described above, and turn over this neatly marked set of reproducible Drawings and specifications representing the "as installed" work to the Architect/Engineers for verification and subsequent transmittal to the Owner.
 - 2. The Contractor shall refer to Division 01 of these Specifications, and to the Uniform General Conditions, for additional information.
 - 3. These Drawings and Specifications shall include as a minimum:
 - a. Addendum written drawing changes.
 - b. Addendum supplementary drawings.

- c. Accurate, dimensioned locations of all underground utilities, services and systems.
 - d. Identification of equipment work shown on Alternates as to whether alternates were accepted and work actually installed.
 - e. Change Order written drawing changes.
- D. "As installed" PDF's shall bear a stamp or hand lettered title block generally located in lower right hand corner of Drawing entitled "AS INSTALLED DRAWING" with Company name of the installing trade Subcontractor and with a place for the date and the name of the responsible company representative.
- E. In addition to the above, the Contractor shall accumulate, during the progress of the job, the following data in electronic format (PDF) and turn over to the Architect/Engineer for review, and subsequent delivery to the Owner:
- 1. All warranties and guarantees and manufacturers` directions on equipment and material covered by the Contract.
 - 2. Operating instructions and preventative maintenance procedures for heating and cooling and other mechanical and electrical systems.
 - 3. Valve tag charts and diagrams specified herein.
 - 4. Approved wiring diagrams and control diagrams representing "as installed" conditions.
 - 5. Copies of approved Shop Drawings.
 - 6. Any and all other data and/or drawings required as submittals during construction.
 - 7. Repair parts list of all major items and equipment including name, address and telephone number of local supplier or agent.
- F. All of the above data shall be submitted to the Architect/Engineer for approval, and shall be corrected as instructed by the Architect/Engineer prior to submission of the final request for payment.
- G. Refer to additional requirements in the commissioning section of Division 01.
- 1.32 ATTIC STOCK
- A. Provide one set of filters and two sets of belts at conclusion of the project to the Owner for attic stock.
- 1.33 WARRANTY
- A. Refer to Division 01 and to individual specification sections for warranty requirements Unless otherwise specified, a 5-year parts and labor warranty shall be provided on all systems and equipment.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be acceptable to the authority having jurisdiction as suitable for the use intended.
- B. Furnish products listed and classified by Underwriter's Laboratory, Inc as suitable for purpose specified and shown.
- C. Unless otherwise specified materials shall be new and free from any defects.

2.2 ACCESS DOORS

- A. General: This Contractor shall provide wall, floor, or ceiling access doors for unrestricted access to all concealed items of mechanical, plumbing, or electrical equipment or devices including items requiring general maintenance or access.
- B. Utilize Section 08 31 13 - Access Doors and Frames for products and requirements.
- C. Access doors shall be a minimum of 24 x 24 inches in size unless approved by UTSW FM in writing. Location shall provide appropriate access.

PART 3 – EXECUTION

3.1 EXISTING FACILITIES

- A. The Contractor shall be responsible for loss or damage to the existing facilities caused by them and their workers, and shall be responsible for repairing or replacing such loss or damage.
 - 1. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and in service maintenance of all plumbing, heating, air conditioning, electrical, and ventilating services for the new and existing facilities.
 - 2. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.

- B. The Contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.
- C. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.
- D. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, all Contractors shall remove and reinstall in locations approved by the Architect/Engineer all devices required for the operation of the various systems installed in the existing construction.
 - 1. This includes but is not limited to temperature controls system devices, electrical switches, relays, fixtures, piping, conduit, etc.
- E. Outages of services as required by the new installation will be permitted but only at a time approved by the Owner.
 - 1. Comply with notification requirements per Section 01 10 00 - Summary.
 - 2. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner.
 - 3. All costs of outages, including overtime charges, shall be included in the contract amount.

3.2 DEMOLITION AND RELOCATION

- A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities.
 - 1. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage.
 - 2. Salvage materials shall remain the property of the Owner, and shall be delivered to such destination or otherwise disposed of as directed by the Owner.
 - 3. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition.
 - 4. The Contractor may, at their discretion, and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.
- B. All items that are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated.
 - 1. The Contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order.
 - 2. All relocations shall be performed by workers skilled in the work and in accordance with standard practice of the trades involved.
- C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner to such items and receive further instructions before removal.
 - 1. Items damaged in repositioning operations are the Contractor's responsibility and shall be repaired or replaced by the Contractor as approved by the Owner, at no additional cost to the Owner.
- D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner.
 - 1. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain.
 - 2. Such services shall be sealed, capped, or otherwise tied off or disconnected in a safe manner acceptable to the Owner.
 - 3. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas.
 - 4. Services to existing areas or facilities that must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as hereinbefore specified.

3.3 INSTALLATION METHODS

- A. Where to Conceal: All pipes, conduits, etc., shall be concealed in pipe chases, walls, furred spaces, or above the ceilings of the building unless otherwise indicated.
- B. Where to Expose:

1. In mechanical rooms, janitor`s closets tight against pan soffits in exposed "Tee" structures, or storage spaces, but only where necessary, piping may be run exposed.
 2. All exposed piping shall be run in the most aesthetic, inconspicuous manner, and parallel or perpendicular to the building lines.
- C. Support: All piping, ducts and conduits shall be adequately and properly supported from the building structure by means of hanger rods or clamps to walls as herein specified.
- D. Maintaining Clearance:
1. Where limited space is available above the ceilings below concrete beams or other deep projections, pipe and conduit shall be sleeved through the projection where it crosses, rather than hung below them in a manner to provide maximum above-floor clearance.
 2. Sleeves shall be as herein specified.
 3. Piping, ductwork and other installed materials shall be located so as to not obstruct maintenance clearance for mechanical components such as controls, filters and the like.
 4. Piping shall not create trip-hazards through floor-mounting but be routed in a manner overhead or below the floor.
- E. Piping:
1. Piping shall be identified with both color and labels as indicated in Section 23 05 53 - Mechanical Identification.
 2. All pipe, conduits, etc , shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing.
 3. All ducts, pipes and conduits run exposed in machinery and equipment rooms shall be installed parallel to the building lines, except that piping shall be sloped to obtain the proper pitch.
 4. Piping, ducts and conduits run in furred ceilings, etc., shall be similarly installed, except as otherwise shown All pipe openings shall be kept closed until the systems are closed with final connections.
 5. All piping not directly buried in the ground shall be considered as "interior piping."
 6. Prior to the installation of any ceiling material, gypsum, plaster, or acoustical board, the Contractor shall notify the construction inspector so that arrangement can be made for an inspection of the above ceiling area about to be "sealed" off.
 - a. The Contractor shall give as much advance notice as possible but no less than 10 working days.
 7. All above ceiling areas will be subject to a formal inspection before ceiling panels are installed, or installation is otherwise concealed from view.
 - a. All mechanical work at and above the ceiling, including items supported by the ceiling grid, such as air inlets or outlets, shall be complete and installed in accordance with contract requirements, including power to fans and other powered items.
 - b. Adequate lighting shall be provided to permit thorough inspection of all above-ceiling items.
 - c. The inspection will include representatives of the following: General Contractor and each Subcontractor having work above the ceiling, Facilities Management, Architect/Engineer, and the Resident Construction Manager`s Construction Inspector Areas to be included and time of inspection shall be coordinated with the Construction Inspector.
 - d. The purpose of this inspection is to verify the completeness and quality of the installation of the air conditioning systems, the electrical systems, the plumbing systems, and any other special above ceiling systems such as pneumatic tube, vacuum systems, fire sprinkler piping and cable tray systems.
 - e. The ceiling supports (tee bar or metal framing) shall be in place so that access panel and light fixture locations are identifiable and so that clearances and access provisions may be evaluated.
 - f. No ceiling materials may be installed until the resulting deficiency list from this inspection is worked off and the Construction Inspector has given approval.
 8. Proper accessibility to equipment may be required to be demonstrated by the commissioning agent or inspector.
- 3.4 CONNECTIONS FOR OTHERS
- A. The Contractor shall rough in for and make all gas, water, steam, sewer, etc. connections to all fixtures, equipment, machinery, etc., provided by others in accordance with detailed roughing-in Drawings

provided by the equipment suppliers, by actual measurements of the equipment connections, or as detailed.

- B. After the equipment is set in place, the Contractor shall make all final connections and shall provide all required pipe, fittings, valves, traps, etc.
- C. Shutoff Valves: In each service line connected to an item of equipment or piece of machinery, provide a shutoff valve.
- D. Traps: On each drain not provided with a trap, provide a suitable trap.
- E. Provide all air gap fittings required, using materials hereinbefore specified. In each service line connected to an item of equipment or piece of machinery, provide a shutoff valve. On each drain not provided with a trap, provide a suitable trap.
- F. All pipe fittings, valves, traps, etc , exposed in finished areas and connected to chrome plated lines provided by others shall be chrome plated to match.
- G. Provide all sheet metal ductwork, transition pieces, etc , required for a complete installation of vent hoods, fume hoods, etc , provided by others.

3.5 CUTTING AND PATCHING

- A. General: Cut and patch walls, floors, etc , resulting from work in existing construction or by failure to provide proper openings or recesses in new construction.
- B. Methods of cutting:
 - 1. Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to the Architect/Engineer.
 - 2. Impact-type equipment shall not be used except where specifically acceptable to the Architect/Engineer. Openings in precast concrete slabs for pipes, conduits, outlet boxes, etc., shall be core drilled to exact size.
- C. Restoration: All openings shall be restored to "as-new" condition under the appropriate Specification Section for the materials involved, and shall match remaining surrounding materials and/or finishes.
- D. Masonry:
 - 1. Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry.
 - 2. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation.
 - 3. All structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to the Architect/Engineer.
- E. Plaster:
 - 1. All mechanical work in areas containing plaster shall be completed prior to the application of the finish plaster coat.
 - 2. Cutting of finish plaster coat will not be permitted.
- F. Special Note: No cutting, boring, or excavating which will weaken the structure shall be undertaken.
 - 1. Rebar placement shall be determined prior to floor coring operations.
 - 2. Any rebar, which has been cut, shall be submitted in writing to the Architect/Engineer for evaluation.

3.6 ROOF PENETRATIONS AND FLASHING

- A. Pipe, conduit and duct sleeves, pitch pockets, and flashings compatible with the roofing installation shall be provided and installed by a qualified contractor for all roof penetrations.
- B. This shall be the responsibility of the General Contractor.

3.7 OPERATION PRIOR TO COMPLETION

- A. When any piece of mechanical equipment is operable and it is to the advantage of the Contractor to operate the equipment, they may do so, providing they properly supervises the operation, and has the Construction Inspector's written permission to do so.
- B. The warranty period shall not commence until such time as the equipment is operated for the beneficial use of the Owner, or date of substantial completion, whichever occurs first.
- 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 deficiency list items before final acceptance by the Owner.
 - 1. The date of acceptance and performance certification will be the same date.

- D. Air handling equipment shall only be operational with all specified filter media in place and additional filter media in place to prevent dust from entering the return and exhaust air systems.
- E. Additional requirements for operation of equipment prior to completion found in the commissioning sections of Division 1 and Division 23 shall be followed.

3.8 CLEANING AND PAINTING

- A. All equipment, piping, conduit, ductwork, grilles, insulation, etc , furnished and installed in the tunnel and mechanical rooms under Division 23 of these Specifications and as hereinafter specified shall be cleaned, prepared, and painted according to the following specification. Color of finish painting in Mechanical Rooms shall be painted in accordance with Color Schedule for machinery spaces using Sherwin Williams paint numbers, or approved equivalent.
 - 1. In the event of a conflict between the specifications referenced, the provisions of this specification shall prevail only for Divisions 22, 23 and 26 work.
 - 2. UTSW Approved paint colors: Refer to Section 23 05 53 - Mechanical Identification.
 - 3. Paint Specification: Refer to Section 09 96 00 - High-Performance Coatings.
 - 4. Natural gas piping shall be painted in its entirety.
- B. All equipment furnished by the mechanical and electrical subcontractors shall be delivered to the job with a suitable factory protective finish and shall be painted, after installation, with the color hereinafter specified.
- C. The following materials shall not be painted:
 - 1. Materials: copper, galvanized metal, stainless steel, fiberglass, PVC, and PVDF.
 - 2. Aluminum jacketing on insulation.
 - 3. Nameplates on equipment shall be protected during painting to prevent damage.
- D. Before painting, materials and equipment surfaces shall be thoroughly cleaned of cement, plaster, and other foreign materials, and all oil and grease spots shall be removed.
 - 1. Such surfaces shall be carefully wiped and all cracks and corners scraped out.
 - 2. Exposed metal work shall be carefully brushed down with the steel brushes to remove rust and other spots and left smooth and clean.
- E. For painting purposes, the equipment and piping inside of built-up air handling units shall be painted the same as if they were within the walls of a Mechanical Room.
- F. Scope of painting for Division 23 work in areas other than those defined as "exposed" is as follows:
 - 1. Underfloor spaces:
 - a. All uncovered steel pipe, supports, exposed pipe and hanger rod threads, and hangers shall be cleaned and painted with two coats of black asphaltic emulsion.
 - b. Galvanized steel and copper lines shall not be painted.
 - 2. Concealed spaces:
 - a. All canvas finishes shall be painted with one sizing coat if not already sized, containing mildew resistant additive and adhesive prior to any other specified finish paint.
 - 3. If insulated, the piping shall be primed, only, prior to insulation, and the insulation jacketing shall be painted as specified for piping The requirements of this paragraph are "primary" and have priority over any conflicting specification or instruction, should a conflict in the Construction Documents exist.
- G. In addition to painting in mechanical rooms, materials, piping, ductwork, conduit, gear, supports, foundations, equipment, and appurtenances installed by the mechanical and electrical subcontractors in exposed areas shall be finish painted with two coats enamel paint of color selected by the Architect/Engineer, refer to Section 09 96 00 - High-Performance Coatings.
- H. Additional areas to be defined as "exposed" for purposes of painting, are defined on the Drawings.
- I. The surfaces to be finish painted shall first be prepared as follows:
 - 1. On canvas finishes pretreated as specified above.
 - 2. Insulated surfaces having vapor barrier jacket exposed to view shall first be painted with one (1) coat of sealer.
 - 3. Galvanized and black steel surfaces shall first be painted with one (1) coat of P&L galvanized metal primer. Primer may be eliminated on concealed fire and gas piping.
 - 4. Aluminum surfaces shall first be painted with one (1) coat of P&L zinc chromate primer.
 - 5. Cast iron pipe shall first be primed with a "non bleed" primer.

- 6. The underside of all cast iron sinks not recessed in a cabinet are included as items to be painted in exposed areas.
 - J. All ferrous metal surfaces without a protective finish and not galvanized in exposed and concealed areas including chases, under floor, and above ceilings shall be painted with 2 coats of P&L zinc chromate primer as the construction progresses to protect against deterioration.
- 3.9 CHECKING AND TESTING MATERIALS AND/OR EQUIPMENT
- A. Before the work is accepted, an authorized representative of the manufacturer of the installed materials and/or equipment shall personally inspect the installation and operation of materials and/or equipment to determine that it is properly installed and in proper operating order.
 - 1. The qualifications of the representative shall be appropriate to the technical requirements of the installation. The qualifications of the representative shall be submitted to the owner for approval.
 - 2. The decision of the Owner concerning the appropriateness of the representative shall be final.
 - 3. Testing and checking shall be accomplished during the course of the work where required by work being concealed, and at the completion of the work otherwise. In addition, the Contractor shall submit to the Architect/Engineer a signed statement from each representative certifying as follows:
 - a. "I certify that the materials and/or equipment listed below have been personally inspected by the undersigned authorized manufacturer's representative and is properly installed and operating in accordance with the manufacturer's recommendations"
 - B. Check inspections shall include plumbing equipment, electrical equipment, heating, air conditioning, insulation, ventilating equipment, controls, mechanical equipment and such other items hereinafter specified or specifically designated by the Owner or the Architect/Engineer.
 - C. Refer to the commissioning sections of Division 1 and Division 23 for additional start-up, testing, and acceptance requirements.
- 3.10 TESTS
- A. The Contractor shall make, at no additional cost to the Owner, any tests deemed necessary by the inspection departments having jurisdiction, and in the National Fire Protection Association, ASTM, etc. Standards listed.
 - 1. The Contractor shall provide all equipment, materials, and labor for making such tests.
 - 2. Reasonable amounts of fuel and electrical energy costs for system tests will be paid by the Owner.
 - 3. Fuel and electrical energy costs for system adjustment and tests which follow beneficial occupancy by the Owner will be borne by the Owner.
 - B. Additional tests specified hereinafter under the various Specification Sections shall be made.
 - C. The Construction Inspector shall be notified in writing at least 10 working days prior to each test and other Specification requirements requiring action on the part of the Construction Inspector.
 - 1. All equipment shall be placed in operation and tested for proper automatic control requirements before the balancing agency starts their work.
 - D. Maintain Log of Tests as hereinafter specified.
 - E. See Specifications for additional tests and requirements.
 - F. All testing reports shall be submitted to UTSW Facilities Management for review and approval.
- 3.11 LOG OF TESTS
- A. All tests shall have pertinent data logged by the Contractor at the time of testing.
 - 1. Data shall include date, time, personnel, description, and extent of system tested, test conditions, test results, specified results, and other pertinent data.
 - 2. Data shall be delivered to the Architect/Engineer and UTSW Facilities Management as specified under "Requirements for Final Acceptance" in Section 01 77 00 - Closeout Procedures and Submittals.
 - 3. All Test Log entries shall be legibly signed by the Project Contractor or the authorized job superintendent.
- 3.12 COOPERATION AND CLEANUP
- A. It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the job site in a clean and safe condition. At the end of each day's work, each trade shall properly store all tools, equipment and materials, and shall clean all debris from the job.
 - B. Upon the completion of the job, each trade shall immediately remove all tools, equipment, any surplus materials, and all debris caused by that portion of the work.

3.13 CLOSEOUT ACTIVITIES

- A. As part of project punch list requirements per Section 01 77 00 - Closeout Procedures and Submittals, include UTSW Utilities / Mechanical Shop, UTSW Controls / Utilities Operations, UTSW Electrical Shop, UTSW Building Maintenance, UTSW PM, Commissioning Agent (if applicable), and other associated teams for mechanical focused review.
- B. Provide revised Operation and Maintenance Data including final installed components schedule, maintenance manuals, and warranty documentation to UTSW PM and to UTSW Building Maintenance.

3.14 TRAINING

- A. Refer to Section 01 79 00 - Demonstration and Training as well as individual technical Sections for specific training requirements.
- B. Where training is called for in other sections provide a minimum of 8 hours on site training for Owner's representatives.
- C. Training shall be presented by a qualified instructor with training experience and technical knowledge of the product.
- D. Submit a training agenda, proposed date, and instructor qualifications to the Owner for approval.

END OF SECTION 23 00 00

SECTION 23 05 13

MOTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. High-efficiency TEFC, horizontal and vertical, single-speed, squirrel cage polyphase induction motors, up to and including 500 hp, in NEMA frame sizes 143T and larger for severe duty applications (commonly referred to as severe duty motors).

1.3 RELATED REQUIREMENTS

- A. Section 01 79 00 - Demonstration and Training.
- B. Section 23 00 00 - UTSW Mechanical Design Requirements.
- C. Section 23 82 19 - Fan Coil Units.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings.
- C. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings.
- D. IEEE 112 - IEEE Test Procedure for Polyphase Induction Motors and Generators.
- E. NEMA MG 1 - Motors and Generators.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 SUBMITTALS

- A. Submit product data under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
- B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
- C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.
- D. Submit manufacturer's installation instructions under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
- E. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
- B. Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture of electric motors for intended use, and their accessories, with minimum five years documented product development, testing, and manufacturing experience.
- B. Comply with NFPA 70.
- C. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of high efficiency motors.
- D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.8 REQUIREMENTS

- A. IEEE Standard for Petroleum and Chemical Industry Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors up to and Including 500 HP.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
- B. Store and protect products under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
- C. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.10 WARRANTY

- A. Provide five-year manufacturer's warranty under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
- B. Warranty: Provide five year manufacturer warranty for motors larger than 1 horsepower.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Toshiba.
- B. Baldor Electric Company/ABB Group.
- C. US Motors.
- D. General Electric.

2.2 GENERAL CONSTRUCTION REQUIREMENTS

- A. Electrical Service: Refer to Drawing Schedules for required electrical characteristics.
- B. Motors: Design for continuous operation in 40 degrees C environment, a service factor of 1 15
- C. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, Service Factor, Power Factor, efficiency.
- D. Electrical Connection: Conduit connection boxes, threaded for conduit For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.
- E. In addition, all motors shall be provided with adequately sized electrical connection box with threaded hub for attachment of flexible conduit, unless bus duct connection is indicated.
- F. Where motors are connected to driven equipment by the use of a V-belt drive, they shall be furnished with adjustable rails.
- G. Single phase motors, in general, shall be less than 3/4 horsepower and shall be 120 or 208 volt, 60-hertz motors.
 - 1. These motors shall have built-in thermal overload protection with automatic reset, and shall be rated for temperature rise as hereinbefore specified for 3-phase motors.
- H. Efficiency: NEMA Premium.

2.3 STARTING EQUIPMENT

- A. Each motor shall be provided with proper starting equipment.
 - 1. The trade furnishing the motor, unless hereinafter specified or scheduled to the contrary, shall provide this equipment.
 - 2. All motor starting equipment provided by any one trade shall be of the same manufacture unless such starting equipment is an integral part of the equipment on which the motor is mounted.
 - 3. The Mechanical Subcontractor shall furnish all starters for Division 23 work, except those starters scheduled to be provided in Section 26 24 19 - Motor Control Centers.
- B. Motor starters shall conform to NEMA Standards for Industrial Control, #IC-1, latest issue, and shall be housed in NEMA Standard enclosures.
- C. Control voltage in each starter shall be either 24V or 120 volts to ground (as required), with an individual control transformer provided in each starter as required.
- D. Manual starters for fractional horsepower single phase motors shall be on-off or snap switch type combined with thermal overload device.
- E. The switch shall be so constructed so that it cannot be held closed under a sustained motor overload.
- F. Magnetic starters shall have thermal overload protection in each of the ungrounded legs and shall be solenoid operated.

- G. Provide the correct size heater element to protect the motor and allow it to operate based on motor nameplate amperes and ambient temperatures anticipated for each individual motor.
- H. Each starter shall be provided with a control power transformer or 120v control power circuit.
- I. Pushbuttons with or without pilot lights, hand-off-automatic switches and other scheduled apparatus shall be standard duty type mounted in NEMA enclosures or in cover of starter as specified or scheduled, and shall be furnished by the trade furnishing the starter except as specifically indicated elsewhere.
- J. Hand-Off-Automatic switches for equipment that could damage itself if left in the "hand" position (such as sump pumps), shall be spring return to "off" from the "hand" position.
- K. Motor bearings shall meet requirements for bearings in applicable equipment sections.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Motors drawing less than 250 Watts and intended for intermittent service may be germane to equipment manufacturer and need not conform to these specifications.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION 23 05 13

SECTION 23 05 15

MECHANICAL PIPING, VALVES, AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. General requirements for all Mechanical piping systems. This section is supplemented by other sections with additional requirements and more detail on specific systems. In the case of conflict, the most stringent requirement will apply.

1.3 RELATED REQUIREMENTS

- A. Section 01 91 00 - General Commissioning Requirements.
- B. Section 23 00 00 - UTSW Mechanical Design Requirements.
- C. Section 23 05 16 - Piping Expansion Compensation.
- D. Section 23 05 29 - Supports and Anchors.
- E. Section 23 05 53 - Mechanical Identification.
- F. Section 23 21 13 - Hydronic Piping
- G. Section 23 21 15 - Hydronic Specialties

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. AGA – American Gas Association.
- C. ASME B31.1 - Power Piping.
- D. ANSI B31.2 – Fuel Gas Piping.
- E. ASME B31.4 – Liquid Petroleum Transportation Systems.
- F. ASME B31.9 – Building service Piping.
- G. ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.
- H. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.
- I. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
- J. AWS A5.8/A5.8M - Brazing Filler Metal.
- K. AWS D1.1/D1.1M - Structural Welding Code.
- L. AWWA C105/A21.5 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
- M. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings.
- N. ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- O. ASTM A234/A234M - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- P. ASTM B32 - Standard Specification for Solder Metal.
- Q. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- R. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- S. ASTM D2235 - Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
- T. ASTM D2680 - Acrylonitrile-Butadiene-Styrene (ABS) Composite-Sewer Piping.
- U. ASTM D2683 - Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
- V. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

1.5 SUBMITTALS

- A. Submit product data under provisions of Division 01 and Section 23 00 00 - UTSW Mechanical Design Requirements.

1. Include data on pipe fittings, valves, and accessories.
 2. Provide manufacturer's catalog information. Indicate valve rating and data.
- B. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.
- 1.6 QUALITY ASSURANCE
- A. Valves: Manufacturer's name and pressure rating marked on valve body.
 - B. Welding Certificates, Materials and Procedures: Conform to ANSI/ASME SEC 9 and applicable state labor regulations.
 1. Welders Certification: In accordance with ASME Section 9.
 - C. Maintain one copy of the above listed documents on site for inspection.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to site under provisions of Division 01 and Section 23 00 00 - UTSW Mechanical Design Requirements.
 - B. Store and protect products under provisions of Division 01 and Section 23 00 00 - UTSW Mechanical Design Requirements.
 - C. Deliver and store valves in shipping containers with labeling in place.

PART 2 - PRODUCTS

2.1 VALVES

- A. Locate valves so removal of bonnets is possible.
- B. Ball valves shall not be used for steam or steam condensate service.
- C. Steam blowdown valves shall be gate valves with plugs.
- D. All flanged valves shown in horizontal lines with the valve stem in a horizontal position shall be positioned so that the valve stem is inclined one bolt hole above the horizontal position. Screw pattern valves placed in horizontal lines shall be installed with their valve stems inclined at an angle of a minimum of 30 degrees above the horizontal position. When installation configuration does not allow any other orientation except horizontal stem, valves with stem in horizontal position shall be drilled and tapped in accordance with MSS-SP-45 at Boss G to accommodate a drain valve.
- E. All valves must be true and straight at the time the system is tested and inspected for final acceptance. Valves shall be installed as nearly as possible to the locations indicated in the Construction Drawings. Any change in valve location must be so indicated on the Record Drawings.
- F. All valves must be of threaded or flanged type. No solder connected or grooved fitting valves shall be used on this project.
- G. All bronze and iron body gate and globe valves shall be the product of one manufacture for each project. Manufacturers of other types may not be mixed on the same project; i.e., all butterfly valves shall be of the same manufacture, all ball valves shall be of the same manufacture, etc.
- H. All valves used in circulating systems, plumbing shall be Class 150 SWP.
- I. All steam and steam condensate valves shall be carbon steel, Class 300 gate valves.
- J. Class 300 valves shall be constructed of all ASTM B61 composition.
- K. All gate, globe and angle valves shall be union or screw-over-bonnet design. Metal used in the stems of all bronze gate, globe and angle valves shall conform to ASTM B371 Alloy 694, ASTM B99 Alloy 651, or other corrosion resistant equivalents. Written approvals must be secured for the use of alternative materials.
- L. All iron body valves shall have the pressure containing parts constructed of ASTM designated of 126 class B iron. Stem material shall meet ASTM B16 Alloy 360 or ASTM 371 Alloy 876 silicon bronze or its equivalent.
- M. Gates and globes shall be bolted bonnet with OS&Y (outside screw and yoke) and rising stem design. A lubrication fitting is preferred on yoke cap for maintenance lubrication of the yoke bushing. Gate and globe valves shall be bolted bonnet outside and screw and yoke design with pressure-temperature rating conforming to ANSI B16-34-1977. Stems shall meet ASTM designation A-186-F6 chromium stainless steel.
- N. Wedge (gate valves) may be solid or flexible type and shall meet ASTM A-182-F6 chromium stainless steel on valves from 2 to 6 inches. Sizes 8 inches and larger may be A-216-WCB with forged rings or

overlay equal to 182-F6. Seat ring shall be hard faced carbon steel or 13 percent chromium A-182-F6 stainless. Handwheels shall be A47 Grade 35018 malleable iron or Ductile Iron ASTM A536.

- O. All cast steel body valves shall have the pressure containing parts constructed of ASTM designation A-216-GR-WCB carbon steel.
- P. All forged steel body valves shall have the pressure containing parts constructed of ASTM 105, Grade 2 forged carbon steel. Seat and wedges shall meet ASTM A-182-F6 chromium stainless steel. Seat rings shall be hard faced. Valves shall conform to ANSI B16-34 pressure-temperature rating.
- Q. All valves shall be repackable, under pressure, with the valve in the full open position. Packing for all valves shall be free of asbestos fibers and selected for the pressure-temperature service of the valve. It is incumbent upon the manufacturer to select the best quality, standard packing for the intended valve service. At the end of one year, period spot checks will be made, and should the packing show signs of hardening or causing stem corrosion then all valves supplied by the manufacturer shall be repacked by the Contractor, at no expense to the Owner, with a packing material selected by the Owner.
- R. All gate valves, globe valves, angle valves and shutoff valves of every character shall have malleable iron hand wheels, except iron body valves 2-1/2 inch and larger which may have either malleable iron or ASTM A-126 Class B, gray iron hand wheels.

2.2 BALANCING AND/OR SHUTOFF VALVES FOR CLOSED WATER CIRCULATING SYSTEMS:

- A. Two inches and smaller, three piece bronze body, bronze or stainless steel ball and stem, Teflon seats, packing and gasket, bronze gland follower, adjustable stuffing box, steel lever type handle, with plastic operating handle, quarter turn stops, and shall be class 150. Manufacturer shall certify ball valves for use in throttling service. Stem extensions shall be furnished for use in insulated lines.
- B. Valves 2-1/2 inch and larger shall be tapped full lug butterfly valves with aluminum bronze discs of ASTM B148 Alloy C955 and 316, 416, or 420 stainless steel shafts. Design must incorporate bushing between shafts and body of material suitable to provide a bearing surface to eliminate seizing or galling. Valve must be capable of providing a bubble tight seal at 200 psi for valves up to 12 inch (150 psi for larger valves) when used for end of line service without requiring the installation of a blind flange on the downstream side. Liners shall be resilient material suitable for 225°F temperature and bodies of ductile iron.
- C. Butterfly valves 8 inch and larger and butterfly valves used for balancing service or control, regardless of size, shall have heavy duty weather proof encased gear operators, with malleable iron handwheel. Valves 2-1/2 inch through 6 inch shall have lever handles which can be set in interim positions between full open and full closed. All butterfly valves shall be absolutely tight against a pressure differential of 150 psi.
- D. Check Valves: Bronze body, 2 inch and smaller, bronze body regrinding disc and seat with screw-in cap. Iron body, 2-1/2 inch and larger, bronze disc and seat or non slam wafer type with stainless pins and springs, and bronze plate. Forged steel lift check valves, 2 inch and smaller shall be bolted cap and body, screwed end connections and conform to ANSI B16.34 and pressure temperature rating.

2.3 STRAINERS

- A. Strainers, 2 inch and smaller, bronze body, screwed ends, No 10 mesh strainer, screwed cap with bronze blow-off valve (size to be determined by standard tap size in cap)
 - 1. Strainers shall have drain port with isolation ball valve and cap.
 - 2. Cast iron body, 2-1/2 inch and larger, isolating type flanged ends where installed in copper lines, No 7 perforated monel strainer, flanged cap with bronze ball blow-off valve (size of blow-off valve shall be determined by standard tap size in cap).
 - 3. Special Note: All strainers 6 inch and larger shall have studs mounted in the body flange in lieu of bolts for removal of cap Baskets for strainers 6 inch and larger shall have stainless steel reinforcing bands at ends to prevent collapsing.
- B. Suction diffusers shall be Paco or approved equal, cast iron body and cover, steel diffuser, and stainless steel strainer, 125 pound ASA (flat face) flange for a working pressure of 175 psi and temperature of 300°F.

2.4 UNIONS

- A. Provide and install unions at proper points to permit removal of pipe and various equipment and machinery items without injury to other parts of the system.

1. No unions will be required in welded lines or lines assembled with solder joint fittings except at equipment items, machinery items and other special pieces of apparatus.
 2. Unions in 2 inch and smaller in ferrous lines shall be Class 300 AAR malleable iron unions with iron to brass seats, and 2-1/2 inch and larger shall be ground flange unions.
 3. Unions in copper lines shall be Class 125 ground joint brass unions or Class 150 brass flanges if required by the mating item of equipment.
 4. Companion flanges on lines at various items of equipment, machines and pieces of apparatus shall serve as unions to permit removal of the particular items.
 5. See particular Specifications for special fittings and pressure.
- B. Unions connecting ferrous pipe to copper or brass pipe shall be dielectric type equal to Epco.
- C. In all domestic water lines where the material of the pipe is changed from ferrous to copper or brass, a dielectric coupling shall be used at the transition.

2.5 WELDED PIPING

- A. Scope:
1. This section applies to all piping systems providing for welded piping, fittings, and other appurtenances.
 2. Specific systems requiring welded piping include, but are not limited to: chilled water, steam, steam condensate, and fire protection systems.
- B. Materials:
1. Weld fittings shall be USA factory made wrought carbon steel butt-welding fittings conforming to ASTM A234 and ASME/ANSI B16 9, latest edition, as made by Weld Bend, Tube Turn, Hackney, or Ladish Company.
 2. Each fitting shall be stamped as specified by ASME/ANSI B16 9 and, in addition, shall have the laboratory control number metal stenciled on each fitting for ready reference as to physical properties required for any fittings selected at random.
 3. Only one manufacturer of weld fittings will be approved for the project.
 4. Fittings which have been machined, remarked, printed or otherwise produced domestically from nondomestic forgings or materials will not be acceptable Each in accordance with MSS SP-25.
 5. Markings shall be placed on the fittings at the farthest point from the edge to be welded to prevent disfiguring from the welding process.
 6. Submittal data for these fittings shall include a letter signed by an official of the manufacturing firm certifying compliance with these specifications.
- C. Execution:
1. Piping and fittings shall be welded and fabricated in accordance with ASME/ANSI the latest editions of Standards B31 1 for all systems, and B31 3 for Steam and Condensate systems, from the Code for Pressure Piping Machine beveling in shop is preferred Field beveling may be done by flame cutting to recognized standards.
 2. Contractor shall ensure complete penetration of deposited metal with base metal.
 - a. Contractor shall provide filler metal suitable for use with base metal Contractor shall keep inside of fittings free from globules of weld metal.
 - b. All welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process.
 - c. All pipe shall have the ends beveled 37-1/2 degrees and all joints shall be aligned true before welding.
 - d. Except as specified otherwise, all changes in direction, intersection of lines, reduction in pipe size and the like shall be made with factory-fabricated welding fittings.
 - e. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction will not be permitted.
 3. Contractor shall align piping and equipment so that no part is offset more than 1/16 inch Set all fittings and joints square and true, and preserve alignment during welding operation Use of alignment rods inside pipe is prohibited.
 4. Contractor shall not permit any weld to project within the pipe so as to restrict it Tack welds, if used, must be of the same material and made by the same procedure as the completed weld Otherwise, remove tack welds during welding operation.

5. Contractor shall not split, bend, flatten or otherwise damage piping before, during or after installation.
 6. Contractor shall remove dirt, scale and other foreign matter from the inside of piping, by swabbing or flushing, prior to the connection of other piping sections, fittings, valves or equipment.
 7. In no cases shall Schedule 40 pipe be welded with less than three passes including one stringer/root, one filler and one lacer. Schedule 80 pipe shall be welded with not less than four passes including one stringer/root, two filler and one lacer. In all cases, however, the weld must be filled before the cap weld is added.
- D. Testing:
1. All welds are subject to inspection, visual and/or Xray, for compliance with specifications
 - a. The owner will, at the Owner's option, provide employees or employ a testing laboratory for the purposes of performing said inspections and/or Xray testing. Initial visual and Xray inspections will be provided by the owner.
 - b. The contractor shall be responsible for all labor, material and travel expenses involved in the re-inspection and retesting of any welds found to be unacceptable.
 - c. In addition, the contractor shall be responsible for the costs involved in any and all additional testing required or recommended by ASME/ANSI Standards B31.1 and B31.3 due to the discovery of poor, unacceptable or rejected welds.
 2. Welds lacking penetration, containing excessive porosity or cracks, or are found to be unacceptable for any reason, must be removed and replaced with an original quality weld as specified herein. All qualifying tests, welding and stress relieving procedures shall, moreover, be in accord with Standard Qualification for Welding Procedures, Welders and Welding Operators, Appendix A, Section 6 of the Code, current edition.
- E. All weld fittings shall be USA factory made wrought carbon steel butt welding fittings conforming to ASTM Spec A234 and ANSI standard B16.9-1964 as made by Grinnell, Tube Turn, Hackney, Taylor Forge, or Ladish Company.
1. Each fitting shall be stamped as specified by ANSI B16.9 and, in addition, shall have the laboratory control number metal stenciled on each fitting for ready reference as to physical properties and chemical composition of the material.
 2. Complete test reports may be required for any fittings selected at random.
 3. Only one manufacturer of weld fittings will be approved for each project.
 4. Fittings which have been machined, remarked, printed or otherwise produced domestically from imported forgings or materials will not be acceptable.
 5. Each fitting shall have the manufacturer's trademark permanently identified in accordance with MSS SP-25.
 6. Markings shall be placed on the fittings at the farthest point from the edge to be welded to prevent disfiguring from the welding process.
 7. Submittal data for these fittings shall include a letter signed by an official of the manufacturing firm certifying compliance with these Specifications.

2.6 FLANGES

- A. 150 lb and 300 lb ANSI flanges shall be weld neck and shall be domestically manufactured, forged carbon steel, conforming to ANSI B16.5 and ASTM A-181 Grade I or II or A-105-71 as made by Tube Turn, Hackney or Ladish Company.
1. Slip on flanges shall not be used. Each fitting shall be stamped as specified by ANSI B16.9 and, in addition, shall have the laboratory control number stenciled on each fitting for ready reference as to physical properties and chemical composition of the material.
 2. Complete test reports may be required for any fitting selected at random.
 3. Flanges which have been machined, remarked, painted or otherwise produced domestically from imported forges will not be acceptable.
 4. Flanges shall have the manufacturer's trademark permanently identified in accordance with MSS SP-25.
 5. Contractor shall submit data for firm certifying compliance with these Specifications. Bolts used shall be carbon steel bolts with semi-finished hexagon nuts of American Standard Heavy dimensions.
 6. Thread rods are not acceptable for flange bolts.
 7. Bolts shall have a tensile strength of 60,000 psi and an elastic limit of 30,000 psi.

8. Flat faced flanges shall be furnished where required to match flanges on pumps, check valves, strainers, etc.
 9. Only one manufacturer of weld flanges will be approved for each project.
- B. All flanges shall be gasketed.
1. Contractor shall place gasket between flanges of flanged joints.
 2. Gaskets shall fit within the bolt circle on raised face flanges and shall be full face on flat face flanges.
 3. Gaskets shall be cut from 1/16 inch thick, non metallic, non asbestos gasket material suitable for operating temperatures from -150°F to +750°F, Klingerseal C-4400, Manville Style 60 service sheet packing, or equivalent.

2.7 BACKFLOW PREVENTERS

- A. Backflow preventers (BFP) shall be reduced pressure type, Febco 825, or approved equal. A BFP shall be installed to isolate all non-potable water requirements from the building domestic water system. (All BFP's shall be installed within the building).

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends, remove burrs, and bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. After completion, fill, clean, and treat systems.

3.2 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.
- B. Install piping to conserve building space, and not interfere with use of space and other work.
- C. Group piping whenever practical at common elevations.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- E. Provide clearance for installation of insulation, and access to valves and fittings.
- F. Provide access where valves and fittings are not exposed.
- G. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- I. Prepare pipe, fittings, supports, and accessories for finish painting. Refer to Section 09 96 00 - High-Performance Coatings.
- J. Install valves with stems upright or horizontal, not inverted.
- K. Locate valves in readily accessible areas and where valve operation will not damage other components, materials, or devices.

3.3 FABRICATION OF PIPE

- A. Piping systems shall be made up straight and true and run at proper grades to permit proper flow of the contained material. Lines shall also be graded for proper drainage.
- B. Piping shall follow as closely as possible the routes shown on Drawings which take into consideration conditions to be met at the site.
 1. Should any unforeseen conditions arise, lines shall be changed or rerouted as required after proper approval has been obtained.
- C. All piping shall be installed with due regard to expansion and contraction and so as to prevent excessive strain and stress in the piping, in connections, and in equipment to which the lines are connected.
- D. All piping shall be clean when it is installed. Before installation it shall be checked, upended, swabbed, if necessary, and all rust or dirt from storage or from lying on the ground shall be removed.
- E. Procedure of Assembling Screw Pipe Fittings:
 1. All screw joints shall be made with taper threads, properly cut.
 2. Joints shall be made tight with Teflon applied to the pipe threads only and not to fittings.
 3. When threads are cut on pipes, the ends shall be carefully reamed to remove any burrs.

4. Before installing pipe that has been cut and threaded, the lengths of pipe shall be upended and hammered to remove all shavings and foreign material.
- F. Procedure for Assembling Other Joints:
1. Procedures for assembling joints in cast iron and copper lines have been set forth elsewhere in these Specifications.
 2. For any special materials, consult the manufacturers for the recommended procedures in assembling the joints.

3.4 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
- D. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- E. Install ball valves for throttling, bypass, or manual flow control services.
- F. Provide spring loaded check valves on discharge of condenser water pumps. Provide non-slam or other system-appropriate check valves on all other pumps.
- G. Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.
- H. Use butterfly valves interchangeably with gate and globe valves.
- I. Use only butterfly valves in chilled and condenser water systems for throttling and isolation service.
- J. Use lug end butterfly valves to isolate equipment.
- K. Provide 3/4 inch (20 mm) ball drain valves at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

3.5 PIPE PRESSURE TESTS

- A. The following lines shall be tested at the stated pressure for the length of time noted:

<u>Line</u>	<u>TestingMedium</u>	<u>Testing Pressure(PSIG)</u>	<u>Time in Hours</u>
Chilled Water	Water	1.5x working pressure	24
Steam M.P. & L.P.	Water	1.5x working pressure	24
Steam Condensate M.P.	Water	1.5x working pressure	24
Pumped Condensate Return	water	1.5x working pressure	24

- B. Where leaks occur, the pipe shall be repaired and the tests repeated. No leaks shall be corrected by peening. Defective piping and joints shall be removed and replaced.

END OF SECTION 23 05 15

SECTION 23 05 16

PIPING EXPANSION COMPENSATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Flexible pipe connectors.
- B. Expansion joints and compensators.
- C. Pipe loops, offsets, and swing joints.

1.3 RELATED REQUIREMENTS

- A. Section 23 00 00 - UTSW Mechanical Design Requirements

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 SUBMITTALS

- A. Submit under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
- B. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- C. Design Data: Submit calculations for the sizing of expansion loops and selection of expansion joints.
- D. Shop Drawings:
 - 1. Submit shop drawings indicating the exact location and calculated axial and lateral loads for all anchors, guides, expansion joints and loops.
 - 2. Provide drawings indicating the proposed method of attachment to the building structure.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and external controls.
- F. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
- B. Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
- B. Maintenance Data: Include adjustment instructions.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Design expansion compensating system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State of Texas.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
- B. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact Inspect for damage.

- C. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.10 WARRANTY

- A. Provide five year warranty.
- B. Warranty: Include coverage for leak free performance of packed expansion joints.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.
- B. Expansion Calculations:
 - 1. Installation Temperature: 50 degrees F.
 - 2. Chilled Water: 120 degrees F.
 - 3. Steam: 450 degrees F.
 - 4. Steam Condensate: 250 degrees F.
 - 5. Domestic Hot Water: 140 degrees F.
 - 6. Safety Factor: 30 percent.

2.2 ACCEPTABLE MANUFACTURERS

- A. Microflex, Inc.
- B. Amber Booth Company.
- C. The Metroflex Company.
- D. ADSCO Manufacturing Corporation.
- E. Substitutions: Under provisions of Section 01 60 00 - Product Requirements.

2.3 FLEXIBLE PIPE CONNECTORS

- A. Steel Piping :
 - 1. Inner Hose: Stainless Steel.
 - 2. Exterior Sleeve: Double braided stainless steel.
 - 3. Pressure Rating: 200 psig WOG and 250 degrees F.
 - 4. Joint: As specified for pipe joints.
 - 5. Size: Use pipe sized units.
 - 6. Maximum offset: 3/4 inch on each side of installed center line.

2.4 EXPANSION JOINTS

- A. Stainless Steel Bellows Type:
 - 1. Pressure Rating: 200 psig WOG and 250 degrees F.
 - 2. Joint: As specified for pipe joints.
 - 3. Size: Use pipe sized units.
 - 4. Application: Steel piping 3 inch and under.
- B. Externally-Internally Guided (Slip Joint) Piston-Ring Type:
 - 1. Pressure Rating: 300 psig steam and 800 degrees F.
 - 2. Joint: Flanged.
 - 3. Size: Use pipe sized units.
 - 4. Accessories: Internal flow liner.
 - 5. Application: Steel piping over 3 inch.

2.5 ACCESSORIES

- A. Pipe Alignment Guides: Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inch travel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Construct spool pieces to exact size of flexible connection for future insertion.

- C. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.
 - D. Install flexible connectors at right angles to displacement.
 - 1. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
 - E. Rigidly anchor pipe to building structure where necessary.
 - F. Provide pipe guides so movement is directed along axis of pipe only.
 - G. Erect piping such that strain and weight is not on cast connections or apparatus.
 - H. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where indicated.
- 3.2 MANUFACTURER`S FIELD SERVICES
- A. Prepare and start systems under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
 - B. Provide inspection services by flexible pipe manufacturer`s representative for final installing and certify installation is in accordance with manufacturer`s recommendations and connectors are performing satisfactorily.

END OF SECTION 23 05 16

SECTION 23 05 19

METERS AND GAUGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Pressure gages and pressure gage cocks.
- B. Thermometers and thermometer wells.
- C. Pressure/temperature test plugs.
- D. Ultrasonic flow meters used for balancing.

1.3 RELATED REQUIREMENTS

- A. Section 23 00 00 - UTSW Mechanical Design Requirements.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ASME B40.100 - Gages - Pressure Indicating Dial Type - Elastic Element.
- C. ASTM E1 - Specification for ASTM Thermometers.
- D. ASTM E77 - Verification and Calibration of Liquid-in-Glass Thermometers.
- E. UL 404 - Gages, Indicating Pressure, for Compressed Gas Service.

1.5 SUBMITTALS

- A. Submit under provisions of Division 1 and Section 23 00 00 - UTSW Mechanical Design Requirements.
- B. Product Data: Include list for every meter and gauge to be provided which indicates use, operating range, total range, and location.
- C. Samples: Submit one of each type of instrument specified upon request by Engineer.
- D. Submit manufacturer's installation instructions.
- E. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit record documents under provisions of Division 01 and Section 23 00 00 - UTSW Mechanical Design Requirements.
- B. Accurately record actual locations of meters and gauges.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 - PRODUCTS

2.1 GAUGES AND GAUGE CONNECTIONS

- A. Pressure Gauges and Accessories: Provide Ashcroft gauges or approved equal, complete with lever handle shut-off cocks, and pulsation piston type dampeners, or approved equal Porous type dampeners will not be accepted. Gauges shall have stainless steel movement and 1/2 of 1% accuracy. Gauges shall have back connection when used on a panel; otherwise they shall have bottom connections.
- B. Pressure Gauge Connections: Provide where noted or indicated on the Drawings or called for elsewhere in the Specifications, gauge connections complete with lever handle union shutoff cocks, or approved equal. All gauge connections shall be made up with brass pipe, nipples and brass screw fittings.
- C. Siphon: Brass, 1/4 inch angle or straight pattern. Model SY14b manufactured by Weiss.
- D. Pressure Test Tap: 1/4 inch full port brass ball valve, 150 psig.

2.2 THERMOMETER AND THERMOMETER WELLS

- A. Provide thermometers of not less than 9 inch length scale complete with brass separable sockets (wells) with extension neck to allow for insulation of piping. These thermometers shall be mercury red reading type in one piece glass tubes extending from top of scale to sensor, and shall be located so that they may be easily read. Field adjustable angle thermometers are acceptable. Thermometers shall be Weksler Industrial Thermometers, or approved equal.
- B. Thermometer test wells shall be 3/4 inch Weksler Thermal Wells, brass with stem of minimum length to extend beyond the mid-diameter of the pipe, 2-1/2 inch extension neck, and brass screw plug. Wells shall be suitable for use of industrial type thermometers.
- C. All thermometers shall be easily read from floor and readily visible from floor.

2.3 PRESSURE TEMPERATURE TEST PLUGS

- A. Test Plug: 1/4 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe. Provide test plugs rated for 400 psig with neoprene core for temperatures up to 200 degrees F; and Nordel core for temperatures up to 350 degrees F and manufactured by Fairfax or approved equal.

2.4 ULTRASONIC FLOW MEASURING AND BALANCING SYSTEM (SUB-METERING)

- A. Furnish and install complete transit time Balance Master Metering systems manufactured by NuSonic. Flow elements shall be installed where indicated in the chilled water, heating water and condenser water systems in straight run of pipe in accordance to manufacturer's guidance for the specific installation in order to maintain rated accuracy.
- B. This shall be a coordinated system, including flow stations to work with a Portable Master Meter. Each flow station shall be complete with quick mount sensor carriers mounted in the 'transverse' arrangement, laminated or metal identification tag on chain giving pipe size, meter series, and station identification. Flow stations shall be of steel construction, welded in place.
- C. Furnish to the Owner a Master Meter mounted in a portable carrying case, complete with 2 (two) 6' (six foot) lengths of meter cable and attached meter sensors, and installation and operating instructions. Meter shall operate on both 115 VAC and self-contained battery pack (field selectable). Meter display shall be backlit LCO, indicating instantaneous flow rate in GPM. Meter full scale accuracy shall be 2% or better with a fluid operating range of 1-15 ft/sec. Meter shall have built-in automatic pipe size compensation. Meter shall have positive zero flow indication.
- D. Unit shall accommodate the following fluid operating ranges:
 1. Temperature: 36° to 250°F.
 2. Pressure: 0 to 150 psi.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Pressure gauges shall be provided on the suction and discharge of base mounted pumps as indicated on the Drawings.
- C. Single pressure gauges shall be installed on in-line pumps as indicated on the Drawings.
- D. Install pressure gages with pulsation dampers. Provide gage cock to isolate each gage. Provide siphon on gages in steam systems. Install thread-o-lets on piping for gage installation, do not weld nipple directly to pipe.
- E. Install thermometers in piping systems in thermometer wells. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets.
- F. Thermometer wells and thermometers shall be located where noted on the Drawings and where called for in other sections of the Specifications. Thermometer test wells only shall be installed in a vertical position in horizontal lines and at 45 degrees, in vertical lines to hold a fluid in the well.
- G. Locate pressure/temperature test plugs on the inlet and outlet of each heating coil in air terminal units, unit heaters, duct heating coils, etc. Mount short nipple with 1/4 inch ball valve. Place in accessible locations.

END OF SECTION 23 05 19

SECTION 23 05 29
SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Pipe and equipment hangers and supports.
- B. Equipment bases and supports.
- C. Sleeves and seals.
- D. Flashing and sealing equipment and pipe stacks.

1.3 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 22 11 16 - Plumbing Piping.
- C. Section 23 00 00 - UTSW Mechanical Design Requirements.
- D. Section 23 07 13 - Ductwork Insulation.
- E. Section 23 07 16 - Equipment Insulation.
- F. Section 23 07 19 - Piping Insulation.
- G. Section 23 21 13 - Hydronic Piping.
- H. Section 23 22 13 - Steam and Steam Condensate Piping.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ASME B31.1 - Power Piping.
- C. ASME B31.2 - Fuel Gas Piping.
- D. ASME B31.5 - Refrigeration Piping.
- E. ASME B31.9 - Building Services Piping.
- F. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
- G. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- H. NFPA 13 - Standard for the Installation of Sprinkler Systems.
- I. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.
- J. UL 203 - Standard for Pipe Hanger Equipment for Fire Protection Services.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Division 03 Concrete Sections.

1.6 SUBMITTALS

- A. Submit under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
- B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.

- C. Product Data: Provide manufacturers catalog data including load capacity.
- D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Manufacturer`s Installation Instructions: Indicate special procedures and assembly of components.
- F. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.7 REGULATORY REQUIREMENTS

- A. Conform to applicable code for support of plumbing, hydronic, steam and steam condensate piping.
- B. Supports for Sprinkler Piping: Shall be in conformance with NFPA 13.
- C. Supports for Standpipes: Shall be in conformance with NFPA 14.

PART 2 – PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Grinnell.
 - 2. Other acceptable manufacturers offering equivalent products.
- B. Supports, hangers, anchors and guides shall be provided for all horizontal and vertical piping.
 - 1. Shop Drawings shall be provided, indicating locations and details of anchors, guides, expansion loops and joints, hangers, etc.
 - 2. The hanger design shall conform to the ASME Code for Pressure Piping.
- C. All auxiliary steel required for pipe supports, anchors, guides, etc shall be provided by the Mechanical Trades unless specifically indicated to be provided by others.
- D. The supports, hangers, anchors, and guides for the chilled water supply and return piping, steam piping, condensate return piping, etc of the Campus Loop System routed through utility tunnels and below buildings shall be provided as indicated on the Drawings.
- E. Contractor shall review all Drawings, including Structural Drawings, for details regarding pipe supports, anchors, hangers, and guides.
 - 1. All pipe supports shall be of type and arrangement to prevent excessive deflection, to avoid excessive bending stresses between supports, and to eliminate transmission of vibration.
 - 2. This trade shall be responsible for structural integrity of all supports, anchors, guides, etc.
 - 3. All structural hanging materials shall have a minimum safety factor of 5 built in.
- F. Anchor points as indicated on Drawings or as required shall be located and constructed to permit the piping system to take up its expansion and contraction freely in opposite directions away from the anchored points.
- G. Guide points shall be located and constructed wherever required or indicated on Drawings and at each side of an expansion joint or loop, to permit free axial movement only.
- H. Pipe supports, hangers, anchors, and guides shall be fastened to the structure only at such points where the structure is capable of restraining the forces in the piping system.
- I. Hangers supporting and contacting brass or copper lines 3-inches in size and smaller shall be Grinnell Fig CT-99c, adjustable, copper plated, tubing ring.
- J. Hangers supporting and contacting brass or copper lines 4-inches and larger shall be Grinnell Fig 260, adjustable clevis, with a nut above and below the hanger, and approved neoprene isolating material between pipe (or tubing) and hanger on the support rod.
- K. For insulated copper or brass domestic water lines, hangers for all sizes of pipe shall be Grinnell Fig 300, adjustable clevis, with a nut above and below the hanger, and approved neoprene isolating material between pipe (or tubing) and hanger on the support rod Isolate all copper or brass lines from all ferrous materials with approved dielectric materials.
- L. Hangers supporting and contacting plastic or glass piping shall be of equal design, but shall be padded with neoprene material or equal The padding material and the configuration of its installation shall be submitted for approval.
- M. Hangers supporting insulated lines where the outside diameter of the insulation is the equivalent of 8 inch diameter pipe or smaller in size and supporting all ferrous lines 6 inch and smaller in size shall be Grinnell Fig 260, adjustable clevis, with a nut above and below the hanger on the support rod.

- N. Hangers supporting and contacting ferrous lines larger than 6 inch in size and outside of insulation on lines with the outside diameter equivalent to 10 inch diameter pipe shall be Grinnell Fig 260, adjustable clevis, with a nut above and below the hanger on the support rod.
- O. Glass riser clamps shall be neoprene coated
- P. Other special type of hangers may be employed where so specified or indicated on the Drawings, or where required by the particular conditions. In any case, all hangers must be acceptable to the owner.
- Q. Each hanger shall be properly sized to fit the supported pipe or fit the outside of the insulation on lines where specified:
 - 1. Hangers for dual or low temperature insulation pipes shall bear on the outside of the insulation, which shall be protected by support shields as specified in Section 23 07 19- Piping Insulation.
 - 2. Protect insulation from crushing by means of a section of rigid insulation to be installed at hanger points.
 - 3. Hangers for high temperature insulated pipes and all insulated hot and cold domestic water pipes shall be encased in the insulation unless supported by trapezes in which case shield and rigid insulation shall be provided as specified above for low temperature insulated pipes.
- R. Hangers for large diameter steam and chilled water piping shall be roller style where thermal expansion is expected.
- S. Supports for vertical piping in concealed areas shall be double bolt riser clamps, Grinnell Fig 261, or other approved equal, with each end having equal bearing on the building structure, and located at each floor.
 - 1. Two-hole rigid pipe clamps at 4 feet on center or Kindorf channels and Grinnell Fig 261 riser clamps may be used to support pipe from vertical surfaces or members where lines are not subject to expansion and contraction.
 - 2. Where brass or copper lines are supported on trapeze hangers or Kindorf channels the pipes shall be isolated from these supports with plastic tape with insulating qualities, or strut clamps as manufactured by Specialty Products Company, Stanton, California.
- T. Supports for vertical piping in exposed areas (such as fire protection standpipe in stairwells) shall be attached to the underside of the building structure above the top of the riser, and the underside of the penetrated structure.
 - 1. The contractor shall use a drilled anchor as specified above, and use a Grinnell No 595 Socket Clamp with Grinnell No 594 Socket Clamp Washers, as a riser clamp.
 - 2. The top riser hanger shall consist of two (2) hanger rods (sized as specified) anchored to the underside of the building structure, supporting the pipe by means of the material specified.
 - 3. Risers penetrating floors shall be supported from the underside of the penetrated floor as specified for the top of the riser, but the hanger rods shall also include spring isolators (see Specification on Vibration Isolation for isolator specification).
 - 4. Floor penetrations in exposed areas shall be finished using Grinnell Fig 395 "Ceiling Plates" painted to match the pipe if uninsulated; or if insulated, the penetration shall be covered using a chrome plated escutcheon.
 - 5. Provide hangers at all changes in direction of pipe.

2.2 PIPE SUPPORTS IN CHASES AND PARTITIONS

- A. Horizontal and vertical piping chases and partitions shall be supported by hangers or other suitable support.
- B. Pipes serving plumbing fixtures and equipment shall be securely supported near the point where pipes penetrate the finish wall.
- C. Supports shall be steel plate, angles or special channels such as Unistrut mounted in vertical or horizontal position.
- D. Pipe clamps such as Unistrut P2426, P2008, P1109 or other approved clamps shall be attached to supports.
- E. Supports shall be attached to wall or floor construction with clip angles, brackets, or other approved method.
- F. Supports may be attached to cast iron pipe with pipe clamp, or other approved method.
- G. Isolate copper or brass lines from ferrous metals with dielectric materials to prevent electrolytic action.

2.3 CONDUITS

- A. Electrical conduits shall be run parallel or perpendicular to adjacent building lines.

- B. Single conduits running horizontally shall be supported by "Caddy" or "Minerallac" type hangers from adequately sized rods (minimum 1/4-inch) from the building structure. Where multiple conduits are run horizontally, they shall be supported on trapeze of "Unistrut" type channel suspended on rods or bolted to vertical building members.
- C. Conduit shall be secured to channel with galvanized "Unistrut" type conduit clamps or stainless steel "Unistrut" type "Uni-Clips".
- D. All hangers shall be fastened to the building structure in the same manner as specified above for pipe hangers.
- E. Spacing of hangers shall be adequate for the weight and rigidity of the conduits involved; in any case, no greater than 8-foot centers.
- F. Where feasible, conduits may be fastened to the concrete by one-hole straps thoroughly anchored to the concrete in an approved manner.
- G. Flexible conduit shall also be supported in an acceptable manner so as not to interfere with the maintenance of above-ceiling equipment, and to support it from touching the ceiling system.
- H. Conduit shall be located so as not to inhibit removal of ceiling tiles.
- I. The suspension system for the lay-in ceiling shall not be used to support electrical conduit.
- J. Vertical conduits shall be supported as often as necessary for rigidity by clamps resting on adjacent beams or floor slabs; minimum of one support per floor.
- K. All support hardware shall be galvanized or cadmium plated, or stainless steel.
- L. Perforated strap iron or wire will not, under any circumstances, be acceptable as hanger material.
- M. Vibration Isolation:
 - 1. Resilient hangers shall be provided on all piping connected to rotating equipment (pumps, etc).
 - 2. Piping that may vibrate and create an audible noise shall also be isolated. Spring hangers or supports shall be provided where indicated on the Drawings and/or specified under Section 22 05 48 - Vibration Isolation.
- N. Attachment:
 - 1. The load and spacing on each hanger and/or insert shall not exceed the safe allowable load for any component of the support system, including the concrete, which holds the inserts.
 - 2. Reinforcement at inserts shall be provided as required to develop the strength required.
 - 3. Inserts for piping shall be of a type which will not interfere with reinforcing as shown on the structural Drawings and which will not displace excessive amounts of structural concrete.
 - 4. Design and install pipe supports to avoid interference with other piping, hangers, ducts, electrical conduit, supports, building structures, equipment, etc.
 - 5. Install piping with due regard to expansion and contraction and the type of hanger method of support, location of support, etc shall be governed in part by this Specification.
 - 6. Pipe hangers shall be attached to the structure as follows:
 - a. Poured In Place Concrete:
 - 1) Where pipes and equipment are supported under poured in place concrete construction, each hanger rod shall be fitted with a nut at its upper end, which nut shall be set into an Underwriters` Laboratories, Inc. listed universal concrete insert placed in the form work before concrete is poured.
 - 2) Where inserts are placed in the bottom faces of concrete joists which are too narrow to provide adequate strength of concrete to hold the insert properly or where a larger insert would require displacement of the bottom joist steel, the hanger rod shall be suspended from the center of a horizontal angle iron, channel iron, I-beam, etc. spanning across two adjacent joists.
 - 3) The horizontal support shall be bolted to nonadjustable concrete inserts of the "spot" type, of physical size small enough to avoid the bottom joist steel.
 - b. Steel Bar Joists:
 - 1) Where pipes and loads are supported under bar joists, hanger rods may be run through the space between the bottom angles and secured with a washer and two nuts.
 - 2) Where larger lines are supported beneath bar joists, hanger rods shall be secured to angle irons of adequate size; each angle shall span across two or more joists as required to distribute the weight properly and shall be welded to the joists or otherwise permanently fixed.

- c. Steel Beams: Where pipes and loads are supported under steel beams, approved type beam clamps shall be used.
 - d. Wood Framing: Where pipes and loads are supported from wood framing, hanger rods shall be attached to framing with side beam brackets or angle clips.
 - e. Pre-Cast Tee Structural Concrete:
 - 1) Hanger supports, anchors, etc. required for mechanical systems attached to the precast, double tee, structural concrete system are to be installed in accord with approved shop Drawings only.
 - 2) Holes required for hanger rods shall be core drilled in the "flange" of the double tee only; impact type tools are not allowed under any circumstances.
 - 3) Core drilling in the "stem" portions of the double tee is not allowed.
 - 4) Holes core drilled through the "flange" for hanger rods shall be no greater than 1/4" larger than the diameter of the hanger rod.
 - 5) Hanger rods shall be supported by means of bearing plates of size and shape acceptable to the Architect/Engineer, with welded double nuts on the hanger rod above the bearing plate.
 - 6) Cinch anchors, lead shields, expansion bolts, and studs driven by explosion charges are not allowed under any circumstances in the lower 15 inches of each stem and in the "shadow" of the stem on the top side of the "double tees".
- O. Trapezes:
- 1. Where multiple lines are run horizontally at the same elevation and grade, they may be supported on trapezes of Kindorf, Elcen, or approved equal, channel-suspended on rods or pipes.
 - 2. Trapeze members including suspension rods shall each be properly sized for the number, size, and loaded weight of the lines they are to support.
- P. Finishes:
- 1. All hangers on piping including clevis hangers, rods, inserts, clamps, stanchions, brackets, shall be dipped in Zinc Chromate Primer before installation.
 - 2. Rods may be galvanized or cadmium plated after threading, in lieu of dipping zinc chromate
 - 3. Universal concrete inserts shall be cadmium plated.
- Q. Ductwork:
- 1. Support ductwork in accordance with the SMACNA recommendation for the service involved; however, all horizontal ductwork shall be supported at intervals not to exceed 8 feet.
 - 2. Horizontal ducts shall be supported using galvanized steel bands extending up both sides and onto the construction above, where they shall turn over and be secured with bolts into nuts fitted in inserts set in the concrete bolted to angles secured to the construction above, or secured in another approved manner.
 - 3. For attaching methods for precast double tee structural concrete, refer to details on the Drawings and as specified.
 - 4. All ductwork over 36 inches wide shall be supported with vibration isolation integral with the hangers or supports.
- R. Terminal units weighing less than 150 lbs shall be supported by four 16 gauge, 1 inch wide sheet metal straps with ends turned under bottom of box at corners and secured by one not over 3/4 inch in length, 1/4 inch diameter sheet metal screw per strap.
- 1. The other strap end shall be attached to the structure by 1/4 inch diameter threaded bolt into the concrete insert or into drilled-hole threaded concrete expansion anchor.
 - 2. Boxes over 150 lbs in weight shall be supported the same as described above except two 1/4 inch diameter sheet metal screws through turned end of strap box shall be provided.
 - 3. Where interferences occur, overhead of the box, not allowing direct vertical support by straps, provide trapezes of Kindorf, Unistrut, or Elcen channel suspended by 1/4 inch diameter galvanized threaded rods providing such channels do not block access panels of boxes.
 - 4. Threaded rods shall be supported from structure by concrete insert or by drilled-hole threaded concrete expansion anchor.
- S. Miscellaneous:
- 1. Provide any other special foundations, hangers and supports indicated on the Drawings, specified elsewhere herein; or required by conditions at the site.

- 2. Hangers and supporting structures for suspended equipment shall be provided as required to support the load from the building structure in a manner acceptable to the Architect/Engineer.
 - T. Standpipe Systems: All hangers and supports for fire standpipe systems and fire sprinkler systems shall be Factory Mutual and Underwriters` Laboratories, Inc listed and labeled Construction of hangers shall be as described above for common piping, except for the above mentioned requirements.
- 2.4 ACCESSORIES
- A. Hanger Rods: Galvanized mild steel threaded both ends, galvanized threaded one end, or galvanized continuous threaded.
- 2.5 INSERTS
- A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
- 2.6 FLASHING
- A. Metal Flashing: 26 gage galvanized or stainless steel.
 - B. Metal Counterflashing: 22 gage galvanized or stainless steel.
 - C. Roofing Flashing: See specifications for Roofing, elsewhere in these Specifications.
 - D. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer`s instructions.

3.2 INSERTS

- A. Provide inserts for placement in concrete formwork.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping in accordance with recognized standard practices, minimum spacing as required by piping materials and size In addition to minimum requirements, hangers and supports must be provided at the following locations:
 - 1. Within 12 inches of any change in direction.
 - 2. Each side of 6 inches and larger valves.
 - 3. Each side of in-line pumps.
- B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- C. Place hangers within 12 inches of each horizontal elbow.
- D. Use hangers with 1-1/2 inch minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- F. Support vertical piping at every floor Support vertical cast iron pipe at each floor at hub.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed, but shall be corrosion protected with galvanized plating.
- L. Hanger Rods: (NOTE: All hanger rods shall be trimmed neatly so that no more than 1 inch of excess hanger rod protrudes beyond the hanger nut In the event a rod is intentionally but temporarily left

excessively long (for sloped or insulated lines for example), the contractor shall take appropriate measures to protect the pipe or other materials from damage).

3.4 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked one inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size.
 - 1. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash, and seal
- C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size Fasten flashing to drain clamp device.
- D. Seal floor, shower, mop sink, and drains watertight to adjacent materials.
- E. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.
- F. Adjust storm collars tight to pipe with bolts; caulk around top edge Use storm collars above roof jacks Screw vertical flange section to face of curb.

3.5 SLEEVES

- A. Set sleeves in position in formwork Provide reinforcing around sleeves.
- B. Size sleeves large enough to allow for movement due to expansion and contraction Provide for continuous insulation wrapping.
- C. Extend sleeves through floors four inches above finished floor level Caulk sleeves.
- D. Where piping, ductwork or conduit penetrates floor, ceiling, or wall, close space between pipe or duct and adjacent work with fire stopping insulation and caulk air tight.
 - 1. Provide close fitting metal collar or escutcheon covers, as appropriate, at both sides of penetration.
- E. Install chrome plated steel or stainless steel escutcheons at finished surfaces.

3.6 SCHEDULES

PIPE SIZE INCHES	MAX HANGER SPACING FEET	HANGER ROD DIAMETER INCHES
1/2 TO 1-1/4	6.5	3/8
1-1/2 TO 2	10	3/8
2-1/2 TO 3	10	1/2
4 TO 6	10	5/8
8 TO 12	14	7/8
14 AND OVER	20	1
PP & PPDV (ALL SIZES)	4	3/8
C I BELL AND SPIGOT (OR NO HUB) AND AT ALL JOINTS	5	5/8
GLASS AND AT ALL JOINTS	4	1/2

- A. Notes: Insulated piping support spacing shall be reduced as necessary to meet the requirements of "blocking" or insulation at the support and at all joints.

END OF SECTION 23 05 29

SECTION 23 05 53

MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Nameplates.
- B. Stencils.
- C. Pipe Markers.

1.3 RELATED REQUIREMENTS

- A. Section 09 91 13 - Exterior Painting.
- B. Section 09 91 23 - Interior Painting.
- C. Section 09 96 00 - High-Performance Coatings.
- D. Section 23 00 00 - UTSW Mechanical Design Requirements

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.5 SUBMITTALS

- A. Submit under provisions of Division 01 and Section 23 00 00 - UTSW Mechanical Design Requirements.
- B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Obtain new equipment identification numbers from the Drawings or the Superintendent of Utilities.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Samples: Submit two of each type of label, tag, etc., of the approximate size specified or implied in the specification.
- F. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- G. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 01 and Section 23 00 00 - UTSW Mechanical Design Requirements.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The Contractor shall make it possible for the personnel operating and maintaining the new equipment and systems in this project to readily identify the various pieces of equipment, major valves, piping, etc., by marking them.
 - 1. All items of equipment such as pumps, etc., shall be clearly marked using engraved nameplates as hereinafter specified.
 - 2. The item of equipment shall indicate the same number as shown on the Drawings. For example, pumps will be identified as 3A, 3B, 3C, etc.
 - 3. The equipment identification will be shown on the Drawings or provided by the Superintendent of Utilities.
 - 4. All piping shall be identified with pipe markers including pipe type, direction, and pipe diameter with colors to match UTSW requirements.
 - 5. Color coded pipe jacketing and fitting covers (to match jacketing type) shall match UTSW colors for mechanical and piping.

2.2 MECHANICAL SPACE AND PIPING COLORS

A. UTSW Colors in mechanical and exposed spaces shall be as follows:

1. Colors shown are with Sherwin Williams paint and approved equivalent are allowed per Section 09 96 00 - High-Performance Coatings.

ITEM	COLOR	PAINT NUMBER
Structural Elements and Railing	Gray	Structural Gray SW 4031
Equipment Supports	Light Gray	Nickel SW 4030
Floor	Gray	Slate Gray SW 4026
Housekeeping Curbs (Face)	Yellow	Safety Yellow SW 4084
Equipment Curbs (Face)	Color to Match Equipment	Confirm with Utilities
Clearances and Safety Marking on Floors and Walls	Yellow	Safety Yellow SW 4084
Walls	White	Extra White LRV 86%
Gantry Crane	Yellow	Safety Yellow SW 4084
Fire Sprinkler / Fire Safety	Red	Safety Red SW 4081
Boiler (Existing)	Match Existing Equipment	Match Existing Color
Boiler (New)	Manufacturer Standard Colors	Confirm with Utilities
Steam	Aluminum Lagging	Aluminum
Condensate Return	Aluminum Lagging	Aluminum
Hot Water (Supply)	Dark Orange	International Orange SW 4082
Hot Water (Return)	Orange	Safety Orange SW 4083
Natural Gas	Yellow	Safety Yellow SW 4084
Natural Gas Vent	Yellow	Safety Yellow SW 4084
Fuel Oil	Yellow	Junction Yellow SW 4034
City Water	Light Blue	Polymer Blue SW 4055
Exterior Water	Aluminum Lagging	Aluminum Lagging with Heat Trace
Chiller (Supply)	Dark Blue	Safety Blue SW 4086
Chiller (Return)	Blue	Turbine Blue SW 4064
Chiller Refrigerant Vent	Aluminum Lagging	Aluminum
Condensing Water (Supply)	Dark Green	Safety Green SW 4085
Condensing Water (Return)	Light Green	Generator Green SW 4070
Condensing Water (Exterior)	Aluminum Lagging	Aluminum
Compressed Air	Green	Green Byte SW 4076
Refrigerant Recovery	Purple	Plumb SW 4080
Vents / Roof Vents	Gray	Galvino SW 4027
Hanger Rods	Same as Related Pipe	Confirm with Utilities
Storm Water	White	Ultra White LRV 88%
Atmospheric Relief Lines	Sames as Related Pipe	Confirm with Utilities
Ductwork, AHU, Fans, and Insulation	Aluminum Lagging	Aluminum

2.3 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.4 TAGS

- A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.
- B. Chart: Typewritten letter size list in anodized aluminum frame.

2.5 PIPE MARKERS

- A. Color: Conform to ASME A13.1.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches (150 mm) wide by 4 mil (0.10 mm) thick, manufactured for direct burial service.
- E. PVC Jacketing and Fitting Covers: Colors to match UTSW requirements and installed as required per Section 23 07 19 - Piping Insulation.

2.6 CEILING LABELS

- A. Description: 1/2 inch minimum diameter color sticker with separate clear label, identifying item above ceiling, attached to ceiling grid.. Lettering on label shall be black.
 - 1. Color code as follows:
 - a. Yellow - HVAC equipment.
 - b. Red - Fire dampers/smoke dampers.
 - c. Blue - Heating/cooling valves.

2.7 GENERAL

- A. The Contractor shall make it possible for the personnel operating and maintaining the new equipment and systems in this project to readily identify the various pieces of equipment, major valves, piping, etc , by marking them.
- B. All items of equipment such as fans, pumps, etc , shall be clearly marked using engraved nameplates as specified.
- C. The item of equipment shall indicate the same number as shown on the Drawings.
- D. The equipment identification will be shown on the Drawings or provided by the Superintendent of Utilities.

2.8 MECHANICAL

- A. Identify new mechanical equipment by the attachment of engraved nameplates constructed from laminated phenolic plastic, at least 1/16 inch thick, 3-ply, with black surfaces and white core.
- B. Engraving shall be condensed Gothic, at least 1/2 inch high, appropriately spaced.
- C. Nomenclature on the label shall be in accordance with UTSW standards.
 - 1. Nomenclature shall be as described in this section Equipment to be labeled shall include but not be limited to the following:
 - a. Fan and Coil Units.
 - b. Condensing Units.
 - c. Compressors.
 - d. Air Conditioning Control.
 - e. Miscellaneous - similar and related items.

2.9 PIPING

- A. Pipe markers and arrow markers also shall be provided on but not limited to the piping of the following systems affected by the project:
 - 1. Primary Chilled Water Supply.
 - 2. Steam Condensate.
 - 3. Primary Chilled Water Return.
 - 4. Secondary Chilled Water Supply.
 - 5. Atmospheric Relief.
 - 6. Secondary Chilled Water Return.
 - 7. Low Pressure Steam.
 - 8. Medium Pressure Steam.

2.10 MARKERS

- A. In addition, pipe runs throughout the building including those above lift out ceilings, under floor, and those exposed to view when access doors or access panels are opened shall be identified by means of Seton Setmark or Brady Mechanical Pipe Markers.
- B. Concealed areas, for purposes of this identification section, are those areas which cannot be seen except by demolition of the building elements.
- C. In addition to the pipe markers, arrow markers shall be used to indicate direction of flow.
- D. The following specific instructions shall apply to the application of these markers:
 - 1. Provide a pipe marker at each valve to indicate proper identification of pipe contents Where several valves exist on one header, it is necessary to mark only the header.
 - 2. Provide an arrow marker with each pipe marker pointing away from the pipe marker to indicate direction of flow.
 - 3. Provide a double ended arrow marker when flow can be in either or both directions.
 - 4. Provide a pipe marker and an arrow marker at every point of pipe entry or exit where line goes through a wall or service column.

5. Provide pipe markers and arrow markers at intervals not exceeding 50 feet.
6. Markers shall be located on the two lower quarters of the pipe where view is unobstructed.
- E. Use Seton Setmark Type SNA or Brady snap-on type identification for all piping systems, 3/4 inch thru 6 inch. For piping systems larger than 6 inch, use Seton or Brady strap on markers.
- F. Pipe Markers shall conform to ANSI A 13 1-1981 "Scheme for the Identification of Piping Systems"
- G. Arrow markers must have same ANSI background colors as their companion pipe markers, or be incorporated into the pipe identification marker.

2.11 NOMENCLATURE

- A. Building designators for the project:
 1. NB.
- B. UTSW Energy Management system Naming and Numbering Specification: The purpose of this document is to define the standard for naming items that become part of the EMS system as well as numbering the BACnet networks and devices.
 1. Network Numbering: The UTSW BACnet configuration utilizes two of the defined Local Area Network (LAN) technologies for its interconnection of devices Ethernet is used for Management level and Integration level device communication That is to say that front-end servers and workstations (Management level devices) talk to floor and building controllers, routers, and BACnet Broadcast Management Devices (Integration level devices). The Field level controllers such as Room Controllers, Air Handler Controllers, and other building system controllers communicate to the Integration level devices via the Master Slave/Token-Passing MS/TP LAN. Including both of these LAN types, the UTSW BACnet control system can contain up to 65,535 (64K) interconnected networks each of which are required to have a unique network number At UTSW, network numbers shall be assigned as follows:
 - a. NBBSS
 - b. Where: N = Network Type
 - 1) 0 = Ethernet
 - 2) 1 = MS/TP
 - 3) 2 = P1
 - 4) 3 = >6 not used
 - 5) SS = 00 to 35 for individual I/P segments in a building
 - 6) BB = the building number
 - 7) 00 = EB (only for JCI)
 - 8) 01 = UH
 - 9) 02 = WC
 - 10) 03 = UW
 - 11) 04 = BE
 - 12) 05 = Unused
 - 13) 06 = Unused
 - 14) 07 = NTEP
 - 15) 08 = V
 - 16) 09 = BTEP
 - 17) 10 = NA
 - 18) 11 = NB
 - 19) 12 = NC
 - 20) 13 = ND
 - 21) 14 = NE
 - 22) 15 = JA
 - 23) 16 = NF
 - 24) 17 = NL
 - 25) 18 = MT - Moncrief Ft. Worth
 - 26) 19 = ZL
 - 27) 20 = XA (2929 Stemmons/Irving)
 - 28) 21 = HA, Annex K
 - 29) 22 = HP, POB1
 - 30) 23 = WA, ASC, Ambulatory Surgical Center

- 31) 24 = WB
- 32) 25 = EQ
- 33) 26 = WD
- 34) 27 = EB
- 35) 28 = EC
- 36) 29 = EF
- 37) 30 = HQ, POB2
- 38) 31 = LC - Empire Plaza
- 39) 32 = A
- 40) 33 = B
- 41) 34 = C
- 42) 35 = D
- 43) 36 = E
- 44) 37 = F
- 45) 38 = G
- 46) 39 = H
- 47) 40 = J
- 48) 41 = K
- 49) 42 = L
- 50) 43 = M
- 51) 44 = MA
- 52) 45 = P
- 53) 46 = N1 (Brain/Cancer Garage)
- 54) 47 = S
- 55) 48 = U
- 56) 49 = X
- 57) 50 = Y
- 58) 51 = CS
- 59) 52 = PE, STEP
- 60) 53 = NM Brain
- 61) 54 = NN
- 62) 55 = NP Cancer
- 63) 56 = NR
- 64) 57 = JB
- 65) 58 = RK
- 66) 59 = LD - Empire Plaza

- 2. For example, a BACnet Ethernet network in P building on the primary segment would be:
 - a. NBBSS.
 - b. 04300 or simply network number 4300.
- C. Device Numbering: A BACnet control system can contain up to 4,194,303 devices each of which are required to have a unique value for the Object Identifier property of the Device object. At UTSW, device numbers shall be assigned as follows:
 - 1. VBBYYY
 - a. Where: V = Vendor
 - b. 0 = JCI Controls
 - c. 1 = Alerton Controls
 - d. 2 = Siemens Controls
 - e. 3 = Trane
 - f. 4 = not used
 - g. BB = Building number as defined in Section above.
 - h. YYYY = 0000 to 9999 for devices
 - 2. For example, for the 112th Siemens device in NB building the device number would be:
 - a. 2110112
 - 3. Or for the 86th Alerton device in CS building the device number would be:
 - a. 1490086

- D. System Naming Convention: To create a consistent naming structure across legacy, proprietary, new/remodel construction, and open protocol implementations at UTSW, the following sections specify conventions for naming buildings and equipment as it relates to the EMS system Deviation from this scheme requires prior approval in writing.
1. All buildings shall be designated by a one-letter or two-letter name Reference construction documents for the most current designation The current exception to this rule is Thermal Energy Plants, whose names can contain TEP.
 2. All items not specifically identified in this document shall be named as BB NNN...N Where BB is the one or two letter building designation and NNN...N is the industry standard designation for that equipment type For example S BBMD-01 is the name for BACnet Broadcast Management Device BBMD number 1 in S building, and described as S BBMD number one.
 3. Rooms shall be designated BBF NNN Where BB is the one or two letter designation, F is the floor number and is always a decimal value; NNN is the actual room number as designated on the official drawings and signage For example, NB10 403 is the name for room 403 on the 10th floor of NB building In the event of multiple room controllers in a large area, they shall be designated as -1, -2... and their relative positions in the room shall be described in the description For example, NB10 403-2 described as NB 10 Room 403, TEC 2 in NW corner.
 - a. Environmental rooms, Refrigerators, and Freezers shall have that designation as part of the name. For example, CY3.333 Refrigerator 33 is described as CY 3 333 Refrigerator #33. Or, F5.222 Freezer #2 is described as F 5 222 UL Freezer #2, NB8.408 Warm Room is described as NB 8 408 Warm Room.
 - b. In a master/slave configuration of room controllers, the master and slave designations shall be added to the description, i.e., NB10.403-02 described as NB 10 Room 403, TEC 02 slaved to TEC 01 in NW corner.
 - c. In the event that corridors or hallways do not have a room number designated, they shall be named as follows: BBF.N Corridor. Where BB is the one or two letter building designation, F is the floor number and N is an incrementing decimal value for controllers throughout that corridor or hallway. The relative location for the controller shall be described in the description. For example, X2.3 Corridor described as X 2, Corridor TEC 3 outside room X2.100.
 - d. ARC rooms shall be designated as BBF.NNN ARC. For example J1.116 ARC described as J 1 116 ARC Room.
 4. Air Handlers shall be designated BB.AHU-NN Where BB is the one or two letter building designation, AHU is a designation for the air handler, and NN is an incrementing decimal value that designates the air handler number in that particular building.
 - a. Air Handler Fans shall be designated BBF.AHUNN Type Fan Where BB is the one or two letter building designation, F is the floor number, AHU is a designation for the air handler, and NN is an incrementing decimal value that designates the air handler number in that particular building, and Type is either Supply Air or Return Air For example, NC AHU1 Supply Air Fan shall be described as NC AHU 1 Supply Air Fan.
 - b. Air Handler Valves shall be designated BBF.AHUNN Type VLV Where BB is the one or two letter building designation, F is the floor number, AHU is a designation for the air handler, NN is an incrementing decimal value that designates the air handler number in that particular building, and Type is CD for Cold Deck, HD for Hot Deck, PC for Precool, PH for Preheat or HUM for Humidity For example, NC.AHU1 CD VLV shall be described as NC AHU 01 Cold Deck VLV.
 - c. Air Handler Dampers shall be designated BBF.AHUNN Type Damper Where BB is the one or two letter building designation, F is the floor number, AHU is a designation for the air handler, NN is an incrementing decimal value that designates the air handler number in that particular building, and Type is OA for Outside Air, MA for Mixed Air, RA for Relief Air or EA for Exhaust Air For example, L.AHUB2 OA Damper shall be described as L.AHU B2 Outside Air Damper.
 - d. Air Handler Safeties shall be designated BB.AHUNN Type Where BB is the one or two letter building designation, AHU is a designation for the air handler, NN is an incrementing decimal value that designates the air handler number in that particular building, and Type is Freeze Stat, High Static, Low Static, Smoke, and High Duct Temp For example, NA.AHU4 Low Static shall be described as NA.AHU 4 Low Static Pressure.

- e. Air Handler Temperatures and set points shall be designated BB.AHUNN Type Where BB is the one or two letter building designation, AHU is a designation for the air handler, NN is an incrementing decimal value that designates the air handler number in that particular building, and Type is SAT for Supply Air, CD for Cold Deck, HD for Hot Deck, PH for Preheat, MAT for Mixed Air, OAT for Outside Air Temp and RAT for Return Air For example, NA AHU4 SAT shall be described as NA AHU 4 Supply Air Temperature.
5. Valves shall be designated BBF.T.FunctionVLV Where BB is the one or two letter building designation, T is Valve type such as:
 - a. RHW = Reheat Water
 - b. DHW = Domestic Hot Water
 - c. CHW = Chilled Water
 - d. HUM = Humidity
 - e. SCHW = Secondary Chilled Water
 - f. PCHW = Process Chilled Water
 - g. CW = Condenser Water
 - h. GLY = Glycol
 - i. Function indicates any special purpose such as Sup for Supply, Ret for Return, BP for Bypass, ISO for Isolation. VLV is the designation for Valve. For example, NE.CHW.BPVLV shall be described as NE CHW Bypass VLV. Or, NL.HX1.1/3VLV shall be described as NL HX1 1/3 VLV.
 6. Exhaust Fans shall be designated BB.Type EFNN Where BB is the one or two letter building designation, Type is EF will be used for general purpose building exhaust, L for Lab, A for Animal, MRI for MRI. EF is a designation for the exhaust fan, NN is an incrementing decimal value that designates the exhaust fan number in that particular building For example, NA AEF13 shall be described as NA Animal EF 13 NE MR1EF17 shall be described as NE MRI EF 17
 7. Fire Status shall be designated BB.Fire Type Where BB is the one or two letter building designation, Type is either Fire Trouble or Fire Alarm or Fire Supervisor
 8. Fire/Smoke Dampers shall be designated BBF.FSD.NN Where BB is the one or two letter building designation, F is the floor number and is always a decimal value, FSD is a designation for the fire smoke damper, NN is an incrementing decimal value that designates the smoke damper number in that particular building
 9. All other items shall be described as BB (ITEM DESCRIPTION) Where BB is the one or two letter building designation, (ITEM DESCRIPTION) is the complete name/description of the item For example J Control Air HI Press shall be described as J.Control Air High Pressure, or NB LAB VAC PMP STATUS shall be described as NB Lab Vacuum Pump Status

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Division 9 for stencil painting.

3.2 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Apply stencil painting in accordance with Division 09 Painting Sections.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- E. Identify air handling units, and fan coil units with plastic nameplates.
- F. Identify control panels and major control components outside panels with plastic nameplates.
- G. Install ceiling labels in accordance with manufacturer's instructions.

END OF SECTION 23 05 53

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Work required to prepare the building HVAC systems for testing, adjusting and balancing indicated by the Contract Documents as follows:
 - 1. Responsibilities of project contractor.
 - 2. Preparation for balancing of air systems.
 - 3. Preparation for balancing of hydronic and steam systems.

1.3 RELATED REQUIREMENTS

- A. Section 01 91 00 - General Commissioning Requirements.
- B. Section 23 00 00 - UTSW Mechanical Design Requirements.
- C. Section 23 05 94 - System Testing, Adjusting and Balancing.
- D. Section 23 08 00 - Commissioning of HVAC Systems
- E. Section 23 09 55 - Control Sequence.
- F. Section 23 31 00 - Ductwork.
- G. Section 23 33 00 - Ductwork Accessories.
- H. Section 23 36 00 - Air Terminal Devices.
- I. Section 23 37 00 - Air Inlets and Outlets.

1.4 SCOPE OF WORK

- A. Testing, adjusting, and balancing (TAB) of the air conditioning systems and related ancillary equipment will be performed by an impartial technically qualified TAB firm selected and employed directly by the Owner, separate and apart from the Construction Contract.
 - 1. Preparation for and corrections necessary for the Testing, Adjusting and Balancing of these systems, as described herein, are the responsibility of the Contractor.
- B. As a part of this project Construction Contract, the Contractor shall make any changes or replacements to the sheaves, belts, dampers, valves, etc required for correct balance as advised by the TAB firm, at no additional cost to the Owner.
- C. The Contractor shall provide and coordinate the services of qualified, responsible Subcontractors, suppliers, and personnel as required to correct, repair, and/or replace any and all deficient items or conditions found during the course of this project, including the testing, adjusting and balancing period.
- D. In order that all systems may be properly tested, balanced, and adjusted as required by these Specifications, the Contractor shall operate said systems at his expense for the length of time necessary to properly verify their completion and readiness for TAB This length of time shall be subject to the approval of the Owner's Representative.
- E. Project Contract completion schedules shall allow for sufficient time to permit the completion of TAB services prior to Owner occupancy.
- F. The contractor shall allow adequate time for the completion of testing and balancing activities of the owner provided services, during the construction period, and prior to Substantial Completion as defined in the Uniform General Conditions of this Construction Document.
- G. The Drawings and Specifications indicate valves, dampers and miscellaneous adjustment devices for the purpose of adjustment to obtain optimum operating conditions, and it will be the responsibility of the Contractor to install these devices in a manner that will leave them accessible and readily adjustable.
 - 1. Should any such device not be readily accessible, the Contractor shall provide access as requested by the TAB firm.

2. Malfunction encountered by TAB personnel and reported to the Contractor or the Owner's Representative shall be corrected by the Contractor immediately so that the balancing work can proceed with the minimum of delays.

1.5 RESPONSIBILITIES OF THE PROJECT CONTRACTOR

- A. The Contractor shall:
 1. Have the building and air conditioning systems in complete operational readiness for TAB work to begin.
 2. The contractor shall allow sufficient time for the TAB firm to perform the contracted work within the construction schedule.
 - a. The contractor shall complete his work by systems or floors whichever is the most efficient for scheduling.
 - b. After award of the contract and the contractor has developed a construction schedule, a TAB coordination meeting shall be held with the TAB firm, the general contractor and his primary subcontractors (i e mechanical, electrical, building automation etc) to develop a testing schedule for the project.
 - c. The contractor shall submit copies of the proposed schedule two (2) weeks prior to this meeting to the Owner and TAB firm.
 3. Promptly correct deficiencies of materials and workmanship identified as delaying completion of TAB work.
 4. The Contractor shall be responsible for any added costs to the Owner resulting from failure to have the building and air conditioning systems ready for TAB when scheduled, or from failure to correct deficiencies promptly.
- B. Complete operational readiness of the building requires that construction status of the building shall permit the closing of doors, windows, ceilings installed, etc , to obtain simulated or projected operating conditions.
- C. Complete operational readiness of the air conditioning systems also requires that the following be accomplished:
 1. Air Distribution Systems:
 - a. Verify installation for conformity to design All supply, return and exhaust ducts terminated and pressure tested for leakage as required by the Specification.
 - b. All volume, smoke and fire/smoke dampers are properly located and functional.
 - c. Dampers serving requirements of minimum and maximum outside, return and relief air shall provide tight closure and full opening, smooth and free operation.
 - d. All supply, return, exhaust and transfer grilles, registers, diffusers and terminal devices installed.
 - e. Air handling systems, units and associated apparatus, such as heating and cooling coils, filter sections, access doors, etc , shall be blanked and/or sealed to eliminate excessive bypass or leakage of air.
 - f. All fans (supply, return and exhaust) operating and verified for freedom from vibration, proper fan rotation and belt tension; heater elements in motor starters to be of proper size and rating; record motor amperage and voltage on each phase at start-up and running, and verify they do not exceed nameplate ratings.
 - g. All single and/or double duct variable and constant volume terminal units ("mixing boxes") shall be installed and functional (i e controls functioning).
 2. Water Circulating Systems:
 - a. Open all valves to their full open position, close bypass stop valves Set mixing valves to full-flow through systems components.
 - b. After the system is flushed and checked for proper operation, remove and clean all strainers.
 - c. The Contractor shall repeat the operation until circulating water is clean.
 - d. Record each pump motor amperage on each phase and voltage after reaching rated speed Readings shall not exceed nameplate rating.
 - e. Verify that the electrical heater elements are of the proper size and rating.
 - f. In preparation of TAB all water circulating systems shall be full and free of air, expansion tanks shall be set for proper water level, and all air vents shall be installed at high points of systems and operating freely.

- g. Systems shall be cleaned and flushed Chemicals shall be added to closed systems to treat piping and inhibit corrosion.
 - h. Check and set operating parameters of the heat exchangers and control devices to the design requirements.
3. Automatic Controls:
- a. The Contractor shall schedule a meeting with the Engineer, Control Contractor, TAB firm, Commissioning Provider (if applicable) and Owner's representative for a pre-submittal review to establish that his interpretation of the sequences of operation are correct.
 - b. Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, dampers sequences, air and water resets, fire and freeze stats, high and low temperature thermostats, safeties, etc.
 - c. Verify that all controlling instruments are calibrated and set for design operating conditions with the exception of room thermostats or sensors, which shall be calibrated at the completion of TAB services with cooperation between the TAB firm and Control Contractor.
 - d. The Automatic Temperature Control Contractor and/or Energy Management System Contractor shall thoroughly check all controls, sensors, operators, sequences, etc before notifying the TAB agency that the Automatic Temperature Controls and Energy Management System are operational.
 - e. The Automatic Temperature Contractor and/or Energy Management System Contractor shall provide technical support (technicians and necessary computers) to the TAB firm for a complete check of these systems.
4. Tabulated Data: The motor amperages, voltages shall be recorded showing "actual" and "nameplate" voltage and amperage and submitted and actual RPM. This applies to each piece of electrically driven air conditioning equipment in the system including supply and exhaust fans, fans of fractional horsepower, pumps, etc. Include any additional relevant start-up information or documentation.
- D. Notification of System Readiness:
- 1. After completion of the work above, the Contractor shall notify the Owner in writing, certifying that the work has been accomplished and that the building and the air conditioning systems are in operational readiness for testing, adjusting, and balancing; include a copy of the tabulated data described above.
 - 2. The Owner will, in turn, notify the TAB firm of the readiness for balancing and forward copies of the Contractor's certification.
 - 3. Should the TAB firm be notified as described above, and the TAB work commenced and the systems are found NOT to be in readiness or a dispute occurs as to the readiness of the systems, the Contractor shall request an inspection be made by duly appointed representative of the Owner, Architect, TAB firm and the Contractor.
 - 4. This inspection will establish to the satisfaction of the represented parties whether or not the systems meet the basic requirements for TAB services.
 - 5. Should the inspection reveal the TAB services notification to have been premature, all cost of the inspection and wasted work accomplished by the TAB firm shall be reimbursed to the appropriated parties by the Project Contractor.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 23 05 93

SECTION 23 05 94

SYSTEM TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SUMMARY

- A. Testing, adjusting and balancing (TAB) of the air conditioning systems and related ancillary equipment will be performed by an impartial technically qualified TAB firm selected and employed by the Owner, separate and apart from the construction contract.
- B. The firm shall be capable of performing the services specified at the location of the facility described within the time specified, of preparing and submitting the detailed report of the actual field work performed, and following up the basic work as may be required.

1.3 QUALIFICATIONS

- A. The Firm shall be one which is organized to provide professional services of this specified type in the State of Texas and as a minimum shall have one (1) professional engineer licensed in the State of Texas, with current registration, to perform such professional services.
 - 1. This engineer shall be personally responsible for developing the job site data as required in the test procedures outlined in these Specifications.
- B. The Firm shall have operated a minimum of five (5) years under its current Firm name, and shall be in good standing with the State of Texas, Franchise Tax Board.
- C. The firm shall submit their full incorporated name, Charter Number and Taxpayer's I D Number for proper verification of the firm's status.
- D. The Firm shall be capable of providing a performance bond, by a bonding company licensed to do business in the State of Texas, if determined by the Owner that such a bond is required.
 - 1. The amount of the bond which may be required shall be equal to the cost of the proposal submitted, or in the case of more than one proposal, the sum of all such proposals and any awarded work in progress.
- E. The Firm shall maintain current insurance coverages in the minimum amounts indicated below.
 - 1. If the Firm normally carries such insurance coverages (minimum or higher) incident to its operation, additional insurance for the specific proposal or proposals is not required. The minimum insurance coverages required are:
 - a. Worker's Compensation as required by law.
 - b. General Liability for not less than \$2,000,000 aggregate.
 - c. Fire Damage, and Extended Coverage, Vandalism and Malicious Mischief, in the full amount of Contract.
 - 2. The above policies shall be carried with companies satisfactory to the Owner.
 - 3. Certificates of each of the above policies, together with a written statement by the issuing company, stating that said policy will not be canceled without ten (10) days prior written notice to the Board of Regents of the University of Texas system, shall be delivered to the Owner before any work is started.
- F. All personnel used on the job site shall be either professional engineers or engineering technicians, who shall have been permanent, full time employees of the firm for a minimum of six (6) months prior to the start of work for this specific project.
- G. The TAB firm shall submit biographical data on the individual proposed to directly supervise the TAB work, as well as other personnel scheduled to perform the technical work under the contract.
 - 1. It shall also submit a background record of at least five years of specialized experience in the field of air hydronic system balancing, and shall possess properly calibrated instrumentation.
 - 2. The supervisory personnel for the TAB firm shall be registered engineers in the mechanical field and all of the employees used in the TAB firm shall be permanent, full-time employees of the firm.

1.4 RELATED REQUIREMENTS

- A. Section 01 91 00 - General Commissioning Requirements.
- B. Section 23 00 00 - UTSW Mechanical Design Requirements.
- C. Section 23 05 93 - Testing, Adjusting, and Balancing.
- D. Section 23 08 00 - Commissioning of HVAC Systems.
- E. Section 23 36 00 - Air Terminal Devices.

1.5 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. AABC (NSTSB) - National Standards for Total System Balance, seventh edition, 2007.
- C. ASHRAE 90.1 - HVAC Applications Chapter 37: Testing, Adjusting and Balancing.

1.6 DOCUMENTS

- A. The Owner or Owner's Representative shall arrange with the Architect to provide one set of mechanical specifications, all pertinent change orders, and the following:
 - 1. One complete set of Digital Drawings less the structural sheets.
 - 2. One digital set of mechanical floor plans of the conditioned spaces
- B. Approved submittal data on equipment installed, and related changes as required to accomplish the test procedures outlined in this Specification will be available through the Owner's Representative.

1.7 RESPONSIBILITIES OF THE TAB FIRM

- A. The TAB personnel shall check, adjust, and balance the components of the air conditioning system which will result in optimal noise, temperature, and airflow conditions in the conditioned spaces of the building while the equipment of the system is operating economically.
- B. This is intended to be accomplished after the system components are installed and operating as provided for in the contract documents.
- C. It is the responsibility of the Mechanical Contractor to place the equipment into service. Variable air volume systems shall be balanced in accordance with AABC Standard 2016, Seventh Edition.
- D. Liaison and Early Inspection:
 - 1. The TAB firm personnel on the job shall act as liaison between the Owner, Architect and Contractor. The following reviews (observations) and tests shall be performed by the TAB Firm:
 - a. During the early design stages of the project, review the mechanical drawings and specifications for balance-ability and provide commentary.
 - b. During construction, review all HVAC submittals such as control diagrams, air handling devices, etc, that pertain to commissioning work and balance-ability.
 - c. Allow for a fixed number of trips to the project site, over and above those required for testing and balancing for inspection of installation of the mechanical piping systems, sheet metal work, temperature controls and other component parts of the heating, air conditioning and ventilating systems during the construction stage.
 - d. These inspections shall be made prior to and/or at the above ceiling inspection. Commentary will be provided to the Owner's Representative of each observation.
 - e. Test one (1) 8 inch single duct terminal box for performance capability and leakage as described in Section 23 36 00 - Air Terminal Devices. The shipment of the box to the TAB Firm's lab will be at the manufacturer's cost and the test period will be for 3 weeks from receipt of the box. Submittal data will not be approved until box testing passes. If the sample box is rejected for any reason, the subsequent testing will be at the Contractor's cost and the time allowed will restart when the box is received at the TAB Firm.
 - f. Test one (1) 8 inch dual duct box for performance capability and leakage as described in Section 23 36 00 - Air Terminal Devices. The shipment of the box to the TAB Firm's lab will be at the manufacturer's cost and the test period will be for 3 weeks from receipt of the box. Submittal data will not be approved until box testing passes. If the sample box is rejected for any reason, the subsequent testing will be at the Contractor's cost and the time allowed will restart when the box is received at the TAB Firm.
 - g. Test 10 percent of the single and dual duct boxes for casing and damper leakage when the shipment arrives at the project site.

- 1) All testing (except for the initial boxes) shall be performed on site.
 - 2) Boxes requiring re-testing will be charged to the Contractor at the unit price provided to the Owner.
- h. Test one (1) lab configuration including fume hood with air valve, general exhaust air with air valve and supply air with air valve for performance capability through a full range of inlet pressures
 - i. The tracking capability of the exhaust air versus the supply air will be with the submitted hood sash fully open and as the sash is closed in 2 inch increments until fully closed.
 - j. Track the three (3) valve`s response time in relation to sash movement and the lab differential.
 - k. Attend Commissioning meetings, as required, to support UTSW during all HVAC Commissioning phases.
2. During the balancing process, as abnormalities and malfunctions of equipment or components are discovered by the TAB personnel, the Owner`s Representative shall be advised in writing so that the condition can be corrected by the Contractor.
 - a. The written document need not be formal, but must be understandable and legible.
 - b. Data from malfunctioning equipment shall not be recorded in the final TAB report.
 - c. The TAB firm shall not instruct or direct the Contractor in any of the work, but will make such reports as are necessary to the Owner.

1.8 FINAL AIR BALANCE

- A. General: When systems are complete and ready for operation, the TAB firm will perform a final air balance for all air systems and record the results.
- B. The outside, supply, exhaust and return air volume for each air handling unit, supply fan and exhaust fan and the supply, exhaust or return air volume for each distribution device shall be adjusted to within plus or minus 5 percent of the value shown on the drawings.
- C. Air handling unit and fan volumes shall be adjusted by changing fan speed and adjusting volume dampers associated with the unit.
- D. Air distribution device volume shall be adjusted using the spin-in tap damper for flexible duct connected devices and the device OBD for duct connected devices.
- E. Air distribution devices shall be balanced with air patterns as specified.
- F. Duct volume dampers shall be adjusted to provide air volume to branch ducts where such dampers are shown.
- G. General scope of balancing by the TAB Consultant will include, but is not limited to, the following:
 1. Filters: Check air filters and filter media and balance only system with essentially clean filters and filter media The Division 23 Contractor shall install new filters and filter media prior to the final air balance.
 2. Blower Speed: Measure RPM at each fan or blower to design requirements Where a speed adjustment is required, the Division 23 Contractor shall make any required changes.
 3. Ampere Readings: Measure and record full load amperes for motors.
 4. Static Pressure:
 - a. Static pressure gains or losses shall be measured across each supply fan, cooling coil, heating coil, return air fan, air handling unit filter and exhaust fan.
 - b. These readings shall be measured and recorded for this report at the furthest air device or terminal unit from the air handler supplying that device.
 - c. Static pressure readings shall also be provided for systems which do not perform as designed.
 5. Equipment Air Flow: Adjust and record exhaust, return, outside and supply air CFM (s) and temperatures, as applicable, at each fan, blower and coil.
 6. Coil Temperatures:
 - a. Set controls for full cooling and for full heating loads.
 - b. Read and record entering and leaving dry bulb and wet bulb temperatures (cooling only) at each cooling coil, heating coil and HVAC terminal unit.
 - c. At the time of reading record water flow and entering and leaving water temperatures (In variable flow systems adjust the water flow to design for all the above readings).
 7. Zone Air Flow: Adjust each zone of multizone units, each HVAC terminal unit and air handling unit for design CFM.
 8. Outlet Air Flow:

- a. Adjust each exhaust inlet and supply diffuser, register and grille to within plus or minus 5 percent of design air CFM.
- b. Include all terminal points of air supply and all points of exhaust.
- 9. Pitot Tube Traverses:
 - a. For use in future troubleshooting by maintenance personnel, all exhaust ducts, main supply ducts and return ducts shall have air velocity and volume measured and recorded by the traverse method.
 - b. Locations of these traverse test stations shall be described on the sheet containing the data.
- 10. Maximum and minimum air flow on terminal boxes.

1.9 FINAL CHILLED WATER BALANCE

- A. General: When systems are completed and ready for operation, the TAB Consultant will perform a final water balance for each chilled and hot water system.
- B. The general scope of balancing by the TAB Consultant will include, but not be limited to, the following:
 - 1. Adjusted System Tests:
 - a. Adjust balancing valves at each coil for design flow, plus or minus 5 percent. Adjust balancing valves at pumps to obtain design water flow.
 - b. Permanently mark the balanced position for each valve (Note: If discharge valves on the pumps are used for balancing record the head being restricted by the valves).
 - 2. Temperature Readings:
 - a. Read and record entering and leaving water temperature at each water coil.
 - b. Adjust as necessary to secure design and conditions.
 - c. Provide final readings at all thermometer well locations.
 - 3. Pressure Readings:
 - a. Water pressure shall be recorded at all gauge connections.
 - b. Pressure readings at coils and pumps shall be related to coil and pump curves in terms of GPM flow through flow measuring status, if provided and installed, at each air handler.
 - c. The flow of water through all water coils shall be adjusted by manipulating valves until the rated pressure drops across each coil is obtained and total water flow is verified by flow measuring status.
 - d. For coils equipped with 3 way valves, the rated pressure drop shall first be adjusted through the coils.
 - e. The bypass valve shall then be adjusted on each coil until an equal pressure drop between supply and return connections is the same as with the flow through the coil.
 - 4. Ampere Readings: Reading and record full load amperes for each pump motor.

1.10 SOUND AND VIBRATION

- A. Sound:
 - 1. Read and record sound levels at up to 15 locations in the building designated by the Engineer.
 - 2. All measurements shall be made using an Octave Band Analyzer.
 - 3. All tests shall be conducted when the building is quiet in the presence of the Engineer, if they so desires.
- B. Vibration:
 - 1. Witness vibration testing as specified in other sections. Provide test results to UTSW Representative.
 - 2. Readings will be made using portable IRD (or approved equal) equipment capable of filtering out various unwanted frequencies and standard reporting forms.
 - 3. Maximum vibration at any point listed above, or specified, shall not exceed 1 mil on fans and 1 mil on pumps unless otherwise specified.
 - 4. Equipment manufacturers shall rectify all systems exceeding vibration tolerances.

1.11 TESTING OF TEMPERATURE CONTROL SYSTEMS

- A. In the process of performing the TAB work, the TAB Firm shall:
 - 1. Work with the temperature control contractor to ensure the most effective total system operation within the design limitations, and to obtain mutual understanding of intended control performance.
 - 2. Verify that all control devices are properly connected.
 - 3. Verify that all dampers, valves and other controlled devices are operated by the intended controller.

4. Verify that all dampers and valves are in the position indicated by the controller (open, closed or modulating).
 5. Verify the integrity of valves and dampers in terms of tightness of close-off and full-open positions This includes dampers in multizone units, terminal boxes and fire/smoke dampers.
 6. Observe that all valves are properly installed in the piping system in relation to direction of flow and location.
 7. Observe the calibration of all controllers.
 8. Verify the proper application of all normally opened and normally closed valves.
 9. Observe the locations of all space thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts or cold walls.
 10. Observe the locations of all sensors to determine whether their position will allow them to sense only the intended temperatures or pressures of the media Control Contractor will relocate as deemed necessary by the TAB Firm.
 11. Verify that the sequence of operation for any control mode is in accordance with approved shop drawings and specifications Verify that no simultaneous heating and cooling occurs.
 12. Verify that all controller setpoints meet the design intent.
 13. Check all dampers for free travel.
 14. Verify the operation of all interlock systems.
 15. Perform variable volume system verification to assure the system and it's components track with changes from full flow to minimum flow.
- B. A systematic listing of the above testing and verification shall be included in the final TAB report:
1. Each system will be tested in accordance with written control sequence verification procedures.
 2. The written control sequence verification will document the performance of the specified control sequence and the control manufacturers as built drawings.
 3. The written control sequence verification will identify each components sequence, safety devices and alarms.
- C. List all the control points of each system Verify back to the front end graphics that the point is calibrated and the graphics indicate a change in value with the correct point name.

1.12 REPORTS

- A. The activities described in this section shall culminate in a report to be provided in an electronic report to the Owner's representative. Comply with requirements in Section 01 77 00 - Closeout Procedures and Submittals.
1. Neatly type and arrange data.
 2. Include with the data the date tested, personnel present, weather conditions, nameplate record of test instrument and list all measurements taken after all corrections are made to the system.
 3. Record all failures and corrective action taken to remedy incorrect situation.
 4. The intent of the final report is to provide a reference of actual operating conditions for the Owner's operations personnel.
 5. The report will be organized in the following manner:
 - a. Title Sheet.
 - b. Table of Contents (Per system).
 - c. AHU Data (Numerical sequence).
 - d. Air Distribution Data, Traverse Data, All Supporting Data, etc.
 - e. FCU, CRAC, etc. with supporting data.
 - f. Fan Data with supporting data.
 - g. Chilled Water System Data (Heat Transfer Equip., Pumps, etc.).
 - h. Heating Water System Data (Heat Transfer Equip., Pumps, etc.).
 - i. Control Verification (Sequences, Sensor Calibration, Point to Point, Graphics, etc).
 - j. All measurements and recorded readings (of air, water, electricity, etc) that appear in the reports must have been made onsite by the permanently employed technicians or engineers of the firm.
 - k. At the option of the Owner's Representative, all data sheets tabulated each day by TAB personnel shall be submitted for initial by the Owner's Representative Those work sheets so initialed, or copies thereof, shall be presented as a supplement to the final TAB report.

- B. Submit reports in electronic forms approved by the Owner & Engineer which will include the following information as a minimum:
1. Title Page:
 - a. Company Name.
 - b. Company Address.
 - c. Company telephone number.
 - d. Project name.
 - e. Project location.
 - f. Project Manager.
 - g. Project Engineer.
 - h. Project Contractor.
 - i. Project Identification Number.
 2. Instrument List:
 - a. Instrument.
 - b. Manufacturer.
 - c. Model.
 - d. Serial Number.
 - e. Range.
 - f. Calibration date.
 - g. What test instrument was used for.
 3. Fan Data (Supply and Exhaust):
 - a. Location.
 - b. Manufacturer.
 - c. Model.
 - d. Air flow, specified and actual.
 - e. Total static pressure (total external), specified and actual.
 - f. Inlet pressure.
 - g. Discharge pressure.
 - h. Fan RPM.
 4. Return Air/Outside Air Data (If fans are used, same data as for 3 above):
 - a. Identification/location.
 - b. Design return air flow.
 - c. Actual return air flow.
 - d. Design outside air flow.
 - e. Return air temperature.
 - f. Outside air temperature.
 - g. Required mixed air temperature.
 - h. Actual mixed air temperature.
 5. Electric Motors:
 - a. Manufacturer.
 - b. HP/BHP.
 - c. Phase, voltage, amperage, nameplate, actual.
 - d. RPM.
 - e. Service factor.
 - f. Starter size, heater elements, rating.
 6. Duct Traverse:
 - a. System zone/branch.
 - b. Duct size.
 - c. Area.
 - d. Design velocity.
 - e. Design air flow.
 - f. Test velocity.
 - g. Test air flow.
 - h. Duct static pressure.
 - i. Air temperature.
 - j. Air correction factor.

7. Air Monitoring Station Data:
 - a. Identification/location.
 - b. System.
 - c. Size.
 - d. Area.
 - e. Design velocity.
 - f. Design air flow.
 - g. Test velocity.
 - h. Test air flow.
8. Air Distribution Test Sheet:
 - a. Air terminal number.
 - b. Room number/location.
 - c. Terminal type.
 - d. Terminal size.
 - e. Area factor.
 - f. Design velocity.
 - g. Design air flow.
 - h. Test (final) velocity.
 - i. Test (final) air flow.
9. Cooling Coil Data:
 - a. Identification/number.
 - b. Location.
 - c. Service.
 - d. Manufacturer.
 - e. Entering air DB temperature, design and actual.
 - f. Entering air WB temperature, design and actual.
 - g. Leaving air DB temperature, design and actual.
 - h. Leaving air WB temperature, design and actual.
 - i. Water pressure flow, design and actual.
 - j. Water pressure drop, design and actual.
 - k. Entering water temperature, design and actual.
 - l. Leaving water temperature, design and actual.
 - m. Air pressure drop, design and actual.
10. Heating Coil Data:
 - a. Identification/number.
 - b. Location.
 - c. Service.
 - d. Manufacturer.
 - e. Air flow, design and actual.
 - f. Entering water or steam temperature, design and actual.
 - g. Entering air temperature, design and actual.
 - h. Leaving air temperature, design and actual.
 - i. Air pressure drop, design and actual.
11. Sound Level Report:
 - a. Location (Location established by the design engineer).
 - b. NC curve for eight (8) bands - equipment off.
 - c. NC curve for eight (8) bands - equipment on.
12. Control verification indicating date performed and any abnormalities identified:
 - a. Point Location/Description.
 - b. EMS Readout (Setpoint and Actual).
 - c. Actual Readout.
 - d. Interlocks.
 - e. Alarms.
 - f. Sequences of Operation.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 23 05 94

SECTION 23 07 13
DUCTWORK INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Ductwork insulation.
- B. Insulation jackets.

1.3 RELATED REQUIREMENTS

- A. Section 09 91 23 - Interior Painting.
- B. Section 23 00 00 - UTSW Mechanical Design Requirements.
- C. Section 23 31 00 - Ductwork.
- D. Section 23 33 00 - Ductwork Accessories.

1.4 REFERENCE STANDARDS

- A. ASHRAE 90.1 - Energy Standards for Buildings Except Low-Rise Residential Buildings.
- B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- D. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
- E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.
- H. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- I. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.
- J. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005.
- K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.5 SUBMITTALS

- A. Submit under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
- B. Product Data: Provide product description, list of materials and thickness for each service, and locations.
- C. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.
- D. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.6 QUALITY ASSURANCE

- A. Materials: Flame spread/smoke developed rating of 25/50 in accordance with NFPA 255.

1.7 QUALIFICATIONS

- A. Applicator: Company specializing in performing the work of this section with minimum three years' experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
- B. Deliver materials to site in original factory packaging, labeled with manufacturer's density and thickness.
- C. Store insulation in original wrapping and protect from weather and construction traffic. In no instance shall ductwork insulation be stored outdoors or where subject to moisture damage.
- D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 - PRODUCTS

2.1 INSULATION A - GLASS FIBER SEMI-RIGID INSULATION

- A. Three pound per cubic foot minimum density glass fiber semi-rigid board insulation with fiber perpendicular to the surface and with factory applied white foil reinforced vapor barrier jacket (ASJ). Insulation shall be equal to E.O. Woods Company "Rigid-Wrap".
- B. The insulation shall be secured to the ducts with mechanical fasteners; "Stick-clips", Graham Pins or Speed Clips, and shall be spaced approximately 12 inches on center on bottom of duct and where required elsewhere to hold insulation securely against the duct per the Insulation Manufacturer recommendations. Stick pins welded to ductwork are not acceptable.
 - 1. Insulation on the bottom of duct and on vertical sections shall be coated with an adhesive and pushed firmly against the ductwork as well as being secured with mechanical fasteners. Adhesives shall be approved by the insulation manufacturer for use with the insulation and shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. After insulation is in place, all joints and seams shall be sealed with Foster 30-90 white vapor barrier mastic (water based) applied over a 3 inches wide strip of Duramesh Glass Fabric. All protrusions through the vapor barrier shall be thoroughly sealed.
- D. On ducts that are reinforced with standing seams or angle iron stiffeners 1 inch and over in height, the Contractor shall apply a strip of fiberglass board 1 inch thick by 6 inches wide, sealing same to the other insulation with mastic.

2.2 INSULATION B - GLASS FIBER RIGID BOARD INSULATION

- A. Three pound per cubic foot minimum density glass fiber rigid board insulation with factory applied white foil reinforced All Service Jacket (ASJ).
- B. Insulation B shall be applied as specified for Insulation A.
- C. Contractor at option may substitute Insulation A where Insulation B is called for.

2.3 INSULATION C - GLASS FIBER BLANKET INSULATION

- A. Blanket insulation with a thermal conductivity (K) of 0.27 or less similar in construction to Owens-Corning Fiberglass Series one pound per cubic foot minimum density with foil reinforced Kraft (FRK) vapor barrier facing. Insulation shall be applied flat on the ductwork with all circumferential joints butted. longitudinal joints overlapped a minimum of 2 inches and per manufacturer's recommendations. Adhere insulation to metal with 4 inches strips of insulation bonding adhesive at 8 inches on center. On circumferential and longitudinal joints, the 2 inch flange of the facing shall be secured using 9/16 inch flare door staples applied 6 inches on center and taped with 4 inch wide fiberglass tape embedded in Foster 30-90 white vapor barrier Emulsion and covered with Foster 30-90 white vapor barrier Emulsion until the tape is completely covered. All pin penetrations or punctures in facing shall also be taped.

2.4 PROTECTIVE JACKETING

- A. Jacketing and fitting covers shall be 0.016 inches aluminum smooth as manufactured by Premetco or Childers. The jacket shall be pre-cut, pre-rolled and lapped a minimum of 2 inches in all directions to shed water. The metal shall be secured at each joint with a minimum of one each 3/4 inch wide 0.020 inch aluminum or stainless steel band and seal. The metal jacketing and fitting covers shall be fabricated of 0.016 inch aluminum or stainless steel with a smooth finish.

2.5 SCOPE OF DUCT INSULATION

- A. All ductwork in the building and in the crawl spaces except toilet exhaust and fume hood exhaust ducts shall be insulated externally unless specifically excluded. Only sound attenuated return ducting may be insulated internally, if specifically designated as such. Refer to Section 23 33 00 - Ductwork Accessories for duct liner specifications.
- B. Where ducts are lined internally, (see Drawings for Scope) no exterior insulation will be required, except where specifically stated otherwise. Where internal and external insulation join, they shall lap at least 24 inches.

- C. Low pressure supply duct taps to ceiling diffusers shall be externally insulated including top of ceiling diffuser with 2 inches Insulation C.
- D. Flexible round ducts are specified in Section 23 31 00 - Ductwork as factory insulated.
- E. All kitchen hood exhaust ductwork connected to both inlet and discharge sides of Fans shall be insulated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that ductwork has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Insulated ductwork conveying air below ambient temperature:
 - 1. Finish with tape and vapor barrier jacket.
 - 2. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 3. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- C. Insulated ductwork conveying air above ambient temperature:
 - 1. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- D. For ductwork exposed in mechanical equipment rooms or in finished spaces, finish with aluminum jacket.
- E. For exterior applications, provide insulation with vapor barrier jacket. Cover with caulked aluminum jacket with seams located on bottom side of horizontal duct section.
- F. All insulation shall be applied by mechanics skilled in this particular work and regularly engaged in such occupation. All insulation shall be applied in strict accordance with these Specifications and with factory printed recommendations on items not herein mentioned. Unsightly, inadequate, or sloppy work will not be acceptable, and all such work shall be removed and replaced as many times as necessary to achieve an acceptable installation.
- G. All insulation, jacket, adhesives, mastics, sealers, etc., utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50 smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application, and is stated as an exception to this requirement. Certificates to this effect shall be submitted along with Contractor's submittal data for this section of the Specifications. No material may be used that, when tested by the ASTM E84 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.
- H. All surfaces to be insulated shall be clean and dry before applying the insulation. All sections of molded pipe covering shall be firmly butted together. Where an insulation covering is applied, it shall lap the adjoining section of insulation by at least 3 inches. Where insulation terminates, it shall be neatly beveled and finished. No insulation shall be applied until the duct has been successfully leak tested. Flexible connections on duct shall not be covered. All materials used shall be fire retardant or nonflammable.
- I. Vapor barrier shall be on the outside. Extreme care shall be taken that the vapor barrier is unbroken. Joints, etc., shall all be sealed. Where insulation with a vapor barrier terminates, it shall be sealed off with the vapor barrier being continuous to the surface being insulated. Ends shall not be left raw.
- J. Extreme care shall be taken in covering high and medium pressure (high and medium pressure ductwork shall be all ductwork between the fan discharge and all mixing boxes) ductwork to insure the duct is not pierced with sheet metal screws or other fasteners. All high and medium pressure ducts in these specifications are classified as high velocity ductwork.
- K. For purpose of definition in this Specification: "concealed" areas are those areas which cannot be seen by the building occupants, and "exposed" areas are all areas which are exposed to view by the building occupants, including under counter and inside cabinet areas, plus all mechanical rooms.
- L. The handling and installation of all insulation materials shall be performed in strict accordance with the manufacturer's recommendations.

3.3 TOLERANCE

- A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

3.4 DUCT INSULATION SCHEDULE

Duct Type	Duct Location	Insulation Type	Insulation Thickness (inches)	R Value	Jacketing
Medium pressure supply ductwork	Concealed, Conditioned and plenum	C	2.2	6.0	ASJ
Low pressure supply ductwork	Concealed	C	2.2	6.0	ASJ
Return air ductwork		C	2.2	6.0	ASJ
Supply diffuser housing / plenum		C	1.5	4.2	ASJ

END OF SECTION 23 07 13

SECTION 23 07 19
PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Piping insulation.
- B. Jackets and accessories.

1.3 RELATED REQUIREMENTS

- A. Section 23 00 00 - UTSW Mechanical Design Requirements.
- B. Section 23 05 29 - Supports and Anchors.
- C. Section 23 05 53 - Mechanical Identification.
- D. Section 23 20 10 - Piping, Valves, and Fittings.
- E. Section 23 21 13 - Hydronic Piping

1.4 REFERENCE STANDARDS

- A. ASHRAE 90.1 - Energy Standards for Buildings Except Low-Rise Residential Buildings.
- B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- C. ASTM C165 - Standard Test Method for Measuring Compressive Properties of Thermal Insulations.
- D. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- E. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
- F. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
- G. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- H. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
- I. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- J. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
- K. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.
- L. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- M. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- N. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing.
- O. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- P. ASTM C1695 - Standard Specification for Fabrication of Flexible Removable and Reusable Blanket Insulation for Hot Service.
- Q. ASTM C1775 - Standard Specification for Laminate Protective Jacket and Tape for Use Over Thermal Insulation for Outdoor Applications.
- R. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
- S. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.
- T. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- U. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

- V. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C.
- W. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- X. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005.
- Y. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.5 SUBMITTALS

- A. Submit under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
- B. Product Data: Provide product description, list of materials 'k' value, 'R' value, mean temperature rating, and thickness for each service, and locations.
- C. Samples: When requested, submit two samples of any representative size illustrating each insulation type.
- D. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.
- E. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.6 QUALITY ASSURANCE

- A. All insulation, jacket, adhesives, mastics, sealers, etc., utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50 smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application, and is stated as an exception to this requirement. Certificates to this effect shall be submitted along with Contractor's submittal data for this section of the Specifications. No material may be used that, when tested by the ASTM E84 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.
- B. All surfaces to be insulated shall be clean and dry before applying the insulation. All sections of molded pipe covering shall be firmly butted together. Where an insulation covering is applied, it shall lap the adjoining section of insulation by at least 3 inches. Where insulation terminates, it shall be neatly beveled and finished. No insulation shall be applied until the pipe, duct, etc., have been pressure tested and found tight. Piping, flexible connections, flanges, valves, strainers, and unions shall be covered unless specifically noted otherwise. Flexible connections on duct shall not be covered. All materials used shall be fire retardant or nonflammable. Refer to Section 23 00 00 - UTSW Mechanical Design Requirements.
- C. All piping shall be insulated as indicated on the Drawings, as specified herein, and as required for a complete system. In each case, the insulation shall be equal to that specified and materials applied and finished as described in these Specifications.
- D. To be considered, alternate materials shall have equivalent thermal and moisture resistance of the specified materials.

1.7 QUALIFICATIONS

- A. The company performing the work of this section shall have a minimum of three years' experience specializing in the trade.
- B. All insulation shall be applied by mechanics skilled in this particular work and regularly engaged in such occupation.
- C. All insulation shall be applied in strict accordance with these Specifications and with factory printed recommendations on items not herein mentioned.
- D. Unsightly, inadequate, or sloppy work will not be acceptable, and all such work shall be removed and replaced as many times as necessary to achieve an acceptable installation.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
- B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product thermal ratings and thickness.
- C. Store insulation in original wrapping and protect from weather and construction traffic. Protect insulation against dirt, water, chemical, and mechanical damage.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.
- C. All insulation materials to be asbestos free.

PART 2 - PRODUCTS

2.1 TYPE A: CALCIUM SILICATE

- A. Manufacturers:
 - 1. Johns Manville Corporation.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation:
 - 1. Manville Thermo-12 or equal calcium silicate sectional piping insulation with a "K" factor of 0.40 BTU-In/Hr.- degree F at 100°F and 0.50 BTU-In/Hr.-degree F at 400°.
 - 2. Rated maximum service temperature of 1200°F (650°C).
 - 3. Maximum density of 15 lbs/ft³.
 - 4. Compressive strength of 100 psi minimum when tested in accordance with ASTM C165.
 - 5. Rated as 0 flame spread and 0 smoke developed when tested in accordance with ASTM E84, UL 723, NFPA 255.
 - 6. Certified to meet the requirements of ASTM C795 for use over stainless steel.
 - 7. Rated as noncombustible when tested in accordance with ASTM E136.
 - 8. Effective corrosion inhibitor is equal to or better than DI water standard.
 - 9. Install product using manufacturer's recommended methods and accessories unless alternate methods are specified in Part 3 – Installation (General) or in this section.
 - 10. Installation:
 - a. Joints shall be sealed with aluminum snap straps provided, fastened in place with 3/4 inch wide x 0.020 inch stainless steel bands. Fittings and valves shall be insulated with the same thickness as that applied to the adjacent pipe and shall have an outer removable covering of aluminum.
 - b. Pipe insulation shall be firmly wired in place by the use of no less than six (6) loops of No. 16 annealed copper clad iron wire per three foot section of insulation. These sections shall be staggered. The ends of these loops shall be twisted together tightly and bent over and hammered into the insulation so as to leave no projection. Bands shall be 0.020 inch thick, 3/4 inch wide, 3 bands per section of insulation. Fittings, valves, etc., shall have bands on each side.
 - c. All fittings on pipe 4 inch and larger shall be covered with the same material as the pipe, mitered and smoothed, and securely wired to the pipe.
 - d. Fittings and valves for pipe smaller than 4 inches shall be insulated with Calcoat-127 insulating finishing cement and each application shall be in layers not thicker than 1/2 inch. Each layer shall be allowed to dry before the next layer is applied.
 - e. All cracks and voids in this insulation shall be filled carefully with Calcoat-127 insulating finishing cement so that the resulting surface is smooth and continuous.
 - f. At all pipe flanges, the insulation shall be beveled in such a manner that access may be had to the bolt studs and nuts without injuring the insulation where removable covers have been specified.
 - g. A layer of 40 pound rosin-size paper or 3/4 pound deadening felt shall be wrapped around the insulation before an 8 ounce canvas jacket is pasted in place. This canvas jacket shall be pasted onto the covered pipe valves and fittings (where insulated) in a neat and workmanlike fashion, using adhesive.
 - h. All flanges, valves, pressure regulating valves, strainers, and any other hot surfaces shall be covered with a built-up removable covering made of Thermo-12 Pipe Covering with a finishing coat of Calcoat-127 insulating finishing cement. This removable covering shall be banded on the valve or joint in such a fashion that it can readily be removed and replaced; it shall be of the same thickness as the insulation on the adjoining pipe.
 - i. Piping insulated with calcium silicate pipe insulation and finished with canvas outer jacket shall be painted in accordance with campus paint scheme.

2.2 TYPE B: CELLULAR GLASS THERMAL INSULATION

A. Manufacturers:

1. Owens Corning Corporation.
2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation:

1. Foamglas One Insulation with a "K" factor of 0.29 BTU-In/Hr.-degree F at 75°F manufactured by Pittsburgh Corning Corporation and fabricated by a Pittsburgh Corning Corporation-approved fabricator. Water vapor permeability shall be 0.00 perm-in. The insulation shall comply with ASTM C552 Type II, furnished in half sections up to 36 inches long or segments 18 inches long.
2. Rated maximum service temperature of 900°F.
3. Maximum density of 7.3 lbs/ft³.
4. Compressive strength of 90 psi minimum when tested in accordance with ASTM C165.
5. Rated as 0 flame spread and 0 smoke developed when tested in accordance with ASTM E84, UL 723, NFPA 255.
6. Certified to meet the requirements of ASTM C795 for use over stainless steel.
7. Rated as noncombustible when tested in accordance with ASTM E136.
8. Install product using manufacturer's recommended methods and accessories unless alternate methods are specified in Part 3 – Installation (General) or in this section.
9. Installation:
 - a. Prior to application of any insulation, all metal surfaces shall be thoroughly cleaned.
 - b. The metal shall then be primed with an asphaltic primer consisting of one (1) coat of Foster No. 60-26 Primer or Pittcote 300 Primer. Cleaning and priming specified in this paragraph is not included in requirements for "Cleaning and Painting" specified in other sections of the Specifications.
 - c. Regular Foamglas or phenolic foam insulation shall be applied to the piping with butt joints staggered and all joints tightly butted and sealed with a 1/4 inch bead of joint sealer 1/2 inch from outside edge. Hold in place with 14 gauge copper clad wire 9 inches o.c. After insulation has been wired in place, a 1/16 inch minimum thick, 3 inch wide band of asphaltic vapor seal mastic shall be brushed or troweled on the outside of the Foamglas or phenolic foam insulation at the approximate location of the aluminum bands. (Note that the asphaltic material specified in this paragraph is intended to be an exception to the flame spread and smoke generation limitations found elsewhere in this specification.) An aluminum jacketing 0.016 inch thickness equal to Gasco, Papco RPR Metals, or other precast, pre rolled Z-lock Kraft paper lined pipe covering with zee type closure and 3/4 inch wide snap straps with permanent sealant shall then be fitted to O.D. of insulation and applied over the insulated pipe with 3 inch end and side caps secured with aluminum bands on 12 inch centers. Longitudinal joint of aluminum jacketing shall be placed with overlap directed to bottom of pipe. Any voids in the completed installation of the insulation shall not be filled with vapor seal coating but shall be eliminated by refitting or replacing insulation.
 - d. Foamglas or phenolic foam insulation on flanges, valves and other fitting shall consist of prefabricated fitting covers of the same thickness as specified for adjoining pipe insulation.
 - e. Fitting covers shall be applied in same manner as pipe application except that 16 gauge aluminum wire may be used to secure screwed fitting covers. Protruding metal parts (such as valve stems) shall be completely sealed off. Fitting cover jacketing shall be equal to Gasco, Papco or RPR Metals prefabricated fitting covers of 0.016 inch paper coated aluminum, secured as recommended by the manufacturer.
 - f. The insulation thickness shall be as scheduled.
 - g. Fitting covers shall be built up of shaped segments of Foamglas or phenolic foam. These fitting covers shall be adhered in place using "Foster No. 30-35 water based vapor seals, then smoothly covered by a 1/4 inch thick application of one coat white insulating cement. All this piping and fittings shall be finished with an eight ounce canvas jacket neatly applied using adhesive.
 - h. Valves, fittings, etc., in congested areas around coil and heat exchanger equipment, etc., shall be insulated by building up fitting segments and pre-molded sections, plus white vapor seal mastic, plus Manville Calcoat-127 insulating finishing cement to smooth surfaces, plus canvas applied and sized for painting with fire resistant adhesive. In addition, all manufactured vapor

barrier jacketing in mechanical rooms and finished spaces shall be finished with canvas applied and sized for painting with fire resistant adhesive.

- i. No chilled water pipe supporting structures shall pierce the insulation except as anchor points as shown on the Drawings. At these points, the anchor member shall occur on the bottom of the piping to allow condensation to drain.
- j. The application of the protective shields at rack and guide points in tunnels and in central chilling stations shall be as detailed on the accompanying Drawings.
- k. All insulation joints (longitudinal and butt) shall be buttered with vapor sealant mastic then pressed firmly together.

2.3 TYPE C: PHENOLIC FOAM

A. Manufacturers:

1. Johns Manville.
2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation:

1. Phenolic Foam by ITW Trymer or equal with a "K" factor of 0.19 BTU-In/Hr.-degree F at 75°F.
2. Rated maximum service temperature of 257°F.
3. Maximum density of 3.75 lbs/ft³
4. Compressive strength of 45 psi minimum when tested in accordance with ASTM C165.
5. Rated as 25 flame spread and 50 smoke developed when tested in accordance with ASTM E84 , UL 723, NFPA 255.
6. Certified to meet the requirements of ASTM C795 for use over stainless steel.
7. Rated as noncombustible when tested in accordance with ASTM E136.
8. Install product using manufacturer's recommended methods and accessories unless alternate methods are specified in Part 3 – Installation (General) or in this section.
9. Installation: As Type B, above.

2.4 TYPE D: FIBERGLASS

A. Manufacturers:

1. CertainTeed Corporation
2. Johns Manville Corporation
3. Knauf Insulation
4. Owens Corning Corporation
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation:

1. Owens Corning or equal glass fiber insulation piping insulation with a "K" factor of 0.23 BTU-In/Hr.-degree F at 75°F and 0.32 BTU-In/Hr.-degree F at 250°
2. Rated maximum service temperature of 850°F.
3. Maximum density of 3.5-5.5 lbs/ft³.
4. Compressive strength of 28.5 psi minimum when tested in accordance with ASTM C165.
5. Rated as 25 flame spread and 50 smoke developed when tested in accordance with ASTM E84, UL 723, NFPA 255.
6. Certified to meet the requirements of ASTM C795 for use over stainless steel.
7. Rated as noncombustible when tested in accordance with ASTM E136.
8. Insulation treated with water resistant resin on the surface and within each layer of the insulation.
9. Install product using manufacturer's recommended methods and accessories unless alternate methods are specified in Part 3 – Installation (General) or in this section.

2.5 TYPE E: CLOSED CELL ELASTOMERIC

A. Manufacturers:

1. Armacell.
2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation:

1. Closed cell elastomeric piping insulation with a "K" factor of 0.25 BTU-In/Hr.-degree F at 75 F as manufactured by Armacell or equal.
2. Rated maximum service temperature of 220°F.

3. Rated as 25 flame spread and 50 smoke developed when tested in accordance with ASTM E84, UL 723, NFPA 255.
4. Certified to meet the requirements of ASTM C795 for use over stainless steel.
5. Rated as noncombustible when tested in accordance with ASTM E136.
6. Elastomeric products shall be supplied in a pre-slit tubular form with a pressure sensitive adhesive system for closure and vapor sealing of the longitudinal joint.
7. Install product using manufacturer's recommended methods and accessories unless alternate methods are specified in Part 3 – Installation (General) or in this section.

2.6 TYPE F: HIGH TEMPERATURE FIBERGLASS

A. Manufacturers:

1. Eslin.
2. Knauf Insulation.
3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation:

1. ESLIN EG-SCUI or equal glass fiber insulation piping insulation with a "K" factor of 0.30 BTU-In/Hr.-degree F at 200°F and 0.48 BTU-In/Hr.-degree F at 600°.
2. Rated maximum service temperature of 1200°F (650°C).
3. Maximum density of 12.5 lbs/ft³
4. Compressive strength of 28.5 psi minimum when tested in accordance with ASTM C165.
5. Rated as 0 flame spread and 0 smoke developed when tested in accordance with ASTM E84, UL 723, NFPA 255.
6. Certified to meet the requirements of ASTM C795 for use over stainless steel.
7. Rated as noncombustible when tested in accordance with ASTM E136.
8. Insulation treated with water resistant resin on the surface and within each layer of the insulation.
9. Install product using manufacturer's recommended methods and accessories unless alternate methods are specified in Part 3 – Installation (General) or in this section.

2.7 SILICA AEROGEL

A. Manufacturers:

1. Aspen Aerogels Pyrogel XT-E.
2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation shall be a high-temperature, flexible, hydrophobic insulation blanket formed of silica aerogel and reinforced with a non-woven, glass-fiber batting. Insulation shall be provided in blanket form for wrapping of straight pipe sections, equipment, and tanks. Prefabricated insulation sections shall be provided for piping elbows. Insulation shall be available in 0.20 inch and 0.40 inch thickness.

1. Insulation shall be the following performance requirements:
 - a. Thermal Conductivity:
 - 1) 0.14 Btu-in/hr-ft²-°F at 32°F
 - 2) 0.16 Btu-in/hr-ft²-°F at 212°F
 - 3) 0.19 Btu-in/hr-ft²-°F at 392°F
 - b. Flame Spread: ≤ 5
 - c. Smoke Production: ≤ 10
 - d. Average Density: 12.5 lb/ft³
 - e. Maximum Temperature: 1,200 °F
 - f. Compressive Strength: 14.8 lb/in² (Stress at 10 percent strain).
2. Insulation shall be secured to pipe using bands per Manufacturer's recommendations.

2.8 FLEXIBLE REMOVABLE AND REUSABLE BLANKET INSULATION

A. Manufacturers:

1. Auburn Manufacturing Inc; Ever Green Cut 'n Wrap.
2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation: ASTM C553 Type V; flexible, noncombustible.

1. Comply with ASTM C1695.
2. K (Ksi) Value: 0.37 at 100 degrees F (0.053 at 38 degrees C), when tested in accordance with ASTM C177 or ASTM C518.
3. Minimum Service Temperature: 32 degrees F (0 degrees C).

4. Maximum Service Temperature: 500 degrees F (260 degrees C).
5. Maximum Water Vapor Absorption: 5.0 percent by weight.
6. Color: Gray, Green.
7. Weight: 7.65 oz/sq ft (2334.4 g/sq m).
8. Effective Thickness: 1.25 +/- 0.25 inch (0.032 +/- 0.0064 m).

2.9 PROTECTIVE JACKETING

- A. General:
 1. All jacketing shall be installed with the seam located along the bottom.
 2. At valves and special fittings, provide removable jackets to nearest flange in both direction for maintenance and removal of fittings.
- B. Aluminum Jacketing and fitting covers: 0.016 aluminum smooth . The jacket shall be pre-cut, pre-rolled, and lapped a minimum of 2 inches in all directions to shed water. The metal shall be secured at each joint with a minimum of one each (1 ea.)
 1. Manufacturers:
 - a. Gasco.
 - b. Papco RPR Metals.
 - c. Childers.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 2. 3/4 inch wide 0.020 aluminum or stainless steel band and seal. The metal jacketing and fitting covers shall be fabricated of 0.016 inch aluminum or stainless steel with a smooth finish.
- C. Aluminum-Foil Laminate Jacket:
 1. Manufacturers:
 - a. H.B. Fuller Construction Products, Inc; Foster - Vapor-Fas.
 - b. Ideal Tape Co., Inc; _____.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Finish: Aluminum smooth.
 3. Comply with ASTM C1775.
- D. PVC Jacketing:
 1. Manufacturers:
 - a. Johns Manville Corporation; _____.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 2. PVC jacketing and fitting covers.
 - a. Material shall have 25/50 rating and shall be limited to piping systems operating at 140 degrees or below.
 - b. Thickness: 10 mil, 0.010 inch (0.25 mm).
 3. PVC color jacketing is required on all piping and shall match color requirements in Section 23 05 53 - Mechanical Identification.
- E. Stainless Steel Jacket: ASTM A666, Type 304 stainless steel.
 1. Thickness: 0.010 inch (0.25 mm).
 2. Finish: Smooth.
 3. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.

2.10 INSULATED UNDERGROUND PIPING

- A. See Section 23 20 10 - Piping, Valves, and Fittings.

PART 3 - INSTALLATION

3.1 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions in the absence of specific instruction herein.
- B. On exposed piping, locate insulation and cover seams in least visible locations, but not higher than at the side of the pipe at the "90°" position, with the seam lapped such that the lap is directed down.
- C. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.

- D. Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:
 1. Provide vapor barrier jackets, factory applied, or field applied.
 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe.
 3. Finish with glass cloth and vapor barrier adhesive.
 4. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
 5. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. For insulated pipes conveying fluids above ambient temperature:
 1. Provide standard jackets, with or without vapor barrier, factory applied or field applied.
 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
 3. If PVC fitting covers are used they shall have 25/50 rating.
 4. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
 5. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions, including those at equipment, but label the insulation to indicate a concealed flange or union.
- F. Where vapor barriers are required, the vapor barrier shall be on the outside. Extreme care shall be taken that the vapor barrier is unbroken. Joints, etc., shall be sealed. Where insulation with a vapor barrier terminates, it shall be sealed off with the vapor barrier being continuous to the surface being insulated. Ends shall not be left raw.
- G. Where specified, aluminum bands shall be used on piping insulation. The bands shall be applied three minimum to a section of pipe. Fittings, valves, etc. shall have bands on each side.
- H. The handling and installation of all insulation materials shall be performed in strict accordance with the manufacturer's recommendations.

3.3 INSTALLATION OF SILICA AEROGEL INSULATION

- A. Follow the manufacturer's installation guidelines where they differ from the following directions.
- B. Install insulation in the longest sections feasible to reduce the quantity of circumferential joints.
- C. Install multiple layers of installation to achieve the specified thickness by wrapping the pipe multiple times. Overlap circumferential joints for lower layers of insulation with the following layer a minimum of 6 inches. Avoid placing longitudinal joints of multiple layers at the same circumferential location.
- D. Cover pipe elbows using pre-fabricated "gore-style" insulation fittings.
- E. Follow manufacturer's detailed instructions for the installation over pipe ends, reducers, tees, piping shoes, valves, and flanges.
- F. Secure insulation in place with metal banding before installing finished jacketing.

3.4 INSERTS, SUPPORTS AND SHIELDS

- A. Application: Piping 3/4 inch diameter or larger for all systems except direct buried.
- B. Shields: Install between pipe hangers or pipe hanger rolls and inserts. Hangers shall be on the outside of the insulation and shall not be in contact with the pipe. Shields shall be installed at all locations of support. Curved metal shields shall be used between the hangers or support points and the bottom of the insulated pipe for insulated pipes 3/4 inch and larger. Curved metal shields shall be designed to limit the bearing stress on the insulation to 35 psi and shall be curved to fit up to mid-perimeter of the insulated pipe. Shields shall be made of galvanized iron, or black iron painted on both sides with two coats of aluminum paint. Required metal shield sizes are as follows:

Nominal IPS (inches)	Metal Thickness of Shield	Lengths (inches)
up thru 2	14 gauge	12
thru 6	12 gauge	16
and above	10 gauge	20

- C. Insert Location: Between support shield and piping and under the finish jacket.
- D. Insert Configuration: Minimum 2 inches longer than length of shield, of same thickness and contour as adjoining insulation; may be factory fabricated.
- E. Insert Material: Heavy density insulating material suitable for the planned temperature range, and the weight of the pipe.
- F. The shields at support points shall be secured with 1/2 x 0.016 inch stainless steel bands and seals.
- G. Finish insulation at supports, protrusions, and interruptions.

H. In lieu of the above the following system of support may be used:

1. At the pipe support positions, the insulation and vapor barrier shall be continuous and shall not be punctured by the support. The insulation at the support shall be the full circumference of 5lbs/ft³ phenolic foam material to withstand the bearing loads transmitted from the pipe to the support; it shall extend for at least 1 inch on either side of the support to allow sealing of the joints with the pipe insulation jacket.
2. The load bearing insulation at the support shall be capable of withstanding the maximum static compressive loads generated by pipe supported at the centers shown in Table Variations: Pipe loads greater than those generated at the support centers shown in Table 1 shall be referred to the manufacturer to establish the length and density of the insulated support block. The support centers are based on the weight of Sch 80 pipe filled with water and covered with 1 inch thickness of 2.2 lbs/ft³ standard insulation including FSK/ASJ vapor barrier.
3. Table 1: K Block Support Centers

Nominal Pipe Size (Inches)	3/4	1	1-1/4	2	2-1/2	3	4	6	8	10	12	14	16	18	20	24
Max support centers (feet)																
Sch 80 pipe filled with water covered with 1 inch of Standard Insulation	6.5	6.5	6.5	10	10	10	10	10	14	14	14	20	20	20	20	20
Metal Saddle Gauge (Galvanized Steel)	22	22	22	20	20	20	16	14	14	14	14	14	14	14	14	14
Length of HLB Block (inches)	6	6	6	6	6	6	6	9	9	9	9	9	9	12	12	12

4. The Insulation at supports shall be Foamglas HLB Blocks. HLB Blocks shall be faced with factory applied FSK/ASJ vapor barrier and fitted with a galvanized steel 1800 saddle bonded to the bottom section of the HLB Block, for all pipe sizes 1 1/2 inch and larger.
 5. The vapor barrier shall be completed by the use of a FSK/ASJ overlap and factory applied self-seal lap tape and sealed with vapor barrier adhesive.
 6. At all support positions, other than those where the insulated pipe support block is surrounded by a clip or saddle in direct contact with the block, a block designed to accept the loads generated by the pipe shall be presented to the engineer for approval.
 7. In all cases where roller supports are used the length of the insulation and the wearing plate where fitted shall extend beyond the limits of the pipe movement.
- I. For purpose of definition in this Specification: “concealed” areas are those areas which cannot be seen by the building occupants, and “exposed” areas are all areas which are exposed to view by the building occupants, including under counter and inside cabinet areas, plus all mechanical rooms.
- J. Self Sealing Lap and butt joints will not be acceptable as the only seal on piping insulation joints. Self Sealing Lap and butt joints may be utilized only if the joints are additionally secured with field applied vapor barrier adhesive (on piping Systems requiring vapor barriers) or staples and field applied adhesive (on piping system which do not require a vapor barrier jacket). Mechanical fasteners shall be used whenever possible to assure permanent installation.
- K. Insulation minimum thickness shall be as scheduled; however, additional thickness shall be provided to prevent condensation on the cold surfaces and to provide a maximum exterior insulation surface of 140 degrees F on the hot surfaces.
- L. Special Protection: All insulated piping in the mechanical rooms within 8’-0” of the floor shall be encased in a protective jacket, and where applicable, finish at top with nickel-plated brass flange plate with set screws or end joint sealing butt strips.

3.5 PAINTING

- A. Prepare exposed insulation receive painting in accordance with Section 09 91 23 - Interior Painting.

3.6 INSULATION APPLICATION SCHEDULE

- A. All insulation R-Values shall be the greater of what is scheduled below or required to meet ASHRAE 90.1.
- B. Where minimum scheduled thickness exceeds the thickness required to meet the minimum R-Value, provide the minimum scheduled thickness. Insulation Thickness depends upon insulation type used.
- C. All insulation R-Values shall be the greater of what is scheduled above or required to meet ASHRAE 90.1.
- D. Use the following jacket types: in concealed interior spaces: All Service Jacket; in interior mechanical spaces: Aluminum Jacket up to 8 feet above floor and All Service Jacket above 8 feet above floor; in tunnel and exterior spaces: Aluminum Jacket.
- E. Minimum 'R' does not consider water vapor transmission and condensation. Additional insulation and/or vapor retarders may be required to limit water vapor transmission and condensation under extreme conditions.
- F. A minus 15 percent tolerance on the insulation performance listed shall be permitted for manufacturers' standard insulation systems.

3.7 PIPING INSULATION SCHEDULE

- A. Insulation thickness for underground piping systems: See Section 33 60 00.
- B. Steam and Steam Condensate:
 - 1. Indoors and in vaults: Minimum Insulation shall be one of the following:
 - a. Pipe sizes 2 inch and smaller: Cellular glass: 3 inches thick.
 - b. Pipe sizes 2.5 inch to 4 inch: Cellular glass: 4 inches thick.
 - 2. Equipment and accessories:
 - a. All valves and flanges: Removable insulation jacket.
 - b. Steam trap stations: Removable insulation jacket.
 - 1) Substitutions: See Section 01 60 00 - Product Requirements.
 - 2) Steam trap stations shall be insulated from the upstream side of the shutoff valve immediately upstream of the steam trap to the downstream side of the shutoff valve immediately downstream of the steam trap station. All components in the steam trap station shall be insulated with one continuous insulation blanket. Strainer blowdown drains and trap drain test ports shall be stubbed through the
- C. Chilled Water
 - 1. Indoors and in vaults: Minimum Insulation shall be one of the following:
 - a. Pipe sizes 2.5 inch and smaller: Cellular glass: 2 inches thick.
 - b. Pipe sizes over 2.5 inch: Cellular glass: 2.5 inches thick.
 - 2. Equipment and accessories:
 - a. All valves and flanges: Removable insulation jacket.
- D. Hot Water
 - 1. Indoors and in vaults: Minimum Insulation shall be one of the following:
 - a. Pipe sizes 2.5 inch and smaller: Cellular glass: 2 inches thick.
 - b. Pipe sizes over 2.5 inch: Cellular glass: 2.5 inches thick.
 - 2. Concealed or plenum spaces: Minimum insulation shall be one of the following:
 - a. Pipe sizes 2.5 inch and smaller: Fiberglass: 2 inches thick.
 - b. Pipe sizes over 2.5 inch: Fiberglass: 2.5 inches thick.
 - 3. Equipment and accessories:
 - a. All valves and flanges: Removable insulation jacket.
- E. Pumped Condensate:
 - 1. Indoors and in vaults: Minimum Insulation shall be one of the following:
 - a. Pipe sizes 2 inch and smaller: Cellular glass: 3 inches thick.
 - b. Pipe sizes 2.5 inch to 4 inches: Cellular glass: 4 inches thick.
 - 2. Equipment and accessories:
 - a. All valves and flanges: Removable insulation jacket.
 - 3. Coil Condensate Drain and City Water Make-up:
 - a. For pipe sizes 1-1/2 inch and smaller"
 - 1) Interior: Fiberglass: 1/2 inch thick.
 - 2) Exterior: Cellular Glass Foam Insulation: 1/2 inch thick.
 - 4. Chilled Water Pumps, Chilled Water Valves:
 - a. All Foamed Plastic Equipment Insulation or Flexible Elastomeric Insulation: 1 inches thick.

3.8 INDOOR OR OUTDOOR, FIELD-APPLIED JACKET SCHEDULE:

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Piping:
 - 1. Steam and Condensate:
 - a. Indoors:
 - 1) Aluminum .016 inch thick.

END OF SECTION 23 07 19

SECTION 23 08 00

COMMISSIONING OF HVAC SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes commissioning process requirements for HVAC systems, assemblies, controls, and equipment.
- B. This project will have selected building systems commissioned. The equipment and systems to be commissioned are specified in Section 01 91 00 - General Commissioning Requirements .

1.2 RELATED SECTIONS

- A. Section 01 91 00 - General Commissioning Requirements.
- B. Section 22 08 00 - Commissioning of Plumbing Systems.
- C. Section 26 08 00 - Commissioning of Electrical Systems.

1.3 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements

1.4 DEFINITIONS

- A. Refer to 01 91 00 - General Commissioning Requirements.

1.5 SUBMITTALS

- A. Certificate Of Readiness, signed by the Contractor, certifying that systems, assemblies, equipment, components, and associated controls are ready for testing.
- B. Manufacturer's completed start-up reports for equipment and systems.
- C. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.6 CONTRACTOR'S RESPONSIBILITIES

- A. Reference Project Specification Section 01 91 00 - General Commissioning Requirements for details of HVAC contractor's responsibilities related to commissioning.
- B. Perform commissioning tests at the direction of the CxA.
- C. Attend commissioning meetings.
- D. Provide information requested by the CxA for functional testing and for final commissioning documentation.
- E. 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.
- F. Functional testing of systems will be carried out solely by Mechanical contractor's personnel, under the direction of CxA. Provide experienced personnel, familiar with the systems being installed under this project.

1.7 COMMISSIONING AUTHORITY RESPONSIBILITIES

- A. Reference Project Specification Section 01 91 00 - General Commissioning Requirements.
- B. CxA will direct commissioning testing.
- C. Verify testing, adjusting, and balancing of Work are complete. Review and comment on testing, adjusting, and balancing report.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 GENERAL TESTING REQUIREMENTS

- A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in Division 23 Sections. Provide submittals, test data, inspector record, and certification to the CxA.
- B. Reference Project Specification Section 01 91 00 - General Commissioning Requirements for detailed requirements of commissioning of Mechanical systems.

- C. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
 - D. 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.
 - E. Tests will be performed using design conditions whenever possible.
- 3.2 SYSTEM START-UP
- A. Contractor is solely responsible for system start-up. CxA may, at his discretion, witness start up procedures, but will not perform any Functional Testing of systems until Contractor has completed start-up and resolved all operating deficiencies, and has so certified.
- 3.3 TESTING PREPARATION
- A. Certify that HVAC and controls systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
 - B. Certify that HVAC 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 that testing, adjusting, and balancing procedures have been completed and submitted, discrepancies corrected, and corrective work approved.
 - D. Set 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. Inspect and verify the position of each device and interlock identified on checklists.
 - F. Check safety cutouts, alarms, and interlocks with life-safety systems during each mode of operation.
 - G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.
- 3.4 FUNCTIONAL TESTING / GENERAL
- A. Reference Project Specification Section 01 91 00 - General Commissioning Requirements for detailed requirements of commissioning of Mechanical systems.
 - B. Provide measuring instruments and logging devices to record test data as directed by the CxA.
- 3.5 CONTROLS TESTING
- A. Submit to CxA all documentation and reports called for in Section 23 09 00 - Instrumentation and Control for HVAC.
 - 1. Verify communications interface with Central Data Acquisition System (CDAS).
 - 2. Verify communications interface with central operator station, all controllers on LAN, and remote communications devices, if applicable.
 - 3. Verify operation of web browser interface.
 - 4. Verify page navigation functions correctly.
 - 5. Verify BAS contractor has calibrated all analog sensors per specifications. Verify sensor accuracy and reasonableness.
 - 6. Verify correctness of graphics: schematics reflect actual installation, all specified all specified input and output points are displayed, spelling is correct, proper units (e.g., deg F, psi, etc.) are used, layout is logical and consistent, floor plans are accurate and identify locations of equipment, thermostats, etc.
 - 7. Verify auxiliary items (printers, screens, computers, etc.) are supplied and functioning.
 - 8. Verify operation of all input and output points, including all safeties, by forcing point, changing setpoints and observing reaction, etc.
 - 9. Verify correct operating sequences, including setpoints.
 - 10. Verify communications with / points display of Modbus and Bacnet controllers of stand-alone equipment items.
 - 11. Verify that equipment alarms register at BAS, and are stored in history log.
 - 12. Verify operation of all condensate drains.
 - B. Trend Logging:
 - 1. Set up historical trend logs to record data points from any and all systems as directed by CxA. The logging frequency and duration of logging will be set up as directed by CxA, and all logged data will be permanently stored, and transmitted to CxA at intervals as directed by CxA.
- 3.6 TESTING AND BALANCING VERIFICATION

- A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
- B. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
- C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
 - 1. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
 - 2. Failure of an item (other than sound) includes a deviation of more than 10 percent from reported value, or other more stringent requirement if called for elsewhere in this project manual. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report.
 - 3. Remedy the deficiency and notify CxA who will re-verify failed portions of test.

3.7 PIPING SYSTEMS

- A. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Division 23 piping Sections. HVAC Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Include sequence of testing and testing procedures, description of equipment for flushing operations, drawings for each pipe sector, showing the physical location of each designated pipe test section, minimum flushing water velocity, and chemical treatment plan.

3.8 DEFERRED TESTING

- A. Initial commissioning will be done as soon as contract work is completed, though building may not be at full occupancy and equipment may not be at full loading.
- B. If adequate load may be artificially placed upon heating or cooling equipment, CxA, at his discretion, may perform functional testing during non-peak load periods. If testing cannot be carried out under these conditions to adequately verify system performance, testing will be deferred until such time as conditions are more satisfactory.
 - 1. Contractor is to provide services of personnel and participate in deferred or seasonal testing process in the same manner as he would in non-seasonal testing.
 - 2. 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.

3.9 RE-TESTING

- A. Reference Project Specification Section 01 91 00 - General Commissioning Requirements for detailed requirements of re-testing of Mechanical systems.

3.10 SYSTEMS TO BE COMMISSIONED

- A. Reference Project Specification Section 01 91 00 - General Commissioning Requirements for list of Mechanical systems to be commissioned.

END OF SECTION 23 08 00

SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. This Section includes control equipment for HVAC systems, components and other systems shown to be controlled by the Building Automation System (BAS), including, but not limited to, all computer software and hardware, controllers, sensors, transmission equipment, local panels, installation, engineering, supervision, commissioning, acceptance testing, training and warranty service necessary for a complete and working system.

1.3 RELATED REQUIREMENTS

- A. Section 26 32 13 - Standby Power Generator Systems.
- B. Section 26 33 53 - Uninterruptible Power Systems.

1.4 SCOPE OF WORK

- A. The Contractor shall furnish and install a complete direct digital control (DDC) building automation system (BAS) including all necessary hardware and all operating and applications software necessary to perform the control sequences of operation as specified herein.
- B. All components of the system – workstations, network controllers, local controllers, etc. shall communicate using a standard protocol, as defined by ASHRAE Standard 135-2001 and as specified herein.
 - 1. Level 1 communication protocol shall be BACnet IP.
 - 2. Level 2 communication protocol shall be BACnet IP, BACnet MS/TP Modbus IP or Modbus RTU, Ethernet IP.
 - 3. Proprietary communications is allowed as an alternate based on the project with owner approval.
 - 4. LON communication protocol is not acceptable at any level in the BAS system.
- C. The BAS contractor shall review and study all HVAC drawings and the entire specification to become familiar with the equipment and system operation and to verify the quantities and types of dampers, operators, alarms, etc. to be provided.
- D. All interlocking, wiring and installation of control devices associated with the equipment described in the sequence of operations, points list and control diagrams shall be provided under this Contract.
- E. Provide services and manpower necessary for commissioning of system in coordination with the Commissioning Authority, HVAC Contractor, Testing and Balancing Contractor, Electrical Contractor and Owner's Representative. Refer to Section 23 08 00 - Commissioning of HVAC Systems.
- F. All work performed under this section of the specifications will comply with all codes, laws and governing bodies. If the drawings and/or specifications are in conflict with governing codes, the Contractor shall submit a proposal with appropriate modifications to the project to meet code restrictions. If this specification and associated drawings exceed governing code requirements, the specification will govern. The Controls Contractor shall obtain and pay for all necessary construction permits and licenses associated with this scope of work.

1.5 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. The control system components shall be new and in conformance with the following applicable standards for products specified:
 - 1. American Society for Testing and Materials, ASTM.
 - 2. Institute of Electrical and Electronic Engineers, IEEE.
 - 3. National Electrical Manufacturers Association, NEMA.
 - 4. Underwriters Laboratory, UL (UL 916 & 864).

5. FCC Regulation, Part 15, Section 156.
6. National Fire Protection Association, NFPA.
7. Local Building Codes.

1.6 PROTECTION OF SOFTWARE RIGHTS

- A. Prior to delivery of software, the Owner and the party providing the software will enter into a software license agreement with provisions for the following:
 1. Limiting use of software to equipment provided under these Specifications.
 2. Limiting copying.
 3. Preserving confidentiality.
 4. Prohibiting transfer to a third party.

1.7 SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for system architecture, operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, communication methods and operator interface equipment.
 2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications including all software licensing agreements.
 3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic control diagram.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 1. Riser diagram of main network architecture depicting all controllers, workstations and associated network wiring.
 2. Bill of materials of equipment indicating quantity, manufacturer, and model number.
 3. Schematic flow/control diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 4. Wiring Diagrams: Power, signal, and control wiring.
 5. Details of control panel faces, including controls, instruments, and labeling.
 6. Floor plans indicating control panel locations.
 7. Written description of sequence of operation.
 8. Schedule of dampers including size, leakage, and airflow characteristics.
 9. Schedule of valves including flow characteristics.
- C. Schedule of airflow monitoring stations including airflow characteristics.
 1. DDC System Hardware:
 - a. Wiring diagrams for control units with termination numbers.
 - b. Schematic diagrams and floor plans for field sensors and control hardware.
 - c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
 2. Control System Software: Graphics outline and "Print Page" examples of final product indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
 3. Controlled Systems:
 - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
 - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
 - c. Written description of sequence of operation including schematic diagram.
 - d. Points list.
- D. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE Standard 135-2001 for each protocol.
- E. Samples for Initial Selection: For each type of sensor cover with factory-applied color finishes.
- F. Software and Firmware Operational Documentation: Include the following:

1. Software operating and upgrade manuals.
 2. Program Software Backup: On CD, complete with data files.
 3. Device address list.
 4. Printout of software application and graphic screens.
 5. Software license required by and installed for operator workstations and control systems.
- G. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.
- H. Field quality-control test report forms.
- I. Operation and Maintenance Data: Include emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Maintenance instructions and lists of spare parts for each type of control device.
 2. Interconnection wiring diagrams with identified and numbered system components and devices.
 3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
 4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 5. Calibration records and list of set points.
- J. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- B. Warranty: Controls Contractor shall guarantee all system components and installations to be free from defects for one (1) year from the date of acceptance as determined by the Owner. Any defects found during this period shall be repaired and/or replaced at no cost to the Owner. The Controls Contractor shall provide maximum of 24-hour response time for trouble calls or maintenance.
- C. Upon completion of the installation, the Contractor shall thoroughly inspect, check, adjust, calibrate, and make ready for use all devices/sensors comprising the control system and certify that they are installed in accordance with "Record" Drawings.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Data Communications Protocol: Certify that each proposed DDC system component complies with ASHRAE Standard 135-2001 for each protocol.
- F. DDC system component testing: Comply with ASHRAE 135.1-2001 for all DDC controllers.
- G. All controllers used to control or monitor equipment and/or field devices shall be tested, compliant with and carry a testing seal:
1. Building Controllers.
 2. Advanced Application Controllers.
 3. Application Specific Controllers.
- H. System Software: Provide latest version of software at Project completion. Provide all software updates for one (1) year after date of acceptance as determined by the Owner.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment in other Sections, arrange for shipping of control devices to equipment manufacturer. Upon delivery the equipment manufacturer shall inspect shipment for visual damages. The Controls Contractor shall replace any damaged control equipment at no cost to the Owner.
- B. Provide factory shipping containers for each piece of equipment. Provide factory applied plastic end caps on each length of pipe and tube. Maintain cartons and end caps through shipping, storage and handling as required to prevent equipment and pipe-end damage, and to eliminate dirt and moisture from equipment and inside of pipe and tube. Where possible store equipment and materials inside and protected from weather. When necessary, to store outside, elevate well above grade and enclose with durable water-proof wrapping.

1.10 WORK BY OTHERS

- A. The installation of motor starters that are not factory installed, thermal overload switches, and power wiring to motors, starters, and thermal overload switches, is specified in another section. This section

includes the furnishing and installing of all controls, devices, interlocks, and wiring to provide a complete operating system as outlined in the sequence of operation.

- B. The following general work scope of Contractors requiring coordination by the Controls Contractor includes, but is not limited to:
1. The Piping Contractor shall:
 - a. Install automatic valves, flow meters and separable wells that are specified to be supplied by the Controls Contractor.
 - b. Furnish and install all necessary pressure taps, wells, as directed by the Controls Contractor.
 - c. Furnish and install all necessary drain and overflow connections and piping.
 - d. Furnish and install all necessary fittings and piping connections required for flow devices.
 2. The Sheet Metal Contractor shall:
 - a. Install all automatic dampers and provide necessary blank-off plates or transitions required to install dampers that are smaller than duct size.
 - b. Assemble multiple section dampers with required interconnecting linkages and extend required number of shafts through duct for external mounting of damper motors.
 - c. Furnish and install necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation. Affix and seal permanently in place once stratification problems have been eliminated.
 - d. Furnish and install access doors or other approved means of access through ducts for service to control equipment.
 - e. Install duct mounted airflow monitoring stations.
 - f. Install AHU and duct mounted heat and smoke detectors.
 3. The General Contractor shall:
 - a. Provide access doors or other means of access through ceilings and walls for services to control equipment.
 - b. Provide necessary housekeeping pads and, where required, concrete inertia bases.
 4. Air Terminal Box Manufacturers shall:
 - a. Factory mount, wire and configure the terminal box DDC controller and actuator.
 - b. Furnish static pressure probes.
 - c. Furnish 24 volt transformers for terminal box controller power.
 5. Electrical Contractor shall:
 - a. Furnish fire alarm system compatible duct mounted heat and smoke detectors and wire to Fire Alarm System. Coordinate with the mechanical contractor the exact placement of duct mounted detectors.
 - b. Provide relay cabinets, required for lighting control and wiring/conduits to the EMS panels.
 6. Provide dedicated 120VAC circuits in j-boxes throughout all building areas for control panel and terminal box control power.

PART 2 - PRODUCTS

2.1 ACCEPTABLE BIDDERS

- A. The specifications are intended to describe the microprocessor based Energy Management System – System 600 APOGEE and Siemens Building Technologies is the acceptable manufacturer/installer.
- B. Alternate bidders are acceptable with ownership approval. Any alternate bidder must be able to demonstrate to UTSW the ability to integrate with the existing Siemens Building Technologies Energy Management System prior to bidding.

2.2 NETWORKING

- A. The design of the EMS shall network operator workstations and stand-alone DDC Controllers. The network architecture shall consist of three levels, a campus-wide (Management Level Network - MLN) Ethernet network based on TCP/IP protocol, high performance peer-to-peer Building Level Network (BLN) and Application Specific Controller Floor Level Networks (FLN) with access being totally transparent to the user when accessing data or developing control programs.
- B. The design of EMS shall allow the co-existence of new DDC Controllers with existing DDC Controllers in the same network without the use of gateways or protocol converters.
- C. All operator devices either network resident or connected via remote connection shall have the ability to access all point status and application report data or execute control functions for any and all other

devices via the peer-to-peer network. No hardware or software limits shall be imposed on the number of devices with global access to the network data at any time.

D. All Networks shall be dynamically connected to allow access to points on different BLN's simultaneously.

2.3 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:

1. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
2. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
3. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
4. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
5. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
6. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
 - a. Water Temperature: Plus or minus 1 deg F.
 - b. Water Flow: Plus or minus 5 percent of full scale.
 - c. Water Pressure: Plus or minus 2 percent of full scale.
 - d. Space Temperature: Plus or minus 1 deg F.
 - e. Ducted Air Temperature: Plus or minus 1 deg F.
 - f. Outside Air Temperature: Plus or minus 2 deg F.
 - g. Dew Point Temperature: Plus or minus 3 deg F.
 - h. Temperature Differential: Plus or minus 0.25 deg F.
 - i. Relative Humidity: Plus or minus 5 percent.
 - j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
 - k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
 - l. Airflow (Terminal): Plus or minus 10 percent of full scale.
 - m. Air Pressure (Space): Plus or minus 0.01-inch wg.
 - n. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
 - o. Carbon Monoxide: Plus or minus 5 percent of reading.
 - p. Carbon Dioxide: Plus or minus 50 ppm.
 - q. Electrical: Plus or minus 5 percent of reading.

B. Graphics User Interface:

1. Menu: Selectable for command entry, information management, network alarm management, and database management functions including, but not limited to:
 - a. Configuration.
 - b. Data Archiving.
 - c. Commanding.
 - d. System Diagnostics.
 - e. Graphic Display Tree.
 - f. Alarm Logs.
 - g. Reports.
 - h. Schedules.
2. Graphic Display: Display graphic with current state of the art dynamic points and refresh speed. As a minimum provide the following graphics pages:
 - a. Overall Building Level: Display building, building name and all exterior equipment.
 - b. Floor Level: Display floor level derived from CAD drawing, active links to monitored and/or controlled equipment on that floor.
 - c. AHU System Level: Similar to floor level but displaying the area of a single AHU system and embedded links for all associated equipment including, but not limited to:
 - 1) AHU.
 - 2) Terminal boxes.
 - 3) Exhaust fans.

- 4) Dampers.
- 5) Thermostats.
- 6) Field sensors.
- d. Equipment Level: Display associated equipment setpoints and real-time sensor readings as defined by the Owner.
- e. Equipment Support Data: Link the following information directly from the Equipment Level graphic display or menu graphic display tree:
 - 1) Operation and Maintenance manual.
 - 2) Equipment schedules.
 - 3) Sequence of operations.
- f. Other graphic displays
 - 1) Alarm log.
 - 2) Energy overview: costs, consumption, production.
 - 3) Equipment runtimes.

2.4 OPERATOR INTERFACE EQUIPMENT (AS APPLICABLE, CONFIRM CURRENT TECHNOLOGY REQUIREMENTS)

- A. Operator Workstation (OWS): One desktop in tower case with configuration commercially available three months before substantial completion:
 - 1. Intel Dual-Processor: 3.0 GHz (ea. processor), 2 MB L2 cache, 800 MHz (min.) front side bus, 64-bit.
 - 2. Random-Access Memory: 6 GB.
 - 3. Graphics Video Adapter: 256 MB video memory.
 - 4. Hard-Disk Drive: 1 TB, 7200 RPM.
 - 5. DVD/CD Combo Read/Write Drive: DVD+R 8X, DVD+RW 8X, DVD-RW 6X, CD-R 24X, CD-RW 16X.
 - 6. Communications Card: 10/100bT Ethernet, integral to motherboard or compatible with expansion slot.
 - 7. Audio Card: Integral to motherboard or compatible with expansion slot, 1-3.5mm microphone input, 1-3.5mm headphone output.
 - 8. Media Drive: Multi-in-1 (SD/XD/CF).
 - 9. USB Connections: 2 front side, 4 back side, version 2.0 compliant.
 - 10. Monitor 24 inch flat panel LCD: 1920 x 1080 (1080p) resolution, DVI & VGA input, 50,000:1 contrast ratio, 300 cd/m2 brightness, 5 ms response time. 2 per OWS.
 - 11. Keyboard: QWERTY, 105 keys in ergonomic shape.
 - 12. Mouse: Three button with scroll wheel, optical.
 - 13. 2 kVA UPS.
 - 14. Speakers: compatible with audio card.
 - 15. Operating System: Microsoft Windows XP or 7.
 - a. Protocol Compliance: Control units shall use BACnet or Modbus protocol.
 - 16. Application Software:
 - a. I/O capability from operator station.
 - b. System security for each operator via software password and access levels.
 - c. Automatic system diagnostics; monitor system and report failures.
 - d. Database creation and support.
 - e. Automatic and manual database save and restore.
 - f. Dynamic color graphic displays with up to 10 screen displays at once.
 - g. Custom graphics generation and graphics library of HVAC equipment and symbols.
 - h. Alarm processing, messages, and reactions.
 - i. Trend logs retrievable in spreadsheets and database programs.
 - j. Alarm and event processing.
 - k. Object and property status and control.
 - l. Automatic restart of field equipment on restoration of power.
 - m. Data collection, reports, and logs. Include standard reports for the following:
 - 1) Current values of all objects.
 - 2) Current alarm summary.

- 3) Disabled objects.
- 4) Alarm lockout objects.
- 5) Logs.
- n. Custom report development.
- o. Utility and weather reports.
- p. Workstation application editors for controllers and schedules.
- q. Maintenance management.
- 17. Custom Application Software:
 - a. English language oriented.
 - b. Full-screen character editor/programming environment.
 - c. Allow development of independently executing program modules with debugging/simulation capability.
 - d. Support conditional statements.
 - e. Support floating-point arithmetic with mathematic functions.
 - f. Contains predefined time variables.
- B. Portable Diagnostic Unit (PDU) (Laptop): Portable notebook-style, PC-based microcomputer terminal capable of accessing system data by connecting to system network via Ethernet cable.
 - 1. System: With one integrated USB 2.0 port, integrated Intel Ethernet, integrated audio, bios, and hardware monitoring.
 - 2. Processor: Intel 2.13 GHz, dual-core.
 - 3. Random-Access Memory: 6 GB, DDR3.
 - 4. Graphics: 512 MB video memory.
 - 5. Monitor: 14 inches, LCD color.
 - 6. Keyboard: QWERTY 105 keys in ergonomic shape.
 - 7. Hard-Disk Drive: 500 GB, 5400 RPM.
 - 8. Audio: Integral sound card with 1-3.5mm microphone input, 1-3.5mm headphone output.
 - 9. Media Drive: Multi-in-1 (SD/XD/CF)
 - 10. USB Drives: 2 side, 2 back, version 2.0 compliant.
 - 11. DVD/CD-ROM Read/Write Combo Drive: DVD+R 8X, DVD+RW 8X, DVD-RW 6X, CD-R 24X, CD-RW 16X.
 - 12. Pointing Device: Touch pad, 2-button.
 - 13. Communications Card: 10/100bT Ethernet, Bluetooth 2.1, IEEE 802.11b/g/n wireless.
 - 14. Operating System: Windows XP or 7.
- C. Archive Server: Provide servers that will provide archive locations for all historical data such as trends, alarm and event histories and transaction logs.
 - 1. Server shall reside on the Campus Network.
 - 2. Equip servers with the same tool set that is located in the network level controllers for the system configuration and custom logic definition and graphic configuration.
 - 3. Access to all information on the server will be through the OWS.
 - 4. The hardware platform for servers will, at minimum, consist of:
 - a. PC processor with minimum 64-bit word structure.
 - b. Minimum 4.0 GHz processor speed.
 - c. Minimum 8 GB RAM.
 - d. Hard drive or equal high-speed data storage, minimum 50 gigabytes.
 - e. OS shall be Windows 2008 Professional.
 - f. Removable high-speed data storage and export device(s) such as Read/Write CD ROM or approved equal.
 - g. Full ASCII keyboard and digital Mouse or equal pointing device.
 - h. Full color, flat screen monitor, minimum 22 inches diagonal screen, minimum 1280 x 1024 resolution, and minimum 72 Hz refresh rate.

2.5 DDC CONTROLLERS

- A. DDC Controllers shall be stand-alone, multi-tasking, multi-user, real-time digital control processors with a minimum word size of 16 bits, minimum 16MHz clock and 4MB memory consisting of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point

modules. Each controller shall support a minimum of 96 FLN Devices. Floor Level Network Controllers (FLNC) are DDC Controllers that only support 96 FLN Devices.

- B. Each DDC Controller shall support its own operating system and databases, including:
 - 1. Control processes.
 - 2. Energy management applications.
 - 3. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
 - 4. Historical/trend data for points specified.
 - 5. Maintenance support applications.
 - 6. Custom processes.
 - 7. Operator I/O.
 - 8. Dial-up communications.
 - 9. Manual override monitoring.
- C. Each DDC Controller shall support any combination of industry standard inputs and outputs.
- D. Provide all processors, power supplies and communication controllers so that the implementation of a point only requires the addition of the appropriate point input/output termination module and wiring.
- E. DDC Controllers shall be provided with one RS-232C serial data communication port for the portable laptop operator's terminal. DDC Controllers shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers or terminals.
- F. As indicated in the point I/O schedule, the operator shall have the ability to manually override automatic or centrally executed commands at the DDC Controller via local, point discrete, on-board hand/off/auto operator override switches for digital control type points and gradual switches for analog control type points.
 - 1. Switches shall be mounted within the DDC Controllers key-accessed enclosure.
 - 2. DDC Controllers shall monitor the status of all overrides and inform the operator that automatic control has been inhibited. DDC Controllers shall also collect override activity information for reports.
- G. DDC Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Graduated intensity LED's for analog indication of value shall also be provided for each analog output. Status indication shall be visible without opening the panel door (MBC only).
- H. Each DDC Controller shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all panel components. The DDC Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.
- I. Isolation shall be provided at all peer-to-peer network terminations, as well as all field point terminations to suppress induced voltage transients consistent with IEEE Standards 587-1980.
- J. In the event of loss of all power, there shall be an orderly shutdown of all DDC Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 100 hours.
 - 1. Battery Backup: Basis of Design
 - a. Basis of Design: Uninterruptible Power Supply In Kit PSH850-UPS-STAT as manufactured by Functional Devices, Inc.
 - b. Product to include 850 VA UPS, 10 amp switch/circuit breaker, two - 120 Vac outlets, terminals, 120 VAC input.
 - 2. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.
 - 3. Should DDC Controller memory be lost for any reason, the user shall have the capability of reloading the DDC Controller via the local RS-232C port, via remote connection or automatically from the network workstation PC.
- K. As a minimum, a separate DDC Controller shall be provided for each mechanical room. There should only be one DDC Controller for each system.
- L. All DDC controllers will be provided with a UPS backup. UTSW will approve acceptable UPS products from APC / Schneider Electric.

2.6 DDC CONTROLLER RESIDENT SOFTWARE

- A. General:
 - 1. The software programs specified in this Section shall be provided as an integral part of DDC Controllers and shall not be dependent upon any higher level computer for execution.
- B. Control Software Description:
 - 1. The DDC Controllers shall have the ability to perform the following pre-tested control algorithms:
 - a. Two-position control.
 - b. Proportional control.
 - c. Proportional plus integral control.
 - d. Proportional, integral, plus derivative control.
 - e. Automatic tuning of control loops.
- C. DDC Controllers shall have the ability to perform any or all the following energy management routines:
 - 1. Time-of-day scheduling.
 - 2. Calendar-based scheduling.
 - 3. Holiday scheduling.
 - 4. Temporary schedule overrides.
 - 5. Start-Stop Time Optimization.
 - 6. Automatic Daylight Savings Time Switchover.
 - 7. Night setback control.
 - 8. Enthalpy switchover (economizer).
 - 9. Peak demand limiting.
 - 10. Temperature-compensated duty cycling.
- D. DDC Controllers shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.
 - 1. A single process shall be able to incorporate measured or calculated data from any and all other DDC Controllers on the network. In addition, a single process shall be able to issue commands to points in any and all other DDC Controllers on the network.
 - 2. Processes shall be able to generate operator messages and advisories to operator I/O devices. A process shall be able to directly send a message to a specified device or cause the execution of connection to a remote device such as a printer or pager.
- E. Alarm management shall be provided to monitor and direct alarm information to operator devices. Each DDC Controller shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic and prevent alarms from being lost. At no time shall the DDC Controllers ability to report alarms be affected by either operator or activity at a PC workstation, local I/O device or communications with other panels on the network.
 - 1. All alarm or point change reports shall include the point's English language description and the time and date of occurrence.
 - 2. The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of six priority levels shall be provided for each point. Point priority levels shall be combined with user definable destination categories (PC, printer, DDC Controller, etc.) to provide full flexibility in defining the handling of system alarms. Each DDC Controller shall automatically inhibit the reporting of selected alarms during system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point.
 - 3. Alarm reports and messages will be directed to a user-defined list of operator devices or PCs.
 - 4. In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 200 character alarm message to more fully describe the alarm condition or direct operator response.
 - 5. In remote alert applications, operator-selected alarms shall initiate a call to a remote operator device.
- F. A variety of historical data collection utilities shall be provided to manually or automatically sample, store and display system data for points as specified in the I/O summary.
 - 1. Any point, physical or calculated may be designated for trending. Any point, regardless of physical location in the network, may be collected and stored in each DDC Controllers point group. Two methods of collection shall be allowed: either by a pre-defined time interval or upon a pre-defined change of value. Sample intervals of 1 minute to 7 days shall be provided. Each DDC Controller

- shall have a dedicated RAM-based buffer for trend data. All trend data shall be available for use in 3rd party personal computer applications such as Excel.
2. DDC Controllers shall also provide high resolution sampling capability for verification of control loop performance. Operator-initiated automatic and manual loop tuning algorithms shall be provided for operator-selected PID control loops as identified in the point I/O summary.
 - a. Loop tuning shall be capable of being initiated either locally at the DDC Controller, from a network workstation or remotely using dial-in modems. For all loop-tuning functions, access shall be limited to authorized personnel through password protection.
 - G. DDC Controllers shall automatically accumulate and store run-time hours for digital input and output points and automatically sample, calculate and store consumption totals for analog and digital pulse input type points, as specified in the point I/O summary.
 - H. DDC Controllers shall be password protected. The user's Password and Privileges shall be identical to the Password and Privileges used at the EMS Workstation.

2.7 APPLICATION SPECIFIC CONTROLLERS

- A. Terminal Equipment Controllers (TEC)
 1. Provide for control of each piece of equipment, including, but not limited to, the following:
 - a. VAV and CAV Dual Duct Boxes.
 - b. VAV Terminal Units with and without heating coils.
 - c. Fan Coil Units.
 2. The controllers shall include all inputs and outputs necessary to perform the specified control sequences. Analog outputs shall be 24 volt floating.
 3. Each controller performing space temperature control shall be provided with a matching room temperature sensor with a setpoint adjustment between 55 Degrees F and 95 Degrees F.
 4. Each room temperature sensor shall include a terminal jack integral to the sensor assembly. The terminal jack shall be used to connect a portable operator's terminal to control and monitor all hardware and software points associated with the respective controller.
 5. Setpoint adjustment and override function shall have the ability to be locked out, overridden, or limited as to time or temperature through software by an authorized operator at the central workstations, at the DDC Controller, or via the portable operator's terminal.
 6. Each controller shall perform its primary control function independent of the DDC Controller. The controller shall receive its real-time data from the DDC Controller time clock. Each controller shall include algorithms incorporating proportional, integral, and derivative (PID) gains for all applications. All PID gains and biases shall be adjustable by the user via terminals as specified herein. This functionality shall allow for tighter control and shall facilitate optimal occupant comfort and energy savings.
 7. Provide each terminal equipment controller with sufficient memory to accommodate point databases and operating programs. All databases and programs shall be stored in non-volatile EEPROM, EPROM, and PROM. The controllers shall be able to return to full normal operation without user intervention after a power failure. Operating programs shall be selectable and may be modified to meet the user's exact control strategy requirements, allowing for additional system flexibility.
 8. Controllers shall be powered from a 24 VAC source, and shall function normally under an operating range of 18 to 28 VAC (-25 percent to plus 17 percent), allowing for power source fluctuations and voltage drops. The controllers shall also function normally under ambient conditions of 32 Degrees to 122 Degree F and 10-95 percent RH (non-condensing). Provide each controller with a suitable cover or enclosure to protect the intelligence board assembly.
 9. Pressure independent controllers shall include differential pressure transducers that shall connect to the terminal unit manufacturer's standard averaging air velocity sensor to measure the average differential pressure in the duct. The controller shall convert this value to actual airflow. The differential pressure transducer shall have a measurement range of 400 to 4,000 FMP and measurement accuracy of plus or minus 5 percent at 400 FPM insuring primary air flow condition shall be controlled and maintained to within plus or minus 5 percent of setpoint at the specified parameters. Each controller shall include provisions for manual and automatic calibration of the differential pressure transducer in order to maintain stable control and insuring against drift overtime. The controller requiring 24 hours a day operation shall calibrate the airflow sensor every 24 hours with the use of an auto-zero module to eliminate the requirement of closing the supply

damper to calibrate the flow sensor. It shall not be necessary to remove the controller to remove the damper actuator.

B. LABORATORY CONTROLS

1. FUME HOOD CONTROLLER (FHC)
 - a. The DDC controller shall control Variable Air Volume laboratory fume hoods.
 - b. The controller will maintain constant face velocity as the sash is raised and lowered.
 - c. An operator display panel will provide the user the operating status of the hood, alarm horn, and emergency purge function.
 - d. The hood controller will interface with the energy management system.
2. BIO-SAFETY CABINET CONTROLLER (BSCC)
 - a. Ducted bio-safety cabinets will be controlled to a constant CFM specified by the cabinet's manufacturer.
 - b. Alarms and flows will be reported to the EMS.
3. ROOM PRESSURE CONTROLLER (RPC)
 - a. The DDC controller will provide room pressurization and temperature control to rooms or labs without fume hoods where positive or negative room pressure is critical.
 - b. The RPC will maintain differential flow between the supply and exhaust terminal boxes.
 - c. The Room Pressurization Controller shall operate as a networked component of the EMS.
4. LABORATORY ROOM CONTROLLER (LRC)
 - a. The DDC controller will provide control for laboratory space pressurization and temperature control with control sequences for both single duct and dual duct supply systems.
 - b. The controller will maintain user defined differential airflow between lab supply air and fume hood controller exhaust and general exhaust terminals by measuring the airflow and controlling the damper position of the supply and general exhaust terminals.
 - c. Lab temperature control will be maintained by measuring the room temperature and controlling the reheat valve and adjusting the air flow.
 - d. Closed loop PID control will be used to maintain tighter air volume and temperature control.
 - e. All air flows will be reported in CFM's from physical air flow stations or flow sensors and not calculated based on valve or damper position.
 - f. The Laboratory Room Controller shall operate as a networked component of the EMS. The LRC shall communicate differential pressure values, air flow values, temperature values and alarm status.
5. DIFFERENTIAL PRESSURE MONITOR (DPM)
 - a. The monitor measures and displays the differential pressure between a room and its adjoining space.
 - b. The Differential Pressure Monitor (DPM) shall operate as a networked component of the LCS. The DPM shall communicate alarm status, differential pressure values, and door status. The alarm setpoint shall be adjustable from the LCS Workstation.
 - c. The Differential Pressure Transmitter shall have an accuracy of plus or minus 0.001 inches of water over a range of - 0.2 to + 0.2 inches of water.
6. CAV FUME HOOD MONITOR
 - a. The DDC Fume Hood Monitor shall continuously monitor the fume hood face velocity.
 - b. Monitor shall be mounted to accurately monitor the face velocity.
 - c. Monitor will be visible to the fume hood user and display the actual face velocity.
 - d. Monitor will issue an audible alarm when the face velocity is below operating parameters.
 - e. The monitor will connect to the EMS system so fume hood face velocity and alarms can be monitored remotely.

2.8 VALVES, DAMPERS AND ACTUATORS

A. VALVES:

1. Water valves shall be sized by the control manufacturer to produce the required capacity at a pressure loss of 15 psi. Nominal body rating shall be not less than ANSI Class 125. However, the valve body and packing selected shall be designed to withstand the system static head plus the maximum pump head and the maximum temperature of control medium and hot water. Single-seated valves shall have close-off ratings equal to 125 percent of the system pressure encountered that is the maximum upstream pressure. The valve body and packing selected shall be designed to

withstand the system static head plus the maximum pump head and the maximum temperature of control medium without leakage for hot water.

2. Two-Way and Three-Way Valves:
 - a. Valves used for control of hot and chilled water shall be of the modulating globe type.
 - b. Valve sizes two inch and smaller shall be screwed and supplied with union fittings. The valves shall be constructed of bronze with stainless steel trim with equal percentage flow characteristics and have a rangeability of 50:1 or greater.
 - c. Valve sizes 2.5 inch and larger shall be flanged. The valves shall be constructed of cast iron ASTM A126 Class B. The trim shall be stainless steel with equal percentage flow characteristics. The valve rangeability shall be 100:1 or greater.
 - d. Valves shall be of the straight-through type as required by the sequence or indicated on the drawings.
3. Low Pressure Steam Valves: Shall be rated to 338 Degrees F at a maximum inlet pressure to the valve of 100 psig. Valves for low-pressure steam shall be sized for 80 percent pressure drop of inlet pressure. Valves shall be equipped with stainless steel trim and disc with linear flow characteristics. Applications, which require steam valves larger than 2 inches, shall utilize two valves in a 1/3 - 2/3 parallel arrangement.
4. Butterfly Valves: Where butterfly valves are indicated to be used as automatic control valves, they shall be line size and designed for motorized control operation with upper disc stem keyed or machined square for mating with the control operator's linkage. All butterfly control valves over 8 inches shall be equipped with a manual, mechanical control actuator override, gear box operator for emergency manual control of the valve position. Provide required accessories to mechanically disengage automatic control actuator linkage and engage manual gear operator without dismantling the valve stem and stem extensions during changeover. Valves 4-20 inches and larger shall be tapped, full lug, cast iron body butterfly valves with aluminum bronze discs, stainless steel stem and EPDM seat. Design must incorporate top and bottom bushings between shafts and body of material suitable to provide a bearing surface to eliminate seizing or galling. Valves 4-20 inches must provide bubble-tight seal at 150 PSIG. Liners are to be resilient material suitable for 250 Degrees F temperature.
5. Valve Constant (Cv) Charts: Control drawings shall indicate the valve constant (Cv rating) of all valves used so that the valve pressure drop may be used for balancing and performance tests. Submittal data shall also state calculated shut-off pressure for each valve size.

B. DAMPERS:

1. The Temperature Control Manufacturer shall provide control dampers of the types and sizes indicated on the drawings, including but not limited to outside air, return, relief air dampers, isolation and exhaust system bypass dampers.
2. Damper frames shall be 5 inches X 1 inch 6063T5 extruded aluminum hat channel with .125 inch minimum wall thickness with mounting holes for flange and enclosed duct mounting.
3. Dampers shall be available in two-inch size increments from 8 inches horizontal and vertical to 48 inches. Requirements over 48 inches shall be standard modules with interconnecting hardware (jack shafting).
4. All damper blades shall be 6 inches 6063T5 heavy gage extruded aluminum airfoil for high velocity performance. Blades on all dampers must be not over 6 inches wide. Blade bearing shall be molded synthetic with 1/2 inch hex plated steel shafts. All blade linkage hardware shall be of corrosion-resistant finish and readily accessible for maintenance after installation.
5. Extruded vinyl edging seals for outdoor dampers and flexible metal compressible type side seals for all dampers shall be provided.
6. Dampers and seals shall be suitable for temperature ranges of -50 Degrees F. to +250 Degrees F. at specified leakage ratings.
7. Dampers used for proportional control shall have opposed blades.
8. Leakage rates shall not exceed 6.25 CFM/Sq. Ft. at 4 inches wg. differential rated in accordance with AMCA 500.
9. Acceptable manufacturers are Ruskin, Arrow United Industries, American Warming and Ventilating, Inc. or approved equal.

C. DAMPER AND VALVE ACTUATORS:

1. Electronic actuators shall be of 0-10 VDC type. The minimum actuator impedance shall be 800 ohms even when more than one actuator is connected in parallel. Spring return shall be required for two-position (NO/NC) control sequence or for steam valve control. Non-spring return actuators shall be used for all modulating sequence of control. They shall conform to all requirements of sequence descriptions specified or scheduled. Main mechanical equipment actuators shall have a manual position dial to allow manual positioning of valve in absence of control power.
2. Valve actuators shall be of sufficient size to close valves at system pressure drop across the valve plus 50.
3. Actuators for Terminal Equipment Controllers shall be 24V floating point, 0-10Vdc or pneumatic depending on Sequence of Operation and required speed of response. Regardless of actuator type, they shall be modulating and their position shall be readable in percentage open at the Workstation.
4. Actuators for VAV Laboratory Applications shall be provided for Laboratory Supply Air Terminals, Laboratory General Exhaust Terminals and Fume Hood Exhaust Terminals. The actuators shall be maintenance free high-speed actuators capable 1.0 second from minimum flow to 90 percent of maximum flow. The actuators shall have a fail safe position based on Sequence of Operation. The actuators shall be capable of accepting either 3-position floating point or 0-10 Vdc.

2.9 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Thermistor, Temperature Sensors and Transmitters:
 1. Sensor Types: Provide one of the following:
 - a. 100 ohm (plus or minus 0.12 percent) platinum resistance temperature detectors having a coefficient of resistivity of 0.00385 ohms/ohm/°C. Provide RTD temperature transducers with of 4-20 mA output signal variations of less than 0.2 percent of full scale output for supply voltage variations plus or minus 10 percent and integral and accessible zero and span adjustment.
 - b. 10,000 ohm thermistor having an accuracy of .5°F at calibration point of 75°F may be used for room temperature only.
 2. Accuracy: Plus or minus 0.5°F (0.3°C) at calibration point.
 3. Wire: Twisted, shielded-pair cable.
 4. Insertion Elements: Single point in center of duct or coil face area, use where not affected by temperature stratification or where airflow cross sectional area is smaller than 9 square feet.
 5. Averaging Elements: Twice the diagonal length of coil or duct. Use where prone to temperature stratification or where airflow cross sectional area is larger than 10 square feet.
 6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches or 75 percent of pipe inside diameter, whichever is less.
 7. Room Thermostats: Off-white enclosure capable of being mounted on a standard single gang electrical back box. Provide each with:
 - a. Local display of current space temperature.
 - b. Local setpoint adjustment (plus or minus 5 deg F) and temporary override button, both of which can be overridden by BAS at OWS.
 - c. RJ45 connection for connection to PDU.
 8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
- C. RTDs and Transmitters:
 1. Accuracy: Plus or minus 0.2 percent at calibration point.
 2. Wire: Twisted, shielded-pair cable.
 3. Insertion Elements in Ducts: Single point; use where not affected by temperature stratification or where ducts are smaller than 9 square feet.
 4. Averaging Elements in Ducts: Use where prone to temperature stratification or where ducts are larger than 9 square feet; length as required.
 5. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2 1/2 inches.
 6. Room Sensor Cover Construction: Off-white enclosure capable of being mounted on a standard single gang electrical back box.
- D. Pressure Transmitters/Transducers:

1. Static-Pressure Transmitter: Non-directional sensor with suitable range for expected input, and temperature compensated. Accuracy of 2 percent of full scale with repeatability of 0.5 percent. Linear output of 4 to 20 mA.
 - a. Building Static-Pressure Range: 0- to 0.25-inch wg.
 - b. Duct Static-Pressure Range: 0- to 5-inch wg.
2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
4. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
5. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 Ma.
6. Solenoid Air Valves (EP). The valve shall be a 3-way solenoid valve for two-position operation of pneumatic valve and damper actuators. Coil voltage shall be 120VAC or 24

2.10 STATUS SENSORS

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.
- B. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- C. Low Limit Temperature Switch: Minimum 20 feet element for freeze protection. Serpentine across the face of the coil and of sufficient length or number for three passes across the width of the coil it is protecting. Connect in series with other safety devices to de-energize fans serviced when a drop in temperature below setpoint is detected.
- D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.
- F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

2.11 GAS DETECTION EQUIPMENT

- A. Carbon Monoxide Detectors: Single or multichannel, dual-level detectors using solid-state plug-in sensors with a 3-year minimum life; suitable over a temperature range of 32 to 104 deg F; with 2 factory-calibrated alarm levels to be determined by OSBC and UTSW CDAS.
- B. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output, for wall mounting.
- C. Oxygen Sensor and Transmitter: Single detectors using solid-state zircon cell sensing; suitable over a temperature range of minus 32 to plus 1100 deg F and calibrated for 0 to 5 percent, with continuous or averaged reading, 4- to 20-mA output; for wall mounting.

2.12 FLOW METERS

- A. BTU Meters (Water): Meters shall be complete with integral brass body flow meter, temperature sensor and standard brass thermowell.
 1. Accuracy
 - a. Flow: plus or minus 0.5 percent of reading at calibrated velocity
 - b. Differential Temperature: plus or minus 0.15 deg F over calibrated temperature range
 - c. Computational Error: plus or minus 0.05 percent
 2. Output Signal: Factory selectable for flow rate, energy rate or delta-T (4-20mA or 0-10V)
 3. Operating Temperature & Pressure: 32 deg F to 200 deg F.

4. Calibration: N.I.S.T. traceable standards.
- B. Thermal Mass Flow Meters (Natural Gas): Meters shall be insertion style complete with wetted materials to be stainless steel.
 1. Accuracy: plus or minus 1.0 percent of reading.
 2. Output Signal: Scalable pulse output for totalization and analog output (4-20mA)
 3. Operating Temperature & Pressure: -40 deg F to 200 deg F.
 4. Calibration: N.I.S.T. traceable standards.
- C. Vortex Flow Meters (Steam): Meters shall consist of a vortex shedding mass flow measurement device, 1000 ohm platinum RTD for temperature measurement and pressure transducer for pressure measurement. Sensor bodies shall be 316 stainless steel.
 1. Accuracy: Volumetric, plus or minus 1.0 percent.
 2. Repeatability: plus or minus 0.1 percent.
 3. Output Signal: Scalable pulse output for flow rate and analog output (4-20mA)
 4. Operating Temperature & Pressure: -40 deg F to 464 deg F.
 5. Calibration: N.I.S.T. traceable standards.

2.13 CONTROL CABLE

- A. Electronic and fiber-optic cables for control wiring are specified in Division 27 Section "Communications Horizontal Cabling."

2.14 LOCAL CONTROL PANELS

- A. Provide control panels with suitable brackets for wall mounting, for each miscellaneous control system. Locate panel adjacent to systems served.
- B. Fabricate panels of 14-gauge furniture-grade steel, or 6063-T5 extruded aluminum alloy, totally enclosed, with hinged doors and keyed lock, with manufacturer's standard shop-painted finish and color. Provide UL listed cabinets for use with line voltage devices.
- C. Panel Mounted Equipment: Include temperature controllers, relays, and other devices excluded in the sequence of operation. Mount devices with adjustments accessible through the fronts of panels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that power supply is available to control units and OWS.

3.2 COORDINATION

- A. Coordinate location of temperature sensors, humidistats, and other exposed control sensors with plans and room finish details before installation.
- B. Coordinate equipment with Division 28 Section "Intrusion Detection" to achieve compatibility with equipment that interfaces with that system and with building master clock.
- C. Coordinate equipment with Division 28 Section "Access Control" to achieve compatibility with equipment that interfaces with that system.
- D. Coordinate equipment with Division 28 Section "PLC Electronic Detention Monitoring and Control Systems" to achieve compatibility with equipment that interfaces with that system.
- E. Coordinate equipment with Division 26 Section "Network Lighting Controls" to achieve compatibility with equipment that interfaces with that system.
- F. Coordinate equipment with Division 28 Section "Fire Detection and Alarm" to achieve compatibility with equipment that interfaces with that system.
- G. Coordinate supply of conditioned electrical branch circuits for control units and OWS.
- H. Coordinate equipment with Division 26 Section "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.
- I. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.
- J. Coordinate equipment with Division 26 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.
- K. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

3.3 INSTALLATION

- A. Install software in control units and OWS. Implement all features of programs to specified requirements and as appropriate to achieve sequence of operations.
- B. Connect and configure equipment and software to achieve sequence of operations specified.
- C. Mount all wall thermostats, humidistats, and other exposed control sensors on dedicated electrical backboxes.
- D. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- E. Install automatic dampers according to Division 23 Section "Air Duct Accessories."
- F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- G. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."
- H. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."
- I. Install refrigerant instrument wells, valves, and other accessories according to Division 23 Section "Refrigerant Piping."
- J. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.
- K. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."
- L. Air flow stations shall be installed in serviceable locations.
- M. Pressure transducer must be mounted outside air stream.

3.4 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install systems and materials in accordance with manufacturer's instructions, rough-in drawings and equipment details. Install electrical components and use electrical products complying with requirements of applicable Division 26, 27, & 28 Sections of these Specifications except where specifically stated in this Section.
- B. The term "control wiring" is defined to include providing of wire, conduit, and miscellaneous material as required for mounting and connecting electric or electronic control devices.
- C. Install all control wiring in conduit for electric/electronic control systems. Conceal wiring, except in mechanical rooms and areas where other conduit and piping are exposed. UL plenum rated cable shall be allowed above accessible lift out ceiling, in air plenums, and in other areas as approved by Architect and local and NEC codes.
- D. Stub conduit to above lift out ceilings. Plastic bushing shall be installed where the sensor wire exits the conduit to prevent damage.
- E. Number-code or color-code conductors, excluding those used for individual zone controls, appropriately for future identification and servicing of control system.
- F. This section shall provide all line voltage power wiring required because of substitution of equipment specified in this section.
- G. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."
- H. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- I. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."
 - 1. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.
 - 2. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - 3. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 - 4. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- J. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

- K. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.
- L. Serve only one DDC controller from any 24V control power transformer.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 - 2. Test and adjust controls and safeties.
 - 3. Test each point through its full operating range to verify that safety and operating control set points are as required.
 - 4. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 - 5. Test each system for compliance with sequence of operation.
 - 6. Test software and hardware interlocks.
- C. DDC Verification:
 - 1. Verify that instruments are installed before calibration, testing, and loop checks.
 - 2. Check instruments for proper location and accessibility.
 - 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 - 4. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
 - 5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 - 6. Check temperature instruments and material and length of sensing elements.
 - 7. Check control valves. Verify that they are operating in the correct direction.
 - 8. Check dampers. Verify that proper blade alignment, either parallel or opposed, has been provided.
 - 9. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.6 ADJUSTING

- A. Calibrating and Adjusting:
 - 1. Calibrate instruments.
 - 2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
 - 3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
 - 4. Control System Inputs and Outputs:
 - a. Check digital inputs using jumper wire.
 - b. Check digital outputs using ohmmeter to test for contact making or breaking.
 - c. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
 - 5. Flow:
 - a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
 - b. Manually operate flow switches to verify that they make or break contact.
 - 6. Pressure:
 - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
 - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
 - 7. Temperature:

- a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
 - b. Calibrate temperature switches to make or break contacts.
 - 8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
 - 9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
 - 10. Provide diagnostic and test instruments for calibration and adjustment of system.
 - 11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.
 - B. Adjust initial temperature and humidity set points.
- 3.7 AIRFLOW MONITORS
 - A. Setup output control signal to be derived from a 5 minute running average airflow monitor input.
- 3.8 SYSTEM EXCEPTANCE
 - A. General: The system installation shall be complete and tested for proper operation prior to acceptance testing for the Owner's authorized representative. A letter shall be submitted to the Architect requesting system acceptance. This letter shall certify all controls are installed and the software programs have been completely exercised for proper equipment operation. Acceptance testing will commence at a mutually agreeable time within ten (10) calendar days of request. When the field test procedures have been demonstrated to the Owner's representative, the system will be accepted. The warranty period will start at this time.
 - B. Field Equipment Test Procedures: DDC control panels shall be demonstrated via a functional end-to-end test. Such that:
 - 1. All output channels shall be commanded (on/off, stop/start, adjust, etc.) and their operation verified.
 - 2. All analog input channels shall be verified for proper operation.
 - 3. Changing the state of the field device and observing the appropriate change of displayed value shall verify all digital input channels.
 - 4. If a point should fail testing, perform necessary repair action and retest failed point and all interlocked points.
 - 5. Introducing an error into the system and observing the proper corrective system response shall verify automatic control operation.
 - 6. Changing the schedule and observing the correct response on the controlled outputs shall verify selected time and setpoint schedules.
 - C. Workstation Test Procedures: The system workstation test procedures shall be as follows:
 - 1. Communication with each DDC control panel shall be demonstrated.
 - 2. Operator commands will be explained and demonstrated.
 - 3. Control sequences shall be demonstrated for proper operation.
 - 4. All available system reports and logs shall be demonstrated at the system workstation.
 - 5. Correct system start-up and shutdown procedures shall be demonstrated.
 - 6. All controllers shall be demonstrated to operate in a standalone mode.
 - D. Record Documentation: After a successful acceptance demonstration, the Contractor shall submit as-built drawings of the completed project for final approval. After receiving final approval, supply "3" complete 11 x 17 as-built drawings sets as well as digital "pdf" copies.
 - E. Operation and Maintenance Manuals: Submit three copies of operation and maintenance manuals. Include the following:
 - 1. Manufacturer's catalog data and specifications on sensors, transmitters, controllers, control valves, damper actuators, gauges, indicators, terminals and any miscellaneous components used in the system.
 - 2. An operator's manual that will include detailed instructions for all operations of the system.
 - 3. An operator's reference table listing the addresses of all connected input points and output points. Settings shall be shown where applicable.
 - 4. A programmer's manual that will include all information necessary to perform programming functions.
 - 5. A language manual that will include a detailed description of the language used and all routines used by the system.

6. Complete program listing file and parameter listing file for all programs.
7. A copy of the warranty.
8. Operating and maintenance cautions and instructions.
9. Recommended spare parts list.

3.9 TRAINING

- A. Contractor shall provide to the engineer a training class outline prior to any scheduled training.
- B. Factory trained control engineers and technicians shall provide training sessions for the Owner's personnel.
- C. The control contractor shall conduct five six-hour training sessions on the DDC System for the designated Owner's personnel in the maintenance and operation of the Systems. The class shall be given upon system acceptance.
- D. The course shall include instruction on specific systems and instructions for operating the installed system to include as a minimum:
 1. HVAC system overview.
 2. Operation DDC Systems.
 3. Function of each Component.
 4. System Operating Procedures.
 5. Programming Procedures.
 6. Maintenance Procedures.

3.10 SERVICE AND GUARANTEE

- A. This system specified under this Section of the Specifications shall be guaranteed from defects in workmanship and material under normal use and service for a period of twelve (12) months from the date of acceptance. If, during the one year period, any of the factory equipment or materials provided in the system is found to be defective in materials or workmanship, it shall be replaced or repaired by the DDC Manufacturer at no additional cost to the Owner.
- B. Upon completion of the installation, the Contractor shall thoroughly inspect, check, adjust, calibrate, and make ready for use all devices/sensors comprising the control system and certify that they are installed in accordance with "Record" Drawings.

END OF SECTION 23 09 00

SECTION 23 09 55
CONTROL SEQUENCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Control sequence is hereby defined to mean the manner in which, and methods by which, the controls function. The requirements for each type of operation are specified in this section
- B. The operating equipment, devices, and system components required for the automatic control system are specified by Section 23 09 00 - Instrumentation and Control for HVAC of these specifications.

1.3 RELATED REQUIREMENTS

- A. Section 23 09 00 - Instrumentation and Control for HVAC.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 SUBMITTALS

- A. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All HVAC systems shall be controlled with Direct Digital Control (DDC) according to the point list contained in this section of the Specifications and shall be stand-alone.
- B. Additional points or software programming not listed in the point list but which are required to meet the following sequence of operation shall be provided.

PART 3 – EXECUTION -- NOT USED

END OF SECTION 23 09 55

SECTION 23 20 10

PIPING, VALVES, AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Pipe and Pipe Fittings
- B. Valves

1.3 RELATED REQUIREMENTS

- A. Section 08 31 13 - Access Doors and Frames.
- B. Section 09 91 23 - Interior Painting.
- C. Section 23 00 00 - UTSW Mechanical Design Requirements.
- D. Section 23 05 16 - Piping Expansion Compensation
- E. Section 23 05 29 - Supports and Anchors.
- F. Section 23 05 53 - Mechanical Identification.
- G. Section 23 07 19 - Piping Insulation.
- H. Section 23 21 13 - Hydronic Piping
- I. Section 23 21 15 - Hydronic Specialties.
- J. Section 23 22 13 - Steam and Steam Condensate Piping.
- K. Section 23 22 23 - Steam and Steam Condensate Specialties.
- L. Division 31 – Trenching and Back Filling.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ASME BPVC – Boiler and Pressure Vessel Code (BPVC).
- C. ASME BPVC-IX – Welding and Brazing Qualifications.
- D. ASME B16.1 – Grey Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
- E. ASME B16.3 – Malleable Iron Threaded Fittings: Classes 150 and 300.
- F. ASME B16.4 – Grey Iron Threaded Fittings: Classes 125 and 250.
- G. ASME B16.5 – Pipe Flanges and Flanged Fittings NPS ½ through 23 Metric/Inch Standard.
- H. ASME B16.9 – Factory-Made Wrought Butt Welding Fittings.
- I. ASME B16.18 – Copper Alloy Solder Joint Pressure Fittings.
- J. ASME B16.22 – Wrought Copper and Bronze Solder-Joint Pressure Fittings.
- K. ASME B16.26 – Copper Alloy Fittings for Flared Copper Tubes.
- L. ASME B16.34 – Valves Flanged, Threaded, and Welding End.
- M. ASME B31.1 – Power Piping.
- N. ASME B31.3 – Process Piping.
- O. ASME B31.9 – Building Service Piping.
- P. ASTM A47/A47M - Ferric Malleable Iron Castings.
- Q. ASTM A53/A53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- R. ASTM A105/A105M – Standard Specification for Carbon Steel Forgings for Piping Applications.
- S. ASTM A106/A106M – Specification Standard for Seamless Carbon Steel Pipe for High-Temperature Service.
- T. ASTM A126 – Standard Specification for Grey Iron Castings for Valves, Flanges, and Pipe Fittings.
- U. ASTM A135/A135M – Standard Specification for Electric-Resistance-Welded Steel Pipe.
- V. ASTM A181/A181M – Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.

- W. ASTM A182/A182M – Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - X. ASTM A234/A234M - Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 - Y. ASTM B32 – Standard Specification for Solder Metal.
 - Z. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
 - AA. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes for Steam or Valve Bronze Castings.
 - BB. ASTM B75/B75M - Standard Specification for Seamless Copper Tube.
 - CC. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 - DD. ASTM B251/B251M - Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
 - EE. ASTM B302 – Standard Specification for Threadless Copper Pipe (TP), Standard Sizes.
 - FF. AWS A5.8M/A5.8 - Brazing Filler Metal.
 - GG. MSS SP-25 – Standard Marking System for Valves, Fittings, Flanges, and Unions.
 - HH. NCPWB (SPS) - Procedure Specifications for Pipe Welding.
- 1.5 SUBMITTALS
- A. Submit under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
 - B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
 - C. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.
- 1.6 PROJECT RECORD DOCUMENTS
- A. Submit under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
 - B. Record actual locations of valves, etc. and prepare valve charts.
- 1.7 OPERATION AND MAINTENANCE DATA
- A. Submit under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
 - B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- 1.8 QUALITY ASSURANCE
- A. Valves: Manufacturer's name and pressure rating marked on valve body.
 - B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
 - C. Welder's Certification: In accordance with ASME BPVC-IX. Submit welder's certifications prior to any shop or field fabrication. Welder's certifications shall be current within six months of submission.
 - D. Maintain one copy of each document on site.
- 1.9 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years' documented experience.
 - B. Installer: Company specializing in performing the work of this section with minimum of three years' documented experience.
- 1.10 DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, protect and handle products to site under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
 - B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
 - C. Provide temporary protective coating on cast iron and steel valves.
 - D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
 - E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
- 1.11 ENVIRONMENTAL REQUIREMENTS
- A. Do not install underground piping when bedding is wet or frozen.
- 1.12 ATTIC STOCK

- A. Furnish under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
- B. Provide two repacking kits for each size valve.

PART 2 - PRODUCTS

2.1 STEEL PIPING

- A. Section applies to all piping systems providing for welded piping, fittings, and other appurtenances. Specific systems requiring welded piping include, but are not limited to: chilled water, hot water, steam, and steam condensate.
- B. Pipe: Unless otherwise indicated, chiller and boiler plant piping shall be Schedule 40, and underground and building piping shall be Standard weight, Grade A or B, seamless black steel pipe conforming in all details to Standard ASTM A53/A53M ASTM A106/A106M, and ASTM A135/A135M, latest revisions. Steam condensate shall be Schedule 80.
- C. Fittings:
 - 1. All weld fittings shall be domestic made wrought carbon steel butt-welding fittings conforming to ASTM A234/A234M and ASME B16.9, latest edition, as made by Weldbend, Tube Turns, or Hackney Ladish Inc. Attach only to pipe with a hole for the entire length. Each fitting shall be stamped as specified by ASME B16.9 and, in addition, shall have the laboratory control number metal stenciled on each fitting for ready reference as to physical properties required for any fittings selected at random. Fittings which have been machined, remarked, printed, or otherwise produced domestically from non-domestic forgings or materials will not be acceptable. Each fitting is to be marked in accordance with MSS SP-25. Markings shall be placed on the fittings at the farthest point from the edge to be welded to prevent disfiguring from the welding process. Submittal data for these fittings shall include a letter signed by an official of the manufacturing firm certifying compliance with these specifications.
 - 2. All screwed pattern fittings specifically called for shall be Class 150 malleable iron fittings of Grinnell Company, Crane Company, or Walworth Company manufacture (Class 300 for unions).
- D. Fabrication:
 - 1. Piping shall be fabricated according to the latest ASME/ANSI B31 Code for Pressure Piping. Welded piping and fittings in chiller and boiler plants shall be fabricated in accordance with ASME/ANSI Standard ASME B31.1 – Power Piping. Direct buried piping mains shall be fabricated in accordance with ASME/ANSI Standard ASME B31.3 – Process Piping. Standard ASME B31.9 – Building Services Piping may be used within buildings. Machine beveling in shop is preferred. Field beveling may be done by flame cutting to recognized standards.
 - 2. Ensure complete penetration of deposited metal with base metal in welds. Contractor shall provide filler metal suitable for use with base metal. Contractor shall keep inside of fittings free from globules of weld metal. All welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process. All pipe shall have the ends beveled 37-1/2 degrees and all joints shall be aligned true before welding. Except as specified otherwise, all changes in direction, intersection of lines, reduction in pipe size, and the like shall be made with factory-fabricated welding fittings. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction will not be permitted.
 - 3. Align piping and equipment so that no part is offset more than 1/16 inch. Set all fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.
 - 4. Do not permit any weld to project within the pipe so as to restrict it. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.
 - 5. Do not split, bend, flatten or otherwise damage piping before, during or after installation.
 - 6. Remove dirt, scale and other foreign matter from the inside of piping, by swabbing or flushing, prior to the connection of other piping sections, fittings, valves or equipment.
 - 7. In no cases shall Schedule 40 pipe be welded with less than three passes, including one stringer/root, one filler, and one lacer. Schedule 80 pipe shall be welded with not less than four passes including one stringer/root, two filler, and one lacer. In all cases, the weld must be filled before the cap weld is added.

8. Procedure of Assembling Screw Pipe Fittings: All screw joints shall be made with taper threads properly cut. Joints shall be made tight with Teflon applied to the pipe threads only and not to fittings. When threads are cut on pipes, the ends shall be carefully reamed to remove any burrs. Before installing pipe that has been cut and threaded, the lengths of pipe shall be upended and hammered to remove all shavings and foreign material.
- E. Weld Testing:
1. All welds are subject to inspection, visual, X-ray and/or Ultrasound, for compliance with specifications. The owner will, at the owner's option, provide employees or employ a testing laboratory for the purposes of performing said inspections and/or X-ray testing. Initial visual and X-ray inspections will be provided by the owner. The contractor shall be responsible for all labor, material and travel expenses involved in the re-inspection and re-testing of any welds found to be unacceptable. In addition, the contractor shall be responsible for the costs involved in any and all additional testing required or recommended by ASME/ANSI Standards ASME B31.1, ASME B31.3, and ASME B31.9, due to the discovery of poor, unacceptable, or rejected welds.
 2. Welds lacking penetration, containing excessive porosity or cracks, or found to be unacceptable for any reason, must be removed and replaced with an original quality weld as specified herein. All qualifying tests, welding and stress relieving procedures shall, moreover, be in accord with Standard Qualification for Welding Procedures, Welders and Welding Operators, Appendix A, Section 6 of the ASME/ANSI B31 Code for Pressure Piping, current edition.

2.2 VALVES:

- A. All valves must be of threaded or flanged type. No solder connected or grooved fitting valves shall be used on this project. All valves shall be located such that the removal of their bonnets is possible. All flanged valves shown in horizontal lines with the valve stem in a horizontal position shall be positioned so that the valve stem is inclined one bolt hole above the horizontal position. Screw pattern valves placed in horizontal lines shall be installed with their valve stems inclined at an angle of a minimum of 30 degrees above the horizontal position. All valves must be true and straight at the time the system is tested and inspected for final acceptance. Valves shall be installed as nearly as possible to the locations indicated in the Construction Drawings. Any change in valve location must be so indicated on the Record Drawings.
- B. All bronze and iron body gate and globe valves shall be the product of one manufacturer for each project. Manufacturers of other types may not be mixed on the same project; i.e., all butterfly valves shall be of the same manufacturer, all ball valves shall be of the same manufacture, etc.
- C. All bronze valves used in circulating systems and steam systems (low and medium pressure) shall be Class 150 SWP. Bronze valves used in high pressure steam systems shall be Class 300 SWP. Iron valves used for low and medium pressure steam systems shall be Class 125. Iron valves used for high pressure steam systems shall be Class 250.
- D. All gate and globe valves shall be union bonnet design.
- E. Metal used in the stems of all bronze gate, globe and angle valves shall conform to ASTM B371/B371M Alloy 694, or other corrosion resistant equivalents. Written approvals must be secured for the use of alternative materials. Alloys used in all bronze ball, gate, globe, check, or angle valves shall contain no more than 15percent zinc. No yellow brass valves will be allowed.
- F. Class 300 valves shall be constructed of all ASTM B61 composition.
- G. All cast steel body valves shall have the pressure containing parts constructed of ASTM A216/A216M - GR-WCB carbon steel. Gate and globe valves shall be bolted bonnet outside and screw and yoke design with pressure-temperature rating conforming to ASME B16.34. Stems shall meet ASTM designation ASTM A182/A182M -F6 chromium stainless steel. Wedges on gate valves may be solid or flexible type and shall meet ASTM A182/A182M -F6 chromium stainless steel on valves from 2 to 6 inches. Sizes 8 inches and larger may be A216-WCB with forged rings or overlay equal to 182-F6. Seat ring shall be hard faced carbon steel or 13 percent chromium ASTM A182/A182M -F6 stainless. Handwheels shall be A47 Grade 35018 malleable iron or ductile iron ASTM A536.
- H. All forged steel body valves shall have the pressure containing parts constructed of ASTM A105, grade 2 forged carbon steel. Seat and wedges shall meet ASTM A182/A182M F6 chromium stainless steel. Seat rings shall be hard faced. Valves shall conform to ASME B16.34 pressure-temperature rating.
- I. All valves shall be repackable under pressure, with the valve in the full open position. All gate valves, globe valves, angle valves and shutoff valves of every character shall have malleable iron hand wheels,

except iron body valves 2 1/2 inches and larger which may have either malleable iron or ASTM A126 Class B, gray iron hand wheels.

- J. Packing for all valves shall be free of asbestos fibers and selected for the pressure-temperature service of the valve. It is incumbent upon the manufacturer to select the best quality standard packing for the intended valve service. At the end of one year, period spot checks will be made, and should the packing show signs of hardening or causing stem corrosion, then all valves supplied by the manufacturer shall be repacked by the Contractor, at no expense to the Owner, with a packing material selected by the Owner.
- K. Valves 12 inches and larger located with stem in horizontal position shall be drilled and tapped in accordance with MSS SP-45 to accommodate a drain valve and equalizing by-pass valve assembly.
- L. Balancing and/or shutoff valves for hot water systems 2 inches and smaller shall be three piece, full port, bronze body ball valves with stainless steel ball and stem. They shall have PTFE seats, packing and gasket, bronze gland follower, adjustable stuffing box, steel lever type handle with plastic sheathed operating handle, adjustable memory stops, and shall be class 150 SWP/600 WOG, screwed pattern. Manufacturer shall certify ball valves for use in throttling service. Stem extensions shall be furnished for use on insulated lines.
- M. Shutoff valves for chilled water 2 inches and smaller shall be two piece, full port, bronze body ball valves with stainless steel ball and stem. They shall have PTFE seats, packing and gasket, bronze gland follower, adjustable stuffing box, steel lever type handle with plastic sheathed operating handle, adjustable memory stops, and shall be class 150 SWP/600 WOG, screwed pattern. Manufacturer shall certify ball valves for use in throttling service. Stem extensions shall be furnished for use on insulated lines.
- N. All balancing and/or shutoff valves 2 1/2 inches and larger shall be tapped full lug butterfly valves with aluminum bronze discs of 316, 416, or 420 stainless steel shafts. Design must incorporate bushing between shafts and body of material suitable to provide a bearing surface to eliminate seizing or galling.
- O. All balancing and/or shutoff valves must be capable of providing a bubble tight seal at 200 psi for valves up to 12 inches, and 150 psi for larger valves, when used for end of line service, without requiring the installation of a blind flange on the downstream side.
- P. All butterfly valves shall be absolutely tight against a pressure differential of 150 psi. Liners shall be resilient material suitable for 225 °F temperature and bodies of ductile iron. Butterfly valves 2 1/2 inches through 6 inches shall have lever handles which can be set in interim positions between full open and full closed. Butterfly valves 8 inches and larger, and butterfly valves used for balancing service, regardless of size, shall have heavy duty weather proof encased gear operators with malleable iron handwheel or crank.
- Q. Check Valves for Water Systems: Valves 2 inches and smaller shall have bronze bodies and a regrinding disc and seat with screw-in cap. Valves 2 1/2 inches and larger shall have iron bodies and be non-slam wafer type with stainless pins and springs, and bronze or stainless steel plates.

2.3 STANDARDS OF QUALITY FOR VALVES

SIZE (INCHES)	SERVICE	MEDIA	CLASS	MILWAUKEE	NIBCO	CRANE CO. STOCKHAM OR AS NOTED
2 & SMALLER	GATE VALVE	L.P. STEAM	150	--	T-134	B-120
2-1/2 & LARGER	GATE VALVE	L.P STEAM	125	F-2885A	F-617-O	G-623
* 2 & SMALLER	BALL VALVE FOR SHUTOFF	RECIRCULATING CHILLED WATER	150	BA-400S	T-585-70-66	APOLLO 82-140
* 2 & SMALLER	BALL VALVE FOR SHUTOFF	RECIRCULATING HOT WATER	150	BA-300S	T-595-Y-66	APOLLO 77-140
2 & SMALLER	GLOBE & BALANCING VALVE	CHILLED WATER, HOT WATER	150	590T	T-235-Y	B-22T

2-1/2 & LARGER	GLOBE & BALANCING VALVE	CHILLED WATER, HOT WATER	125	F-2981A	F-718- B	G-512
2-1/2 & LARGER	BUTTERFLY VALVE FOR SHUTOFF	RECIRCULATING CHILLED AND HEATING WATER	150	ML233E (LEVER); ML333 (GEAR)	LD- 2000	DEZURIK BHP SERIES
2 & SMALLER	CHECK VALVE	ALL WATER SYSTEMS	150	510T	T-433- Y	B-345
2-1/2 & LARGER	CHECK VALVE	ALL WATER SYSTEMS	125	8800*	W- 920-W	CRANE "DUO- CHEK" SERIES

- A. * Requires extended stem in insulated lines.
- B. Note: Valves 8 inches and larger, and valves used for balancing service regardless of size, shall have heavy-duty weatherproof encased gear operators.

2.4 UNIONS

- A. Provide and install two-piece unions at proper points to permit removal of pipe, valves and various equipment and/or machinery items without injury to other parts of the system. No unions will be required in welded lines or lines assembled with solder joint fittings except at all valves, equipment items, machinery items and other special pieces of apparatus. Unions 2 inches and smaller in ferrous lines shall be Class 300 AAR malleable iron unions with iron to brass seats, and 2 1/2 inches and larger shall be ground flange unions. Unions in copper lines shall be Class 125 ground joint brass unions or Class 150 brass flanges if required by the mating item of equipment. Companion flanges on lines at various items of equipment, machines and pieces of apparatus shall serve as unions to permit removal of the particular items. See particular Specifications for special fittings and pressure.
- B. Unions connecting ferrous pipe to copper or brass pipe shall be dielectric type equal to EPCO.
- C. In all water lines where the material of the pipe is changed from ferrous to copper or brass, a two-piece dielectric union shall be used at the transition.

2.5 FLANGES

- A. All 150 lb. and 300 lb. ANSI flanges shall be weld neck and shall be domestically manufactured, forged carbon steel, conforming to ASME B16.5 and ASTM A181/A181M Grade I or II or ASTM A105/A105M as made by Tube Turns or Hackney Ladish Inc. Slip on flanges shall not be used. Each fitting shall be stamped as specified
- B. by ASME B16.9 and, shall have the laboratory control number stenciled on each fitting for ready reference as to physical properties and chemical composition of the material. Complete test reports may be required for any fitting selected at random. Flanges which have been machined, remarked, painted or otherwise produced domestically from imported forges will not be acceptable. Flanges shall have the manufacturer's trademark permanently identified in accordance with MSS SP-25. Contractor shall submit data for firm certifying compliance with these Specifications. Bolts used shall be carbon steel bolts with semi-finished hexagon nuts of American Standard Heavy dimensions. Allthread rods will not be an acceptable for flange bolts. Steam system flange bolts shall have a tensile strength of 105,000 psi and an elastic limit of 81,000 psi and be rated at least ANSI Grade V. Other bolts shall have a tensile strength of 80,000 psi and an elastic limit of 36,000 psi and be rated at least ANSI Grade I.
- C. Flat faced flanges shall be furnished to match 125 lb cast iron flanges on pumps, check valves, strainers, etc. with full flange gaskets. Bolting of raised face flanges to flat faced flanges is not allowed.
- D. Flange Gaskets
 1. Gaskets shall be placed between the flanges of all flanged joints.
 2. Gaskets for steam piping - All steam flange joints shall use Flexitallic Class 150 spiral wound for low pressure applications and Flexitallic Class 300 spiral wound gaskets for medium or high pressure applications. Raised and flat face flange gaskets shall be Flexitallic compression gauge (CG) style. External ring shall be Type 304 stainless steel and color coded yellow. Filler material shall be Flexite Super and color coded with pink stripe. Equivalentents may be submitted with all design data so that an evaluation of the gasket can be made.

3. Gaskets for all other applications: Gaskets shall be ring form gaskets fitting within the bolt circle of their respective flanges. Gaskets shall be 1/16 inch thick asbestos free material recommended for service by Anchor, Garlock, or John Crane. The inside diameter of such gaskets shall conform to the nominal pipe size and the outside diameter shall be such that the gasket extends outward to the studs or bolts employed in the flanged joint.
 4. Spares - Contractor shall provide ten spares for every flange size and rating.
- E. Flange Bolt Installation:
1. Bolt Lubrication: Bolts shall be well lubricated with a heavy graphite and oil mixture.
 2. Torque Requirements - Bolts shall be stressed to 45,000 psi.

Nominal Bolt Dia. (Inch)	Torque (Foot-Pounds)
0.25	6
0.3125	12
0.375	18
0.4375	30
0.5	45
0.5625	68
0.625	90
0.75	150
0.875	240
1.0	368
1.125	533
1.25	750
1.375	1020
1.5	1200

1. Torque shall be checked with a calibrated breaking action torque wrench on the final torque round. Bolts shall be cold and hot torqued.
2. Torque Pattern - Shall be a cross or star pattern with at least four passes. Limit each pass to 30 percent of full torque increases.
3. Hot Torque - Re-torque the flange bolts with system at normal operating pressure and temperature for at least four hours.
4. Inspection - Owner shall verify hot torqueing of all medium and high pressure steam flange bolts.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify excavations under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
- B. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

- A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Route piping in orderly manner and maintain gradient.
- C. Install piping to conserve building space and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide clearance for installation of insulation and access to valves and fittings.
- G. Coordinate access door location with architectural features.
- H. Establish elevations of buried piping outside the building to ensure a minimum of cover. Refer to Section 23 00 00 - UTSW Mechanical Design Requirements .

- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
 - J. Provide support for utility meters in accordance with requirements of utility companies.
 - K. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting. Refer to Division 09.
 - L. Excavate in accordance with Section 23 00 00 - UTSW Mechanical Design Requirements for work of this Section.
 - M. Backfill in accordance with Section 23 00 00 - UTSW Mechanical Design Requirements for work of this Section.
 - N. Install bell and spigot pipe with bell end upstream.
 - O. Install valves with stems upright or horizontal, not inverted.
- 3.4 ERECTION TOLERANCES
- A. Establish invert elevations, slopes for drainage to 1/8 inch per foot (one percent) minimum. Maintain gradients through each joint of pipe and throughout system.
 - B. Slope water piping and arrange to drain at low points.

END OF SECTION 23 20 10

SECTION 23 21 13
HVAC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Piping and pipe fittings for:
 - 1. Chilled Water Piping
 - 2. Heating Water Piping
 - 3. Steam Piping
 - 4. Steam Condensate Piping
 - 5. Food Service Heat Rejection Piping

1.2 RELATED REQUIREMENTS

- A. Section 23 05 00 - UTSW Mechanical Design Requirements
- B. Section 23 21 15 - Hydronic Specialties
- C. Section 23 20 10 - Piping, Valves, and Fittings
- D. Section 23 07 19 - Piping Insulation
- E. Section 23 22 23 - Steam and Steam Condensate Specialties

1.3 REFERENCE STANDARDS

- A. ASME B1.1 - Unified Inch Screw Threads.
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.
- C. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard.
- D. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings.
- E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- F. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
- G. ASME B31.1 - Power Piping.
- H. ASME B31.3 - Process Piping.
- I. ASME B31.9 - Building Services Piping.
- J. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- K. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
- L. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
- M. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.
- N. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
- O. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- P. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.
- Q. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings.
- R. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast.
- S. MSS SP-25 - Standard Marking System for Valves, Fittings, Flanges and Unions.
- T. ASME B18.2 - Square, Hex, Heavy Hex, and Askew Head bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws; 2013.
- U. ASTM A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2010.

- V. ASTM A21.51 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water; 2002.
- W. ASTM A193 - Standard Specification for alloy Steel and Stainless Steel Bolting Materials for High Temperature Service; 2014.
- X. ASTM A194 - Standard Specification for Carbon and Alloy Steel Nuts for bolts for High Pressure or High Temperature Service, or Both; 2014.
- Y. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2014.

1.4 SUBMITTALS

- A. Submit product data for review on piping and fittings. Submittal data shall include:
 - 1. Manufacturer of pipe.
 - 2. Tests or listings by recognized testing laboratory that certifies material composition is in accordance with ANSI/ASTM requirements.
 - 3. Product data for pipe and fittings to be used on each piping system.
 - 4. Welding procedures for steel pipe.
 - 5. Solder and brazing product data and installation procedures for copper pipe.

PART 2 - PRODUCTS

2.1 STEEL PIPE

- A. Black steel: Electric resistance welded or seamless, ASTM A53 or ASTM A106 Grade B. Mill wrap uninsulated underground steel pipe with Republic X-Tru-Coat or equal.
 - 1. Through 10" standard weight Schedule 40
 - 2. 12" pipe and larger: standard weight with 0.375" wall thickness
- B. Provide for the following services:
 - 1. Chilled water supply and return piping, 1-1/4" diameter and larger. (Contractor option: copper up to 2" diameter; see "COPPER PIPE" below.)
 - 2. Heating water supply and return piping, 1-1/4" diameter and larger. (Contractor option: copper up to 2" diameter. See "COPPER PIPE" below.)
 - 3. Food service heat rejection supply and return piping, 1-1/4" diameter and larger (Contractor Option: Copper up to 2" diameter: See "Copper Pipe herein")
- C. Schedule 40, seamless: ASTM A53 or ASTM A106, Grade B. Provide for the following services:
 - 1. Steam piping
- D. Schedule 80, seamless: ASTM A53 or ASTM A106, Grade B. Provide for the following services:
 - 1. Steam Condensate piping
 - 2. Boiler blowdown piping
 - 3. Pumped condensate piping
- E. Schedule 40, A53 or A106 galvanized pipe for:
 - 1. Cooling Coil condensate drain piping. (Contractor option: Copper; see "COPPER PIPE" below.)
 - 2. Drain piping from equipment 1-1/2" diameter and smaller.

2.2 STEEL PIPE FITTINGS

- A. Flanges, Fittings, and Unions: Mark in accordance with MSS-SP-25.
- B. Fittings:
 - 1. 2-1/2" and larger: Class 150, wrought steel, butt welded fittings, ASME B16.9
 - 2. 2" and Smaller
 - a. Water Service: Class 150, malleable iron, screwed.
 - b. Steam, 125 psi (861.84 kPa) and less: Class 150, A53 malleable iron, screwed, ASME B16.3
 - c. Condensate: Class 150 malleable iron, A53 screwed, ASME B16.3
- C. Flanges, 2-1/2" and larger: Class 150, A53 wrought forged steel, slip-on or weld neck, ASME/ANSI B16.5. Flange faces shall match equipment or mating flanges (i.e. flat-faced flanges shall be used adjacent to equipment with integral flat-faced flanges, such as pumps, control valves, etc.)

- D. Gaskets:
 - 1. Inorganic fibers, 1/16 or 1/8 inch (3.18 mm) thick, reinforced EPDM binder, 550 degrees Fahrenheit (287.78 degrees Celsius) and 700 psig (4826.33 kPa) operation, Garlock 5507 or equal:
 - a. Chilled water
 - b. Heating water
 - 2. Spiral wound "chevron" metallic gaskets, flexible graphic filler, class 150 and 300 service, Flexitallic LS, CG or equal
 - a. Steam
 - E. Unions, 2" and smaller: Material as specified under fittings, screwed with brass seat.
 - F. Branch connections from mains or headers, 2-1/2" and larger: Welded tees or welding outlets, Bonney Forge Weldolets or Thredolets. Use forged outlets only if branch line is at least one pipe size smaller than main or header.
 - G. Galvanized steel pipe fittings: Same as above, except galvanized coated.
 - 1. Provide drainage pattern type fittings for drain piping.
 - H. Bolting Materials: Torque all bolts to 50% of yield strength or per equipment manufacturer's recommendation, whichever is lower. Use anti-seize lubricant on all bolt threads. Same finished carbon steel bolts and hex nuts, ASTM A307. Threads and Dimensions: ASME/ANSI B1.1 and B18.2.
 - 1. Systems 210 degrees Fahrenheit (98.89 degrees Celsius) and less: Use ASTM A449 studs or bolts and ASTM-A563 Grade B hex nuts
 - 2. Systems above 210 degrees Fahrenheit (98.89 degrees Celsius): Use ASTM-A193 Grade B7 studs or bolts and ASTM-A194 Grade 2 Heavy Hex Nuts
 - 3. Use galvanized bolts and nuts on piping outside the building, inside tunnels, and inside manholes.
 - I. Thread Lubricant: Similar to Crane "Formula 425".
- 2.3 IPS GROOVED PIPING SYSTEM
- A. Grooved piping shall only be allowed in EXPOSED locations and for straight run piping only. Example: Mechanical rooms where piping is visible above/below ductwork.
 - 1. Applicable Systems:
 - a. Chilled Water Supply/Return
 - b. Heating Hot Water Supply/Return
 - c. Secondary Chilled Water Supply/Return
 - B. Grooved mechanical pipe couplings, fittings, valves and other grooved components may be used as an option to welding, threading or flanged methods as specified herein. All grooved components shall be of one manufacturer and conform to local code approval and as listed by ASME/ANSI B-31.1, B-31.3, B-31.9, ASME, UL/ULC, FM, IAPMO or applicable Building Code. Grooved end product manufacturer to be ISO-9001 certified. Grooved couplings shall meet the requirements of ASTM F-1476.
 - C. Grooved Pipe: Carbon Steel, as specified with roll or cut grooved-ends as appropriate to pipe material, wall thickness, pressures, size and method of joining. Pipe ends shall be grooved in accordance with manufacturer's current listed standards conforming to ANSI/AWWA C-606.
 - D. Mechanical Couplings for Steel Pipe
 - 1. Acceptable manufacturers: Victaulic. Victaulic model numbers are used to establish product type, quality and performance.
 - 2. Mechanical couplings shall be manufactured in two segments of cast ductile iron, conforming to ASTM A-536, Grade 65-45-12. Gaskets shall be pressure-responsive synthetic rubber, grade to suit the intended service, conforming to ASTM D-2000. Mechanical coupling bolts shall be zinc plated (ASTM B-633) heat treated carbon steel track head conforming to ASTM A-449 and ASTM A-183. Couplings shall comply with ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

- a. Rigid Type: coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity, support, and hanging in accordance with ANSI B31.1, B31.9, with Victaulic Style 107H/107N (Quick-Vic) installation ready rigid coupling for direct stab installation without field disassembly. Gasket shall be Grade "EHP" EPDM designed for operating temperature from -30 deg. F (-34 deg. C) to 250 deg. F (120 deg. C).
- b. Victaulic AGS mechanical couplings, 14 inch (355.6 mm) through 60 inch (1524 mm): Couplings shall consist of two ASTM A-536 ductile iron housing segments with lead-in chamfer on housing key and a wide-width elastomer pressure responsive gasket. Victaulic Style W07 AGS Rigid and Style W77 AGS Flexible Coupling.

2.4 COPPER PIPE

- A. Conform to ASTM B-88 specification for wrought seamless copper.
- B. Type L, hard for:
 - 1. HVAC reheat water pipe, 1" and smaller; Contractor option for copper or steel pipe 1-1/4" to 2".
 - 2. HVAC chilled water pipe, 1" and smaller. Contractor option for copper or steel pipe 1-1/4" to 2".
 - 3. Food service heat rejection supply and return water piping, 1" and smaller. Contractor option for copper or steel pipe 1-1/4" to 2".
- C. Type M, hard for:
 - 1. For non-pressurized drain piping.
 - 2. Fan coil unit condensate piping.
 - 3. Cooling coil condensate piping.

2.5 COPPER PIPE FITTINGS

- A. Sweat type, wrought copper, ASTM B62, with dimensions conforming to ASTM/ANSI B16.22 and sweep patterns for copper tubing.
- B. Dielectric Connections:
 - 1. Provide at junction of copper pipe and equipment with steel piping systems.
 - 2. Central, Dielectric insulating unions, and insulating flange unions, as manufactured by Central Plastic Company or CTS Fabrication USA (1-1/2" thru 8").
 - 3. Provide copper solder joint to plated female iron pipe for sizes 1/2" through 2".
 - 4. Provide insulating flange unions, malleable female iron pipe thread to copper solder joint flange unions for sizes 2-1/2" through 4".
 - 5. Brass fittings and valves may not be used for dielectric union locations.
- C. Unions: Brass ground joint, 250 lb. working pressure.
- D. Nipples: Brass.

2.6 MISCELLANEOUS PIPE ACCESSORIES

- A. Escutcheons: Chrome pipe escutcheons, slip-on or split type where pipe passing through finished walls or ceiling may be visible.
- B. Exposed Metal Pipe and Trim: Chrome plated.
- C. Control System Connectors: Crane No. 386, 1" steel half couplings, or 1" female pipe thread connectors.
- D. Install 18 gauge sheetmetal or galvanized steel pipe saddles to protect insulation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Clean inside of pipe before installation. Keep installed piping clean, and protect ends from foreign matter by capping or plugging them.
- B. Install pipe so that it does not interfere with opening of doors or apparatus, access to equipment, or to electrical equipment.

- C. Do not install pipes in such a way that they will apply torque to pumps. After pumps have been installed and pumps have been operated, recheck and realign pumps if necessary.
- D. Run pipes in straight lines and square with building. Install risers plumb. Make offsets only where indicated and where necessary.
- E. Install branch connections using separate tee or lateral fittings for each branch. Do not combine branches into "bullhead tee" arrangement.
- F. Do not install water pipes in electric rooms, tele/data rooms, transformer rooms, audio/visual rooms or elevator equipment rooms. Fire protection piping runouts serving only these rooms shall be installed in these rooms.
- G. Do not install piping above electrical equipment such as starters, variable frequency motor controllers, motor control centers, or disconnects. Maintain code required clearance above, below and to sides of electrical equipment.
- H. Provide flanges or unions throughout the pipe systems at all equipment. Make provisions for servicing and removal of equipment without dismantling piping.
- I. In so far as possible, drainage piping shall not be installed overhead, whether exposed or above ceiling, in operating rooms, delivery rooms, nurseries, food preparation or serving areas, or in rooms listed above. Where unavoidable, provide drain troughs or other means to carry away leakage.
 - 1. Slope cooling coil condensate drains at 1/8" per foot.
- J. Slope steam pipes and steam condensate drain pipes at 1/4" per 10 feet (304.8 cm). Do not raise condensate pipe except at ends of main drips.
- K. Branch Lines:
 - 1. Where possible branch lines shall come off top of mains to prevent sediment, welding slag, or pipe burrs from entering the branch lines and causing valve leakage or failure.

3.2 PIPE JOINTING

- A. Preparing Pipe Ends:
 - 1. Machine cut pipe ends square.
 - 2. Ream pipe ends, after cutting, to full diameter.
 - 3. Where pipe is to be threaded, secure pipe in pipe stand, die cut, full depth, right hand threads. Threads to be taper type.
 - 4. All threaded pipe joints to have suitable pipe sealant applied to threads prior to assembly of joint. Joints shall be leak proof.
 - 5. Where pipe is to be welded, die-cut end of butt joints at 30 degree taper. Weld should have a full penetration with no bubbles or holes. Remove all slag.
- B. Welded Steel Piping:
 - 1. Where welded piping is specified, make welds by oxy-acetylene process or electric process in accordance with ASME/ANSI B31.1.
 - a. Welding Rods: Grade recommended for purpose by manufacturer's and identification.
 - 2. Line welds, single V-butt type:
 - a. Mill or machine bevel pipe at 37 1/2 degrees to within 1/16" of inside wall, except that in field limited amount of pipe may be flame beveled.
 - b. Pipe with a wall thickness of 3/16" or less need not be beveled but may be welded by melting down into building up over abutting ends.
 - c. Separate abutting ends of joints before welding to permit complete fusion to bottom without overlapping.
 - d. Tack in two or more points to maintain alignment, and fusion weld.
 - 3. Make all welds of sound weld metal, thoroughly fused into ends of pipe, and to bottom of vee.
 - a. Build in excess of pipe wall to give reinforcement to one fourth pipe wall thickness.
 - b. Weld metal shall present a gradual increase in thickness from surface of pipe to center of weld.
 - c. Minimum weld width: Two and one half times thickness of pipe wall.
 - 4. Use welding ells at turns in welded lines

5. Do not weld pipe couplings in place of welding fittings for any branch connections.
 6. Weld-o-lets and thread-o-lets:
 - a. Scribe and cut openings in main pipes for welded branches accurately taking care to remove all of plugs and cuttings from main pipe.
 - b. Full weld fillet welds for full depth of fillet, with additional beads to form well rounded connection as recommended by weld-o-let manufacturer.
 7. Cut openings into pipe for welded connections accurately to give matched intersections.
 8. Make welded fittings of same material with same pressure and temperature rating as pipe with which they are used.
 9. Make flanged connections to control valves, pump suction and specialties with ANSI standard welding neck flanges. All other flange connections may be made with slip-on flanges provided they are seal welded on inside.
 10. Fuse all fillet welds for flanges or fittings into pipe and plate for minimum distance of 1-1/2 times pipe wall thickness and depth weld on 1-1/4 times pipe wall thickness.
- C. Grooved Coupling Installation:
1. Pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove for proper gasket sealing.
 2. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified.
 3. All grooved components (couplings, fittings, valves, gaskets, bolts and nuts) shall be of one manufacturer.
 4. Grooved joints shall be installed in accordance with manufacturer's latest published installation instructions.
 5. Grooved ends shall be clean and free from indentations, projections, and roll marks.
 6. A factory trained field representative (direct employee) of the mechanical joint manufacturer shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. The factory trained representative shall periodically review the product installation and ensure best practices are being followed. Contractor shall remove and replace any improperly installed products at their cost. A distributor's representative is not considered qualified to conduct the training.
- D. Soldered and Brazed Joints:
1. Make Type L and M copper pipe joints with suitable flux and 95/5, lead free solder.
 2. Make Type K copper pipe joints with silver (BAg Series) brazing filler material with flux or copper-phos (BCup Series) brazing filler material without flux per the recommendations of the Copper Development Association.
- E. "T" Drill Branch Connections are not allowed.
- F. Bracing Joints:
1. Provide braces and bridle rods as required to reinforce joints.
 2. If mechanical lock type couplings are used, then prepare pipe ends and make joints in accordance with pipe coupling manufacturer's printed instructions.
 3. Where large pipes underground are subject to shock because of sudden changes in liquid flow rate, provide concrete "kicker" blocks at joints, fittings, and changes of pipe direction. Provide "kicker" blocks in accordance with applicable pipe industry trade or research organization recommendations.
 - a. For example, for ductile iron pipe follow recommendations of Ductile Iron Pipe Research Association.

3.3 ESCUTCHEONS

- A. Provide chrome plated escutcheons where uninsulated pipes penetrate walls or ceilings of finished spaces.

3.4 STRAINERS

- A. Install strainers so the strainer basket can be removed without spilling water on motors and electrical equipment.

3.5 AIR VENTING

- A. Provide manually operated air vents at high points in vertical risers and at water coils to eliminate air from systems. Air vents are not required at reheat coils.
- B. Use ball valves for manual air vents.

3.6 VALVE ACCESS

- A. Locate ceiling/wall access panels at shut-off and control valves for proper access and operation. Furnish and install access doors in accordance with Section 23 05 00 and other Divisions as applicable.

3.7 CONTROL SYSTEM CONNECTORS

- A. Weld connectors at points indicated, and at other points where necessary for installation of thermometers, sensors, and automatic controls.

3.8 TESTING

- A. Before piping is concealed or insulated, recheck it for leaks.
- B. Rework or replace defective and leaking joints, and joints which are otherwise unsatisfactory. Peening, caulking, and doping are not permitted.

END OF SECTION 23 21 13

SECTION 23 21 15
HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Air vents.
- B. Strainers.
- C. Water flow measuring and balance system.

1.3 RELATED REQUIREMENTS

- A. Section 01 91 00 - General Commissioning Requirements .
- B. Section 22 00 10 - Basic Plumbing Requirements.
- C. Section 23 00 00 - UTSW Mechanical Design Requirements.
- D. Section 23 21 13 - Hydronic Piping.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ASME BPVC - Boilers and Pressure Vessels Code.
- C. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels.

1.5 REGULATORY REQUIREMENTS

- A. Conform to ASME BPVC-VIII-1 for manufacture of tanks.

1.6 QUALITY ASSURANCE

- A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.7 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 22 00 10 - Basic Plumbing Requirements.
 - 1. Submit shop drawings and product data for manufactured products and assemblies required for this project.
- B. Include component sizes, rough-in requirements, service sizes, and finishes Include product description, model and dimensions.
- C. Submit inspection certificates for pressure vessels from authority having jurisdiction.
- D. Submit manufacturer's installation instructions under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- E. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.8 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Include installation instruction, assembly views, lubrication instructions, and replacement parts list.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 22 00 10 - Basic Plumbing Requirements.
- B. Store and protect products under provisions of Section 22 00 10 - Basic Plumbing Requirements.

PART 2 - PRODUCTS

2.1 AUTOMATIC AIR VENTS

- A. Provide at the highest points of the chilled water system and on the chilled water coils as shown on the Drawings, an automatic air vent, Armstrong No 21AR or approved equal, with a pressure rating of 250 psig.
 - 1. Provide shut-off valve to facilitate maintenance of air vent.
 - 2. Locate all air vents and their discharge lines in accessible locations, preferably clustered.

2.2 STRAINERS

- A. Strainers, 2 inches and smaller, bronze body, screwed ends, No 10 mesh strainer, screwed cap with bronze blow-off valve (size to be determined by standard tap size in cap).
- B. Cast iron body, 2-1/2 inches and larger, isolating type flanged ends where installed in copper lines, No 7 perforated monel strainer, flanged cap with bronze ball blow-off valve (size of blow-off valve shall be determined by standard tap size in cap).
 - 1. Special Note: Strainers 6 inches and larger shall have studs mounted in the body flange in lieu of bolts for removal of cap.
- C. Baskets for strainers 6 inches and larger shall have stainless steel reinforcing bands at ends to prevent collapsing.
- D. Suction diffusers shall be Paco or approved equal, cast iron body and cover, steel diffuser, and stainless steel strainer, 125 pound ASA (flat face) flange for a working pressure of 175 psi and temperature of 300°F.

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

- A. Install specialties in accordance with manufacturer's instructions to permit intended performance.
- B. Support from building structure in accordance with manufacturer's instructions.
- C. Provide manual air vents at system high points and as indicated.
- D. Provide manual air vents at entrance to all water coils, with a "cane" shaped discharge tube, positioned to permit draining to a portable receptacle.
- E. For automatic air vents in ceiling spaces or other concealed locations, extend vent tubing to nearest drain.
- F. Provide full supply line size strainers on all branches to chilled water coil connections Do not reduce to coil inlet piping size.
- G. Provide valved drain and hose connection on strainer blow down connection.
- H. Provide pump suction fitting on suction side of base mounted centrifugal pumps.
 - 1. Remove temporary strainers after cleaning systems.
 - 2. Clean all permanent strainers after circulating systems for a minimum of 48 hours at full capacity.
- I. Support pump fittings with floor mounted pipe and flange supports.
- J. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.
- K. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity Select equipment relief valve capacity to exceed rating of connected equipment.
- L. Pipe relief valve outlet to nearest floor drain.
- M. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

END OF SECTION 23 21 15

SECTION 23 22 23

STEAM AND STEAM CONDENSATE SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Steam traps.
- B. Inverted bucket traps.
- C. Float and thermostatic traps.
- D. Thermostatic traps.
- E. Flash tanks.
- F. Condensate pumping units.
- G. Steam pressure reducing valves.
- H. Steam relief valves.
- I. Steam safety valve discharge elbows.
- J. Steam muffler attachments.
- K. Steam pipe anchors.
- L. Steam pipe guides.
- M. Drip traps.
- N. Sediment strainers.
- O. Gauges and gauge connections.
- P. Thermometer and thermometer wells.

1.3 RELATED REQUIREMENTS

- A. Section 23 00 00 - UTSW Mechanical Design Requirements.
- B. Section 23 05 15 - Mechanical Piping, Valves, and Fittings.
- C. Section 23 05 13 - Motors.
- D. Section 23 05 29 - Supports and Anchors.
- E. Section 23 07 19 - Piping Insulation.
- F. Section 23 07 16 - Equipment Insulation.
- G. Section 23 21 15 - Hydronic Specialties.
- H. Section 23 22 13 - Steam and Steam Condensate Piping.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ASTM A105/A105M - Forgings, Carbon Steel, for Piping Components.
- C. ASTM A126 - Gray Iron Casings for Valves, Flanges, and Pipe Fittings.
- D. ASTM A216/A216M - Steel Casings, Carbon, Suitable for Fusion Welding, for High Temperature Service.
- E. ASTM A395/A395M - Ferric Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
- F. ASME B31.9 - Building Services Piping.

1.5 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 - Building Services Piping.

1.6 QUALITY ASSURANCE

- A. For each product specified, provide components by same manufacturer throughout.

1.7 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Division 01 and Section 23 00 00 - UTSW Mechanical Design Requirements for manufactured products and assemblies required for this project.
 - 1. Include product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
 - B. Submit schedule indicating manufacturer, model number, size, location, rated capacity, and features for each specialty.
 - C. Submit manufacturer's installation instructions under provisions of Division 01 and Section 23 00 00 - UTSW Mechanical Design Requirements.
 - D. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.
- 1.8 OPERATION AND MAINTENANCE DATA
- A. Submit operation and maintenance data under provisions of Section Division 01 and Section 23 00 00 - UTSW Mechanical Design Requirements.
- 1.9 ATTIC STOCK
- A. Provide two service kits for each size and type of steam trap under provisions of Division 01 and Section 23 00 00 - UTSW Mechanical Design Requirements.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - STEAM TRAPS

- A. Armstrong.
- B. Spirax/Sarco.
- C. ITT Hoffman.
- D. Substitutions: Under provisions of Division 01 and Section 23 00 00 - UTSW Mechanical Design Requirements.

2.2 INVERTED BUCKET TRAPS

- A. Cast iron or semi-steel body and bolted cover for 250 psig WSP; provide access to internal parts without disturbing piping; with top test plug and bottom drain plugs, brass or stainless steel bucket, stainless steel seats and plungers, and stainless steel lever mechanism with knife edge operating surfaces, integral inlet strainer of monel or stainless steel.

2.3 FLOAT AND THERMOSTATIC TRAPS

- A. ASTM A126, cast iron or semi-steel body and bolted cover for 250 psig WSP; provide access to internal parts without disturbing piping; with bottom drain plug, stainless steel or bronze bellows type air vent, stainless steel or copper float stainless steel lever and valve assembly.

2.4 THERMOSTATIC TRAPS

- A. Pressure balanced type with ASTM A216 WCB cast steel body and bolted or screwed cover, and integral ball joint union, for 300 psig WSP; monel or stainless steel bellows, stainless steel valve and seat, integral stainless steel strainer.
- B. Freeze proof type with cast iron body for 300 psig WSP, bronze bellows, stainless steel valve and seat, external adjustment.
- C. Bi-metallic type with ASTM A105 forged steel body and cover, for 300 psig WSP, bi-metal element with stainless steel components, integral Type 304 stainless steel strainer screen, 1/4 inch blow down valve.

2.5 FLASH TANKS

- A. Closed type, welded steel construction, tested and stamped in accordance with Section 8D of ANSI/ASME Boilers and Pressure Vessels Code for 125 psig working pressure; cleaned, prime coated, and supplied with steel support legs.
- B. Construct with nozzles and tapings for installation of accessories and piping connections.

2.6 CONDENSATE PUMPING UNITS

- A. Condensate pumping units shall be Duplex Type manufactured by Sarco, Armstrong, Skidmore, Aurora, or approved equivalent.
 - 1. Unit shall be complete with 3/16 inch thick steel receiver galvanized inside and outside and shall have magnesium anode protection.

2. Each motor shall be provided with a fused safety switch and a magnetic starter providing overload and undervoltage protection.
 3. Magnetic starters shall be provided with three pole overload protection.
 4. The pump shall be bronze fitted throughout.
 5. The bearings shall be such as to protect them from dust and corrosion.
 6. Each duplex pump shall be mounted on a heavy steel mounting plate.
 7. Each unit shall have fully automatic control by a float and float switch.
 8. An alternator switch shall, furthermore, be provided as a part of this pumping device which will automatically alternate the operation of the pumps of this unit at the end of each pump operation A.
 9. All accessories and auxiliaries, such as pressure gauges, water gauge glasses, etc , shall be installed complete.
 10. The electrical wiring required shall be so complete that no wiring beyond that required by the driving motor need be supplied in the field.
 - a. Such units shall be tested at the factory and adjusted prior to shipment.
 11. Alternator preferably shall be mechanical type.
 - a. If electrical alternator is used, it shall be Allen Bradley.
 12. Pumps shall be capable of pumping 212 degrees F condensate at the controlled water level.
 - a. Each pump shall have stainless steel shafts.
 13. Contractor shall furnish an extra set of Viton seals or provide the pump with Viton seals installed.
 14. No turbine pumps will be permitted: only centrifugal type pumps shall be provided.
- B. Capacities and electrical characteristics shall be as scheduled on Drawings.
- C. Provide high level alarm switch complete with transformer, bell and one set of normally open contacts for connection to the Energy Management System.
- D. Submit complete wiring diagram for this specific contract.

2.7 STEAM PRESSURE REDUCING VALVES

- A. All pressure reducing valves shall be capable of maintaining the set pressure from zero to the maximum steam flow within reasonable limits when subjected to usual steam pressure fluctuations.
1. They shall be single seated valves with stainless steel trim, with renewable valve, lugs and seats.
 2. Valve bodies shall be cast steel for high pressure service and cast iron for medium and low pressure service.
 - a. These valves shall be self contained type with upstream and downstream pressure gauges and shall be installed as per manufacturer`s recommendations.
 - b. Valve capacities are scheduled on the drawings.
 - c. Each stage of pressure reduction shall consist of two PRVs sized 113 and 2/3 capacity.
 - d. Discharge pressure shall be adjustable to any value between 10 psig and 75 percent of the supply pressure.
- B. All pressure regulators 2-1/2 inches and larger shall have flanged connections and those 2 inches and smaller may have screwed connections.
1. Unions shall be installed on each side of any screwed pattern regulators installed.
- C. Each reducing valve shall be preceded by a sediment strainer complete with a full-sized blow off valve with threaded end for hose connection.
1. These valves shall be Leslie, Spence, Spirax Sarco, Fisher, Mason Neilan, or approved equal, with suitable automatic controllers.

2.8 STEAM RELIEF VALVES

- A. Relief valves 2 inches and smaller shall have brass bodies and arranged for screwed connections.
1. Such relief valves shall be Crane No 2501 or Spirax Sarec 6010 Brass Safety Valves for steam or approved equal Bushings shall not be used.
- B. Relief valves 2-1/2 inch and larger shall in the case of all medium and low pressure steam piping systems be arranged for flanged inlet and screwed outlet connections.
1. Such relief valves shall be Consolidated Type 1511 or Spirax Sarco 252, ASME Standard Cast Iron Safety Valves, or approved equal.
- C. The pressure at which each relief valve shall open is designated on the Drawings.
1. When such valves are ordered by the Contractor, he shall definitely specify the pressure at which each relief valve is to be set.

2. Each valve shall have a metal tag attached stamped with the valve identification plus the pressure setting.

2.9 STEAM SAFETY VALVE DISCHARGE ELBOWS

- A. All vent lines from safety valves shall be provided with safety valve discharge elbows at the point at which such lines rise to an elevation higher than that of the safety valve.
 1. The nature and design of the piping systems involved shall be such as to drain effectively all condensate from the discharge side of all relief valves.
 2. These safety valve discharge elbows shall be Grinnell Company's Safety Valve Drip Pan Elbows Figure No 1538F, Spirax Sarco No 299, or approved equivalent.
 3. No force shall be exerted on the safety valve by the discharge piping.

2.10 STEAM MUFFLER ATTACHMENTS

- A. At the point at which vent lines from safety valve discharge elbows terminate, a muffler attachment of the proper size shall be installed.
 1. Muffler attachments shall be screwed pattern members Consolidated Type 1441, or approved equal.

2.11 STEAM PIPE ANCHORS

- A. All steam lines shall be securely anchored at points designated on the Drawings and/or at such points as required to assure proper control of the expansion and contraction of such systems.
- B. See Section 23 05 29 - Supports and Anchors for additional requirements.

2.12 STEAM PIPE GUIDES

- A. All steam piping systems shall be properly guided as shown on the Drawings or as directed by Engineer.

2.13 DRIP TRAPS

- A. High pressure drip trap assemblies shall be provided wherever called for on the Drawings and where required to keep such piping systems completely drained of condensate.
 1. Traps used in assemblies shall be 3/4 inch traps unless specifically shown to the contrary, i e , they shall have 3/4 inch inlet and outlet connections.
 2. They shall have semi-steel bodies and the internal operating mechanisms shall be made of heat treated chrome steel.
 3. The caps shall be bolted to the bodies by the use of alloy steel heat treated machine bolts
 4. These No 213 Armstrong Traps, manufactured by Armstrong Machine Works, or approved equal, shall have a capacity for discharging at least 3,500 pounds of condensate per hour when operating at a pressure of 250 pounds per square inch.
 5. Where drip traps are installed in conjunction with 3 inches and larger steam lines, a drip pocket of the nature detailed on the Drawings shall be provided where a natural pocket does not exist
 6. The piping and valves in trap assemblies shall be arranged as detailed on the Drawings; extra strong pipes shall be used on both sides of the trap.
- B. All drip traps used in medium pressure steam piping systems where automatic steam control valves are not employed shall be arranged as shown on the Drawings.
 1. They shall be 3/4 inch Armstrong No 811 Inverted Bucket Traps, or approved equal, with cast iron bodies, vacuum breakers and stainless steel trim.
 2. Each trap shall be provided with a valved test line and shall be preceded by a sediment strainer.
- C. Condensate from coils, converters, hot water generators, low pressure drips and from all other devices where modulating steam valves are employed shall be of the float and thermostatic type.
 1. These traps shall be sized to handle 200 percent of the load with an inlet pressure drop of 0.5 psig and shall be equal to Armstrong "A" or "B" series, with vacuum breaker suitable for the system pressures.
 2. Installed traps with less than 12 inches of height between equipment outlet and trap inlet shall be sized for not less than 300 percent of the load.
 3. Each trap shall be provided with a 1/2 inches valve test line and shall be preceded by a sediment strainer
 4. Under no circumstances shall a float and thermostatic trap be installed in a manner to lift condensate up in a return line.
- D. Shop Drawing submittal of traps shall contain an itemized list with a tabulation of the load, trap type, and trap size.

2.14 SEDIMENT STRAINERS

- A. Each drip trap assembly, each control valve, for steam and each pressure reducing valve assembly regardless of its size shall be preceded by a sediment strainer.
 - 1. The arrangement of these sediment strainers shall be such that the screens may be removed for cleaning with ease through a gasketed plug.
- B. Sediment strainers shall be placed in steam piping systems wherever shown on the Drawings and at such other points as may be required for the removal of foreign material from the piping systems.
- C. Strainers in high pressure steam piping shall be cast steel sediment strainers and shall be suitable for working steam pressures as high as 300 pounds per square inch and temperatures not in excess of 750 degrees F.
 - 1. Strainers shall be the size designated on the Drawings.
 - 2. In the case of pipe sizes 2-1/2 inch and larger, Ranged pattern sediment strainers shall be used. In the case of pipe smaller than 2-1/2 inch, screwed pattern shall be used.
 - a. Such strainers shall be Yarway No 821 or 822 strainers manufactured by Yarnall Waring Company, or approved equal.
 - b. The flanges of Ranged strainers shall be dimensioned, faced, drolled, and spot faced to conform to the 300 pound American Standard for Steel Pipe Flanges and Flanged Fittings (B16e-1939).
- D. Strainers in low and medium pressure steam piping systems 2-1/2 inch and larger shall be flanged iron body strainers having bolted covers.
 - 1. These strainers shall be suitable for operating pressures as high as 125 psig.
 - 2. They shall be Crane Company No 989-1/2 Sediment Separators, or approved equal.
- E. Sediment strainers in low and medium pressure steam piping systems 2 inches and smaller shall be arranged for screwed pipe connections.
 - 1. They shall be Crane No 988-1/2 Sediment Separators, or approved equal.
- F. Full sized blow off valves shall be installed on all strainers in steam, condensate, chilled and hot water lines.

2.15 GAUGES AND GAUGE CONNECTIONS

- A. See Section 23 05 19 - Meters and Gauges.

2.16 THERMOMETER AND THERMOMETER WELLS

- A. See Section 23 05 19 - Meters and Gauges.

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

- A. Install specialties in accordance with manufacturer`s instructions.
- B. Install thermostatic steam traps to drain condensate from Steam radiation units, convectors, and other terminal heating units.
- C. Install float and thermostatic traps to drain condensate from unit heaters, convertors, heating coils, steam separators, flash tanks, steam jacketed equipment and direct steam injected equipment.
- D. Install inverted bucket steam traps to drain condensate from steam main headers and branch lines.
- E. Size steam traps to handle minimum of two times maximum condensate load of apparatus served.
- F. Traps used on steam mains and branches shall be minimum 3/4 inch size.
- G. Install steam traps with union or flanged connections at both ends.
- H. Provide gate valve and strainer at inlet, and gate valve at discharge of steam traps.
- I. Provide minimum 10 inch long dirt pocket of same pipe sizes as apparatus return connection between apparatus and steam trap.
- J. Remove thermostatic elements from steam traps during temporary and trial usage, and until system has been operated and dirt pockets cleaned of sediment and scale.
- K. Provide pressure reducing stations with pressure reducing valve, valved bypass, strainer and pressure gage on upstream side, relief valve and pressure gage on downstream side of pressure reducing valve.
- L. Pressure reducing station shall be one or two stages as indicated, to produce flat reduced pressure curve over range of capacity.

- M. Rate relief valves for pressure upstream of pressure reducing station, for full operating capacity Refer to schedules on Drawings for relief valve settings.
- N. Terminate relief valves to outdoors with muffler attachment Provide drip pan elbow with drain connection to nearest floor drain.
- O. When several relief valve vents are connected to a common header, header cross section area shall equal sum of individual vent outlet areas.

END OF SECTION 23 22 23

SECTION 23 31 00

DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Low Pressure Ducts.
- B. Medium and High Pressure Ductwork.
- C. Casings.
- D. Kitchen Hood Ductwork.
- E. Duct Cleaning.

1.3 RELATED REQUIREMENTS

- A. Division 09 Section, Painting, priming or coating of metal ductwork exposed to view.
- B. Section 23 00 00 - UTSW Mechanical Design Requirements
- C. Section 23 05 29 - Supports and Anchors
- D. Section 23 05 53 - Mechanical Identification
- E. Section 23 07 13 - Ductwork Insulation
- F. Section 23 33 00 - Ductwork Accessories
- G. Section 23 36 00 - Air Terminal Devices
- H. Section 23 37 00 - Air Inlets and Outlets
- I. Section 23 05 93 - Testing, Adjusting, and Balancing

1.4 REFERENCE STANDARDS

- A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals.
- B. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications.
- C. ASTM A90 - Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- E. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- F. NFPA 45 - Standard on Fire Protection for Laboratories Using Chemicals.
- G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
- H. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
- I. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- J. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.
- K. SMACNA (ROUND) - Round Industrial Duct Construction Standards.
- L. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005.
- M. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.

1.5 DEFINITIONS

- A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.
- B. Low Pressure: 3 inch WG positive or negative static pressure and velocities less than 1,500 fpm.
- C. Medium Pressure: 6 inch WG positive static pressure and velocities greater than 1,500 fpm.
- D. High Pressure: 10 inch WG positive static pressure and velocities greater than 2,500 fpm.

1.6 SUBMITTALS

- A. Product Data:
 - 1. Provide product data for all ductwork systems to be used on project. Product data submittals shall include the following as a minimum:

- a. System name and type.
 - b. Duct system design pressure.
 - c. Hangers and supports, including materials, fabrication, methods for duct and building attachment.
 - d. Sealant type.
- B. Shop Drawings shall be submitted on all items of sheet metal work specified herein.
- 1. Shop Drawings of ductwork at air units shall be submitted at a minimum scale of 3/8 inch equal to one foot.
 - 2. Shop drawings of ductwork located at all other locations shall be prepared at a scale of not less than 1/4 inch equal to one foot.
 - 3. Reproduction and submittal of the construction documents is not acceptable.
 - 4. Shop drawings shall include the following:
 - a. Clearance dimensions between ducts and dimensions above finished floors for bottom and tops of ducts.
 - b. Call out of duct materials other than galvanized including but not limited to stainless steel, aluminum, or prefabricated fire rated ductwork.
 - c. Shop Drawings shall indicate location of all supply, return, exhaust and light fixtures from the approved reflected ceiling plans.
 - d. Shop drawings shall identify all duct sizes, reinforcement and spacing.
 - e. Penetrations through fire rated and other partitions.
 - f. Show major equipment with ductwork connections.
 - g. Show all dampers, turning vanes, access doors, fire dampers and all other ductwork accessories to be provided.
 - h. Submit shop drawings and product data under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements
- C. Submit two samples of stainless steel welded duct joint to Engineer and Owner for approval. After approval, sample shall remain at job site for reference.
- D. Welding Certificates. Provide for all welders including procedures and standards of acceptance.
- E. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to site under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
 - B. Store and protect products under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.

PART 2 - PRODUCTS

2.1 DUCTWORK GENERAL:

- A. All ductwork indicated on the Drawings, specified or required for the air conditioning and ventilating systems shall be of materials as hereinafter specified unless indicated otherwise.
 - 1. All air distribution ductwork shall be fabricated, erected, supported, etc., in accordance with all applicable standards of SMACNA Duct Manuals where such standards do not conflict with NFPA 90A and where class of construction equals or exceeds that noted herein.
 - 2. All exhaust ductwork including toilet room exhausts shall be constructed and leak tested as specified for medium pressure supply ducts at negative pressure.
- B. All ductwork shown on the Drawings, specified or required for the heating, ventilating and air conditioning systems shall be constructed and erected in a first class workmanlike manner.
 - 1. The work shall be guaranteed for a period of 1 year from and after the date of acceptance of the job against noise, chatter, whistling, vibration, and free from pulsation under all conditions of operation.
 - 2. After the system is in operation, should these defects occur, they shall be corrected as directed by the Architect.
- C. All duct sizes shown on the Drawings are air stream sizes. Allowance shall be made for internal lining where required, to provide the required cross sectional area.
- D. All holes in ducts for damper rods and other necessary devices shall be either drilled or machine punched (not pin punched), and shall not be any larger than necessary. All duct openings shall be provided with sheet metal caps if the openings are to be left unconnected for any length of time.

- E. Except for special ducts specified elsewhere herein, all sheet metal used on the project shall be constructed from prime galvanized steel sheets and/or coils up to 60 inches in width.
 - 1. Each sheet shall be stenciled with manufacturer's name and gauge.
 - 2. Coils of sheet steel shall be stenciled throughout on 10 foot centers with manufacturer's name and must be visible after duct is installed.
 - 3. Sheet metal must conform to SMACNA sheet metal tolerances as outlined in SMACNA's "HVAC Duct Construction Standards."
 - F. Where ducts that are exposed to view (including equipment rooms), pass through walls, floors or ceilings, furnish and install sheet metal collars around the duct.
- 2.2 DUCTWORK LOW PRESSURE: (INCLUDES ALL EXHAUST DUCTWORK DOWNSTREAM OF FANS.)
- A. The scope of low pressure ductwork is defined as all ductwork downstream of terminal units, and all exhaust ductwork downstream of fans.
 - 1. Construction of all low pressure duct shall be in accordance with Low Velocity Duct Construction Standards as published by Sheet Metal and Air Conditioning Contractors National Association (SMACNA) and shall be sealed and tested at 3 inch static with the same test procedures as medium pressure ductwork.
 - B. Spiral wound round duct shall be as manufactured by United McGill Sheet Metal Company or approved equal.
 - C. The metal gauges listed in the 1995 SMACNA HVAC Duct Construction Standards for Metal and Flexible Duct are the minimum which shall be used for this project.
 - 1. It shall be noted that the Contractor is responsible that the metal gauge selected is heavy enough to withstand the physical abuse of the installation.
 - D. Elbows:
 - 1. Elbows shall be radius type and have a centerline radius of 1-1/2 times the duct diameter or width.
 - 2. Elbows in round ducts may be smooth radius as described above or 5-piece 90 degree elbows and 3-piece 45 degree elbows.
 - 3. Joints in round ducts shall be slip type with a minimum of three sheet metal screws.
 - 4. Joints in sectional elbows shall be sealed as specified for duct sealing. 90° mitered elbows are not acceptable unless approved by the Architect/Engineer or Project Manager.
 - E. SEALANT:
 - 1. All ductwork (except welded exhaust duct) shall be sealed with either "MP" (Multi-Purpose), Hardcast "Iron-grip 601", Polymer Adhesive "Airseal #11", or "United Duct Seal" (United McGill Corp.) water base, latex or acrylic type sealant.
 - 2. Note that, except as noted, oil or solvent based sealants are specifically prohibited for use on this project.
 - 3. For exterior applications, "Uni-Thane " (United McGill Corp.) polyurethane based sealant shall be used.
 - 4. No other sealants may be used.
 - 5. All seams and joints in shop and field fabricated ductwork shall be sealed by applying one layer of sealant, then immediately spanning the joint with a single layer of 3 inch wide open weave fiberglass tape. Sufficient additional sealant shall then be applied to completely imbed the cloth.
 - 6. All sealants shall be UL rated at no more than flame spread of 5 and smoke developed of 0.
 - 7. At contractor's option, Hardcast 1602 sealant tape may be used in lap joints and flat seams.
- 2.3 DUCTWORK MEDIUM PRESSURE: (INCLUDES ALL EXHAUST DUCTWORK UPSTREAM OF FANS).
- A. The scope of medium pressure ductwork is defined as all ductwork downstream of all air handlers, up to and including terminal units, plus all return air ductwork.
 - B. Construction of all ducts shall be in accordance with High Velocity Construction Standards as published by SMACNA. All round and rectangular duct construction, duct fittings, dampers, etc., are covered in this manual and it is to be adhered to.
 - 1. Spiral wound round duct shall be as manufactured by United McGill Sheet Metal Company or approved equal.
 - 2. The metal gauges are listed herein for round duct and for rectangular duct.

- C. All ductwork (except welded exhaust duct) shall be sealed with either "MP" (Multi-Purpose), Hardcast "Iron-grip 601", or "United Duct Seal" (United McGill Corp.) water base, latex or acrylic type sealant. Note that, except as noted, oil or solvent based sealants are specifically prohibited for use on this project.
- D. For exterior applications, "Uni-Thane" (United McGill Corp.) polyurethane based sealant shall be used. No other sealants may be used.
- E. All seams and joints in shop and field fabricated ductwork shall be sealed by applying one layer of sealant, then immediately spanning the joint with a single layer of 3 inch wide open weave fiberglass tape. Sufficient additional sealant shall then be applied to completely imbed the cloth.
- F. At contractor's option Hardcast 1602 sealant tape may be used in lap joints and flat seams.
- G. Testing of Medium Pressure Ductwork: (Includes from fan discharge through to the discharge of terminal units.)
 - 1. All medium pressure ducts shall be pressure tested according to SMACNA Chapter 10 test procedures.
 - a. Design pressure for testing ductwork shall be 6 inches of water.
 - b. Total allowable leakage shall not exceed 1 percent of the total system design air flow rate.
 - c. When partial sections of the duct system are tested, the summation of the leakage for all Sections shall not exceed the total allowable leakage.
 - 2. The entire system of medium pressure ductwork shall be tested, including the VAV/Constant Volume Terminal Units (i.e. The ductwork shall be capped immediately prior to the Terminal Units, and tested as described above).
 - a. After testing has proven that the ductwork is installed and performs as specified, the terminal units shall be connected to the ductwork and the connections sealed with extra care.
 - b. The contractor shall inform the project inspector when the joints may be visually inspected for voids, splits, or improper sealing of the joints.
 - c. If any leakage in the terminal unit connections/joints after the systems have been put into service, the leaks shall be repaired by:
 - 1) Complete removal of the sealing materials.
 - 2) Thorough cleaning of the joint surfaces.
 - 3) Installation of multiple layers of sealing materials.
 - 3. At the option of the Owner, the Contractor may be allowed to eliminate the terminal units from testing by capping the supply ductwork prior to the terminal units, then inspecting the connection to the terminal units when complete. This option may only be exercised by the Resident Construction Manager, and then only if documented in writing prior to testing.
- H. All exhaust ductwork, including toilet room exhausts, shall be constructed as for medium pressure ducts and shall be tested for leaks in the same manner as for medium pressure supply ducts.
- I. Contractor may use DUCTMATE or Ward flanged Duct Joint system, reference SMCNA FIG. 1-4 "Transverse Joints" T-25a or T-25b on rectangular ductwork. Slip-on duct flanges are not acceptable. Contractor may at his option (where space permits) use rectangular ductwork with DUCTMATE or Ward system in lieu of oval ductwork.
- J. Elbows:
 - 1. Rectangular 90 degree elbows shall be constructed with single thickness turning vanes mounted on an integral rail.
 - 2. Mitered 90 degree elbows are not allowed unless approved by the Engineer and Construction Manager.
 - 3. Radius type rectangular elbows shall have a centerline radius of 1-1/2 times the duct diameter or width.
 - 4. Elbows in round or oval ducts may be smooth long radius as described above or 5-piece 90 degree elbows and 3-piece 45 degree elbows.
 - 5. Joints in round ducts shall be slip type with a minimum of three sheet metal screws. Joints in sectional elbows shall be sealed as specified for duct sealing.

2.4 VANES

- A. Where rectangular elbows are shown, or are required for good air flow, contractor shall provide and install turning vanes.
- B. Turning vanes shall be factory fabricated with integral support rail.

- C. Radius elbows shall have a centerline radius of not less than one and one-half (1-1/2) times the duct width.
- D. Submit Shop Drawings on factory fabricated and job fabricated turning vanes. Provide turning vanes in all rectangular radius elbows and offsets.
- E. All turning vanes shall be anchored to the cheeks of the elbow in such a way that the cheeks will not breathe at the surfaces where the vanes touch the cheeks.

2.5 FLEXIBLE DUCTS

- A. Low Pressure Insulated Flexible Duct may be used where shown on the drawings.
- B. Duct shall be made with factory preinsulated duct supported by a corrosion resistant metal spiral, or a coated spring steel helix and solid inner liner mechanically interlocked or permanently bonded to the helix wire, covered with a minimum of 1-1/2 inch thick, 3/4 pound density fiberglass blanket sheathed in a vapor barrier of fiberglass reinforced aluminum foil and Mylar laminate.
 - 1. The insulation shall have a minimum "K" factor of 0.29 at 60 degrees F. mean and a vapor barrier permeability rating of 0.05 per ASTM method E96-66, Procedure A.
 - 2. The C factor shall be 0.24 to meet HUD requirements.
- C. The duct shall be rated for a positive working pressure of 10 inches w.g. and a temperature of up to 250 degrees F.
- D. The duct shall comply with NFPA 90A and be listed and labeled by Underwriters Laboratories, Inc., as Class I Air Duct, Standard 181, and meet GSA, FHA, and other U. S. Government standards; flame spread, not over 25; smoke developed, not over 50.
- E. Flexible ducts shall be not more than 5 feet in length, shall be installed as indicated in the diffuser connection detail, and shall be Flexmaster Type 1M or approved equal.
- F. Connections:
 - 1. The terminal ends of the duct core shall be secured by compression coupling or stainless steel worm gear type clamp equal to Ideal Series 56 Snaplock.
 - 2. The fittings on Air Devices and on sheet metal duct shall be coated with the sealant specified for low pressure ductwork, then flexible duct core slipped over duct and coupling or clamp tightened, then connection sealed with more sealant.
 - 3. Insulation of flexible duct shall be slipped over connection to point where insulation abuts mixing box or insulation on duct.
 - 4. These insulation connections shall be sealed by imbedding fiberglass tape in the sealant specified for medium pressure ductwork and coating with more sealant to provide a vapor barrier. (This applies to all flex connections to diffusers, grilles, etc. when allowed on the drawings.)
 - 5. Medium and High Pressure Insulated Flexible Duct:
 - a. Shall be factory applied insulation of 1 inch minimum thickness, 3/4 pound density with a permeability rating of 0.30.
 - b. The duct shall be composed of dead soft, spiral wound, triple locked corrugated aluminum core covered with Ratings shall be as described for Low Pressure Duct above.
 - 6. Flexible ducts shall be not more than 2 feet in length, used for alignment or sound/vibration purposes only, and may only be installed in straight runs.
 - 7. Flexible duct shall NOT be used for changes of direction of air flow, and shall be Flexmaster Type TL-M or approved equal. Installation, clamps and sealing shall be the same as specified for rigid duct.

2.6 LABORATORY EXHAUST DUCTWORK

- A. Applies to stainless steel ductwork indicated in specification application table for Laboratory Exhaust Systems.
- B. Provide exhaust ductwork of minimum gages:

DUCT SIZE	GAGE
28-inch diameter or less	18
30-inch to 60-inch diameter	16
61-inch diameter or greater	14
Greater than 60 x 42 (rectangular or oval)	Comply with SMACNA

- C. ALL LAB EXHAUST DUCTWORK SHALL HAVE LONGITUDINAL BUTT ("SOLID") WELD SEAMS WITH BUTT WELD JOINTS. Butt-weld all joints and fittings using Gas Tungsten Arc Welding ("TIG"). Welding

procedures shall meet the requirements of AWS D1.1. Welds on exposed ductwork inside the building shall be ground and polished. Duct sealant shall not be used to seal ductwork.

- D. Provide required transitions from duct to equipment and make equipment connections as called out on drawings.
- E. Fittings:
 - 1. Refer to Round and Oval Ducts and Fittings General Requirements in this specification. Transverse and longitudinal seams shall be butt welded joints.
 - 2. Refer to drawings for additional information.
- F. Submit certification of welder's qualifications to perform the required welding operations and all project WPS for TIG welding sheet metal. All welder certifications shall be maximum 2 years prior to date of awarding contract.

2.7 DUST COLLECTOR SYSTEMS

- A. Duct system shall be galvanized, constructed and supported in accordance with SMACNA Industrial Round Duct Construction for Class 2, 8 inch w.g. pressure.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer also to requirements included in Part 2 of this specification.
- B. Obtain manufacturer's inspection and acceptance of fabrication and installation of fiberglass ductwork prior to beginning of installation.
- C. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- D. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- E. Slope underground ducts to plenums or low pump out points at 1:500. Provide access doors for inspection.
- F. Coat buried, metal ductwork without factory jacket with one coat and seams and joints with additional coat of asphalt base protective coating.
- G. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.
- H. Connect terminal units to medium or high pressure ducts directly or with two feet maximum length of flexible duct. Do not use flexible duct to change direction. Allow for a minimum of 3 diameters of straight duct to the entrance of all terminal units.
- I. Connect diffusers with 5 feet maximum length or troffer boots with 2 feet maximum length of flexible duct to low pressure ducts. Hold in place with strap or clamp, and seal as specified.
- J. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for cleanout. Use stainless steel for ductwork exposed to view and stainless steel or galvanized steel for ducts where concealed.
- K. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

3.2 LOW PRESSURE DUCT SUPPORTS

- A. See Section 23 05 29 - Supports and Anchors

3.3 MEDIUM PRESSURE DUCT SUPPORTS:

- A. See Section 23 05 29 - Supports and Anchors

3.4 DUCTWORK APPLICATION SCHEDULE

AIR SYSTEM	MATERIAL
MEDIUM PRESSURE SUPPLY	GALVANIZED STEEL
LOW PRESSURE SUPPLY	GALVANIZED STEEL
RETURN/RELIEF AIR	GALVANIZED STEEL

GENERAL EXHAUST AIR	GALVANIZED STEEL
LAB HOOD/BIOSAFETY CABINET EXHAUST/WASHER EQUIPMENT CONNECTION	316L STAINLESS STEEL TO MAIN DUCT CONNECTION – SLOPED BACK TO SOURCE

3.5 CLEANING OF SYSTEMS

- A. Before turning the installation over to the Owner, all ducts should be cleaned and blown free of all dust and dirt that has collected in the ducts.

END OF SECTION 23 31 00

SECTION 23 33 00
DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Manual and Automatic Volume Control Dampers.
- B. Backdraft Dampers.
- C. Air Turning Devices.
- D. Flexible Duct Connections.
- E. Duct Access Doors.
- F. Duct Test Openings.

1.3 RELATED REQUIREMENTS

- A. Section 01 91 00 - General Commissioning Requirements.
- B. Section 23 00 00 - UTSW Mechanical Design Requirements.
- C. Section 23 05 29 - Supports and Anchors.
- D. Section 23 05 53 - Mechanical Identification.
- E. Section 23 31 00 - Ductwork.
- F. Section 23 36 00 - Air Terminal Devices.

1.4 REFERENCE STANDARDS

- A. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- C. Bluetooth CS - Bluetooth Core Specification.
- D. IEEE 802.11 - IEEE Standard for Information Technology--Telecommunications and Information Exchange between Systems - Local and Metropolitan Area Networks--Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications.
- E. IEEE 802.15.4 - IEEE Standard for Low-Rate Wireless Networks.
- F. LonMark Interoperability Guide - LonMark Application-Layer Interoperability Guide and LonMark Layer 1-6 Interoperability Guide; Version 3.4.
- G. Modbus (PS) - The Modbus Organization Communications Protocol..
- H. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- I. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
- J. NFPA 92 - Standard for Smoke Control Systems.
- K. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- L. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives.
- M. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005.
- N. UL 33 - Safety Heat Responsive Links for Fire-Protection Service.
- O. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.
- P. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.
- Q. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
- R. UL 263 - Standard for Fire Tests of Building Construction and Materials.
- S. UL 555C - Standard for Safety Ceiling Dampers.
- T. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.

1.5 SUBMITTALS

- A. Product Data: Provide published literature for volume control dampers, duct access doors, duct test holes, and hardware used including dimensions, weights, capacities, ratings, gauges, and finishes of materials, and electrical characteristics and connection requirements.
- B. Shop Drawings: Submit under the provisions of 23 00 00 - UTSW Mechanical Design Requirements. Submit assemblies for shop fabricated assemblies indicated including model numbers, locations, and qualities for components including volume control dampers.
- C. Submit manufacturer's installation instructions under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements for fire dampers and combination fire and smoke dampers.
- D. Mockups: Provide mockups for all types of fire and smoke dampers in locations as directed by Owner's Project Manager and OSBC.
- E. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

PART 2 - PRODUCTS

2.1 DAMPERS

- A. Furnish and install manual volume dampers where shown on the drawings and wherever necessary for complete control of the air flow, including all supply, return and exhaust branches, "division" in main supply, return, and exhaust ducts, each individual air supply outlet and fresh air ducts.
 - 1. Where access to dampers through a fixed suspended ceiling is necessary, the Contractor shall be responsible for the proper location of the access doors.
- B. Locations: Dampers shall be carefully fitted, and shall be controlled by locking quadrants equal.
 - 1. Exposed uninsulated ductwork: Provide equal to Ventlok No. 555.
 - 2. Exposed externally insulated ductwork: Provide equal to Ventlok No. 644.
 - 3. Concealed ductwork above lay-in accessible ceilings: Provide Ventlok No. 555 or No. 644 locking quadrant for splitter dampers.
 - 4. Concealed ductwork not above lay-in accessible ceilings: Provide equal to Ventlok No. 677 (2 5/8 inch diameter) chromium plated cover plate.
 - 5. When No. 555 or No. 644 regulators are used, furnish and install end bearings for damper rods on the ends opposite the quadrant.
 - 6. When No. 677 regulators are used, furnish and install end bearings for the damper rods on both ends.
- C. Dampers larger than three (3) square feet in area shall be controlled by means of rods hinged near the leading edge of the damper with provisions for firmly anchoring the rod and with end bearings supporting the axle.
- D. Manual volume dampers shall be equal to Ruskin model CD60, Greenheck model VCD-33, or approved equal.
 - 1. Blades shall not exceed 48 inches in length or 12 inches in width and shall be of the opposed interlocking type.
 - 2. The blades shall be of not less than No. 16-gauge galvanized steel supported on 1/2 inch diameter rust proofed axles.
 - 3. Axle bearings shall be the self-lubricating ferrule type.
- E. Install all automatic control dampers, furnished by the Temperature Control Manufacturer, in strict accordance with the manufacturer's recommendations and requirements of these Specifications.
- F. All adjustable dampers installed in externally insulated ductwork shall be installed with Ventlok No. 639, or equivalent elevated dial operators.
 - 1. Insulation shall extend under the elevated dial.

2. All adjustable dampers installed in internally insulated ductwork shall be installed with Ventlok No. 635 or equivalent dial operators.
3. All damper shaft penetrations in the ductwork shall be installed with Ventlok #609 end bearings.

2.2 FLEXIBLE CONNECTIONS

- A. Provide Ventglas fabric connection where flexible connections for ducts connect to fans, including roof exhausters.
 1. Fabric connection shall be fire resistant, waterproof, mildew resistant, and air tight, and shall weigh approximately 30 ounces per square yard.
 2. 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 except that there shall also be a minimum of 1 inch of slack for each inch of static pressure on the fan system.
 3. This does not apply to Air Handling Units with internal isolation.

2.3 DUCT ACCESS DOORS

1. Provide low, medium, and high-pressure duct access doors with gaskets/seals appropriate for designed pressures of each installation. Provide product greater than or equal to Ductmate Duct Access Door sandwich style with double thumbscrew latch.
 2. Double-skin doors with one-inch of insulation in the door required where ducts are insulated.
 3. Doors shall be 18 inches by 16 inches or 18 inches in diameter minimum, dependant on duct sizing, and provide Ventlok No. 260 latches on rectangular doors.
 4. Doors sized smaller than 18 inches by 16 inches shall use Ventlok No. 100 or 140 latches.
 5. Doors for zone heating coils shall be minimum 10 inches by 12 inches or 12 inches in diameter Ventlok doors. Provide stamped, insulated doors, complete with latch and two (2) hinges.
 6. Doors required to be round shall be Flexmaster USA "Inspector Series" spin-in type or approved equal.
 7. Doors for personnel access to ductwork shall be nominal 24 inches in diameter.
- B. Where these access doors are above a suspended ceiling, this Contractor shall be responsible for the proper location of the ceiling access doors.

2.4 SCREENS

- A. Furnish and install screens on all duct, fan, etc., openings furnished by this Contractor that lead to, or are, outdoors.
- B. Screens shall be No. 16 gauge, 1/2 inch mesh in removable galvanized steel frame.
- C. Provide safety screens meeting OSHA requirements for protection of maintenance personnel on all fan inlets and fan outlets to which no ductwork is connected.

2.5 DUCT TAPS (CONICAL FITTINGS)

- A. Conical fittings shall be used for duct taps and shall include quadrant dampers on all lines to air devices (diffusers and grilles), even though a volume damper is specified for the air device. A damper is not required for medium pressure duct taps. Spin in fittings shall be sealed at the duct tap with a gasket, or compression fit, or sealed with sealant specified for medium pressure ductwork. The location of spin in fittings in the ducts shall be determined after dual or single duct terminal units are hung or the location of the light fixtures is known to minimize flexible duct lengths and sharp bends.
- B. The conical fitting shall be made of at least 26-gauge galvanized sheet metal. The construction to be a two-piece fitting with a minimum overall length of 6 inches and shall be factory sealed for high pressure requirements. Average loss coefficient for sizes 6, 8, and 10 shall be less than 0.055.
- C. Each fitting shall be provided with a minimum 24-gauge damper plate with locking quadrant operator and sealed end bearings. Damper blade shall be securely attached to shaft to prevent damper from rotating around shaft.
- D. Provide flange and gasket with adhesive peel-back paper for ease of application. The fitting shall be further secured by sheet metal screws spaced evenly at no more than 4 inches on-center with a minimum of four screws per fitting.
- E. The conical bell-mouth fitting shall be one of the following:
 1. Flexmaster U.S.A., Inc. Series 3000G.
 2. Buckley Air Products, Inc., 'AIR-TITE'.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions.
- B. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Use splitter dampers only where indicated.
- C. Provide balancing dampers on medium or high pressure systems where indicated.
- D. Provide backdraft dampers on exhaust fans or exhaust ducts where indicated.
- E. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment. Cover connections to medium and high pressure fans with leaded vinyl sheet, held in place with metal straps.
- F. Provide duct test holes where indicated and where required for testing and balancing purposes.

END OF SECTION 23 33 00

SECTION 23 36 00

AIR TERMINAL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Variable volume terminal units.
- B. Integral sound attenuator.
- C. Integral damper motor operators.
- D. Integral controls.

1.3 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.
- B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018
- C. AHRI 880 (I-P) - Performance Radiant of Air Terminals; 2011 with Addendum 1.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Submit shop drawings under provisions of Division 01 and Section 22 00 10 - Basic Plumbing Requirements.
 - 2. Submit shop drawings indicating configuration, general assembly, and materials used in fabrication.
- B. Product Data:
 - 1. Submit product data under provisions of Division 01 and Section 22 00 10 - Basic Plumbing Requirements.
 - 2. Submit product data indicating configuration, general assembly, and materials used in fabrication Include catalog performance ratings that indicate air flow, static pressure, and NC designation.
 - 3. Include schedules listing discharge and radiated sound power level for each of second through seventh octave bands at inlet static pressures of one inch w g.
 - 4. Submit manufacturer's installation instructions under provisions of Division 01 and Section 22 00 10 - Basic Plumbing Requirements.
- C. Samples:
 - 1. A sample 8 inch size production run unit shall be submitted for examination and approval by the Engineer, UTSW FM, and the Owners Testing and Balancing (TAB) Consultant.
 - a. This submittal box shall be submitted, in addition to the required written submittal, well in advance of any requirement for installation of boxes, but absolutely no later than 60 days after the date of the start of construction stipulated in the Work Order letter from the Owner to the General Contractor.
 - b. A minimum of three weeks shall be allowed by the Contractor for file testing of the box from the time of submittal to the time of determination of project worthiness.
 - c. This period shall restart if the sample box is rejected and another box is resubmitted.
 - d. If rejected for any reason, the Contractor shall expedite the corrections documented, and shall resubmit a sample box as soon as possible.
 - e. Any delay in the submittal of the box for approval shall not be grounds for a claim of delay on the part of the Contractor.
 - f. If approved, the unit shall remain in the possession of the Owner at the job site for comparison with units as shipped to project.
 - g. The unit shall be installed in the project, at an accessible, marked location.
 - h. The unit manufacturer shall test and certify that each box used on this project has been tested as specified.

- D. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Division 1 and Section 23 00 00 - UTSW Mechanical Design Requirements.
- B. Include manufacturer`s descriptive literature, operating instructions, maintenance and repair data, and parts lists

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum five years documented experience

1.7 WARRANTY

- A. Provide one-year manufacturer`s warranty under provisions of Division 01 and Section 22 00 10 - Basic Plumbing Requirements.

PART 2 -- PRODUCTS

2.1 VARIABLE OR CONSTANT VOLUME TERMINAL UNITS

- A. The Contractor shall furnish and install pressure independent dual and/or single duct variable air volume control assemblies with integral attenuator (single duct units) and attenuator-mixers (dual duct units), of the sizes, capacities and configurations shown on the Drawings.
 - 1. Casing Construction:
 - a. The units shall be constructed of a minimum of 22 gauge galvanized steel and internally lined with a minimum of 1 inch thick, three pound per cubic foot density insulation.
 - b. The insulation shall be foil faced with the edges and seams sealed or "captured", encapsulating all fibers of the insulation.
 - c. The insulation shall be neatly installed with no rough edges to interrupt the smooth flow of air through the box.
 - d. The casing shall be insulated throughout its interior.
 - e. The external insulation shall be as specified in other sections of this specification for duct insulation with full vapor barrier, and shall be field installed unless coil and plenum section is furnished as an integral part of the box.
 - f. All interior features of the boxes (such as mixing baffles, damper housings, etc) shall be secured within the casing to avoid excessive movement or rattling with air movement or externally generated vibration.
 - g. All external features of the terminal units shall be designed not to extend beyond the ends of the unit (For example, the actuator mounting brackets, etc., shall not extend beyond the plane of the inlet "bulkhead").
 - 1) The only exception shall be flow sensors installed in the inlet duct connections.
 - 2) Note that if a separate flow station is installed within a frame within the casing, then it shall be so installed not to allow air flow to bypass the flow measurement station.
 - 2. The terminal units shall be constructed with inlet and discharge ductwork connections.
 - a. The inlet ductwork connections shall extend a minimum of 4 inches from the unit casing including an allowance for the installation of air flow station(s) or probe(s).
 - b. The discharge connection shall include 1 inch extension with slip and drive connections for use by the contractor to secure the discharge ductwork or appurtenances to the unit and shall be reinforced to provide a rigid assembly.
 - 3. Casing Leakage:
 - a. Assembled Units shall be so constructed and sealed to limit air leakage to the following listed quantities at 6 inch static pressure
 - b. Leakage curves or tables will be required as part of the submittal data. The following is the maximum allowable casing leakage including all components:

Diameter(inches)	Maximum Allowed CFM (Area x 2000 fpm)	Maximum AllowableCFM Casing Leakage
4, 5, 6,	393	8.0
7 - 8	698	14.0
9 - 10	1091	22.0

11 - 12	1571	30.0
12 - 14	2138	40.0

4. Access Plenum and Door:
 - a. An access panel shall be provided immediately downstream of the dampers for inspection and service of the dampers.
 - b. The access plenum shall contain a minimum of a 12 inch diameter or 12 inch by 12 inch (or full width of unit if less than 12 inches) access door as manufactured by Ventlok.
 - c. Door frame may be bolted, screwed or flanged and sealed to the casing.
 - d. Door shall be gasketed and shall be double all construction or insulated similar to main casing
 - e. Door shall be held in place with latches or other captive retainer devices.
 - f. If the damper assembly is easily removed from the rear of the box, the access size can be reduced to 8 inch round or 8 inches by 8 inches for inspection only.
5. Damper Construction:
 - a. The damper blades shall be an equivalent of 18 gauge galvanized steel or equal aluminum and shall be securely riveted or bolted through the damper shafts to assure no slippage of the blades.
 - b. The damper shafts shall operate in rust-proof self-lubricating bearings.
 - c. Damper shafts penetrating the unit casings shall be sealed against leakage, and bearings shall be installed for protection against wear in the casing penetration.
 - d. Damper shafts shall be formed of, or cut from solid stock; no hollow shafts will be allowed.
 - e. The dampers shall seat against gasketed stops or the dampers shall have gasketed edges.
 - f. The dampers shall be so constructed to prevent "oil canning" of the damper blade.
 - g. The units shall be tested for leakage in both inlets with 6 inches static pressure imposed on one inlet at a time.
 - h. The maximum percent leakage from all tests shall be reported.
 - i. Leakage curves as a function of pressure shall be supplied as part of the submittal data.
 - j. The damper actuator linkage, if used, shall be constructed of material of sufficient strength to avoid buckling under extreme loads.
 - k. Linkages shall not allow play greater than 5 degrees of damper movement.
 - l. The controls for the dampers shall cause the dampers to fail in the position of last control (freeze in place), or fail to the open position.
6. Damper Leakage:
 - a. The following is the maximum damper leakage allowable for the various size diameter inlets at 6 inches w g differential pressure.
 - 1) The damper leakage shall not exceed the values listed in the table below at 6 inches S P, following ARI 880 Testing Procedures.

Diameter (inches)	Maximum Allowed CFM (Area x 2000 fpm)	Maximum Allowable CFM Damper Leakage
4, 5, 6,	393	6.0
7 - 8	698	10.5
9 - 10	1091	16.5
11 - 12	1571	20.0
12 - 14	2138	30.0

7. Unit Pressure Drop:
 - a. Single duct unit pressure drop shall be limited to 0.15 inches water gauge under the same conditions above.
8. Certification:
 - a. The unit manufacturer shall certify that each unit used on this project will perform as specified.
 - b. Each unit shall bear a tag or decal listing the following specified information:
 - 1) Test Pressure.
 - 2) Leakage CFM (damper).
 - 3) Leakage CFM (casing).
 - 4) Date of Mfg.
 - 5) Room or area served.
 - 6) Unit size - 6 inches, 8 inches, etc.

- 7) Calibrated CFM, i.e. 800 CFM.
9. Flow Measurement:
- a. Air flow thru the unit shall be accomplished by the use of brass "T's" and a metal multi-port sensing device with a minimum of four radially distributed pick-up points connected to a center averaging chamber with adequate internal passages to prevent restrictions that can result in control "hunting".
10. Sound: (Note that the maximum sound levels listed in this paragraph refer to raw sound levels, with no credits taken for the construction).
- a. Discharge Sound:
- 1) Maximum discharge Sound Power Levels at 2000 fpm primary air inlet velocity with 1.5 inch w.g. inlet static pressure shall not exceed that listed in the following table.
 - 2) No credit for lined discharge duct, branching, flow division, end reflection, room absorption or any other effects shall be allowed.

Octave Band	Center Frequency (Hz)	Sound Power Level (dB re 10 ¹² Watts)
2	125	76
3	250	66
4	500	63
5	1000	58
6	2000	60
7	4000	55

- b. Radiated Sound:
- 1) Maximum discharge Sound Power Levels at 2000 fpm primary air inlet velocity with 1.5 inch w.g. inlet static pressure shall not exceed that listed in the following table.
 - 2) No credit for ceiling plenum, ceiling tiles, room absorption, or any other effects shall be allowed.

Octave Band	Center Frequency (Hz)	Sound Power Level (dB re 10 ¹² Watts)
2	125	
3	250	
4	500	
5	1000	
6	2000	47
7	4000	

- c. All sound power levels shall be obtained from testing in accordance with ARI-ADC Standard 880 and shall be certified at ARI-880 certification points.
11. Testing Prior to Installation:
- a. Shipment Testing:
- 1) A minimum of ten percent of each size of the terminal units (but no less than one unit of each size used) may be tested for conformance to this specification, at the Owner's discretion.
 - 2) The Contractor shall allow sufficient time during construction and space for the Owners TAB Consultant to perform all testing as may be required.
- b. Unit Non-Performance:
- 1) If the results of the Shipment Testing show that any of the units do not perform as specified, then an additional 10 percent of each size (but no less than one unit of a size, unless 100 percent of the size has been tested) of the units shall be tested.
 - (a) If this testing, in the Owner's opinion, shows that 10 percent or more of the units tested do not perform as specified, then 100 percent of all sizes of the units shall be tested for conformance with these specifications.
 - (b) The results of that testing shall be reviewed carefully between the Contractor, manufacturer, the Owner's construction administrator(s), and the Owner's design engineer(s).
 - (c) A method of repair or replacing the units will be negotiated.
 - (d) The Owner, however, shall maintain the right of final approval of any proposed solution.

- 2) Should for any reason the testing described above under "Submittal" and "Shipment Testing" prove that any of the units do not perform as specified, the Contractor shall be responsible for all subsequent labor, travel, travel expenses, and incidental expenses, penalties, or other costs attendant to any additional testing as described under "Unit
 - (a) Non-Performance", or as required to prove that the units perform as specified.
 - (b) This shall Include, but not be limited to, the labor, travel and reasonable incidental expenses of not only the Contractor and Owner's TAB Consultant, but also those incurred by the Owner as may be specifically required for this purpose.
 - (c) The expenses to be reimbursed to the Owner shall be labor at a rate of \$300 per day or any portion of a day, plus travel and travel expenses at actual cost, plus reasonable incidental expenses at actual cost.
12. Manufacturer:
 - a. All Terminal Units shall be as manufactured by Titus (model DESV or DMDV), Metal*Aire (TH-500), Nailor Industries (model 3000-UT or 3200-UT) or Price Industries (models SDV-UT or DDS-UT).
 - b. Note that the model and series numbers listed may differ slightly from catalogue information.
 - c. No other manufacturers or models are acceptable.
 - d. Even though specific manufacturers may be named, the material supplied by any approved manufacturer shall meet all of the provisions of this specification without exception.
 13. Hot water Coils:
 - a. Hot water coils installed in conjunction with single duct terminal units shall be factory installed, one or two row with a maximum of 10 aluminum fins per inch.
 - b. Air side pressure drop shall be limited to 0.2 inch wg at box rated flow.
 - c. Full fin collars shall be provided for accurate fin spacing and maximum fin-to-tube contact.
 - d. Tubes shall be 1/2 inch diameter seamless copper with a minimum wall thickness of 0.016 inch, tested at 400 psig air pressure under water with a minimum rated burst pressure of 1500 psig.
 - e. Male sweat-type water connections shall be provided.
 - f. Side and end plates shall be a minimum of 18 gauge galvanized sheet metal construction.
 - g. All coils shall be constructed and tested in accordance with UL and/or ARI Standards.
 14. General Performance:
 - a. Devices using mechanical CFM limiters will not be accepted, nor shall it be necessary to change control components to make airflow rate changes.
 - b. DDC flow stations shall be furnished, mounted and adjusted by the terminal unit assembly manufacturer to assure their proper placement within the units It shall be noted that the terminal unit manufacturer shall be responsible for the workmanship and materials of the entire assembly of unit controls.
 - c. The terminal unit manufacturer shall be responsible only for the construction of the terminal unit and the installation of internal control components installed at the manufacturers factory, and shall not be responsible for the installation of controls not installed at the terminal unit manufacturer's factory, nor shall the manufacturer be responsible for the performance of the DDC controls.
 - d. The terminal unit manufacturer will furnish and install the control power disconnect and control voltage transformer.
 - e. The performance of DDC controls, especially in connection with terminal units, shall be the responsibility of the DDC controls manufacturer.
 15. Control Performance:
 - a. Assemblies shall be able to be reset to any airflow between zero and the maximum cfm shown on Drawings.
 - b. To allow for maximum flexibility and future changes, it shall be necessary to make only simple screwdriver or keyboard adjustments to arrange each unit for any maximum air flow within the ranges for each inlet size as scheduled on the Drawings.
 - c. The control devices shall be designed to maintain the desired flow regardless of inlet flow deflection.
 - d. All terminal units shall be installed with a minimum of four diameters of straight duct directly prior to the entry into each terminal unit connection.

16. Control Sequences:
 - a. The control sequence arrangements shall be as described on the Drawings, whether the controls used on this project are pneumatic or DDC, and the terminal units shall be shipped from the manufacturer with all necessary control devices to accomplish each sequence, except as may be prohibited by the controls manufacturer.
 - b. The desired sequence shall be adjustable according to space usage or a change in space conditions.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to requirements included in Part 2 of this specification.
- B. Install in accordance with manufacturer's instructions.
- C. Provide ceiling access doors or locate units above easily removable ceiling components. Refer to Section 08 31 13 - Access Doors and Frames.
- D. Support units individually from structure Do not support from adjacent ductwork.
- E. Connect to ductwork in accordance with Section 23 31 00 - Ductwork.
- F. Install heating coils in accordance with Section 23 82 16 - Air Coils.

3.2 TERMINAL UNIT SCHEDULE

- A. Refer to Drawings for schedule.

END OF SECTION 23 36 00

SECTION 23 36 10
AIR VALVES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Air Valves

1.2 RELATED REQUIREMENTS

- A. Section 23 00 00 - UTSW Mechanical Design Requirements
- B. Section 23 21 13 - Hydronic Piping
- C. Section 23 05 23 - General Duty Valves for HVAC Piping
- D. Section 23 05 53 - Mechanical Identification
- E. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC
- F. Section 23 07 13 - Ductwork Insulation
- G. Section 23 31 00 - Ductwork

1.3 REFERENCE STANDARDS

- A. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- B. Air Movement and Control Association, AMCA Standard 210.
- C. ASHRAE Standard 70-2006, Method of Testing the Performance of Air Outlets and Air Inlets.
- D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
- E. SMACNA HVAC Duct Construction Standards.

1.4 SUBMITTALS

- A. Submit product data and all required information in accordance with the provisions of Division 01.
- B. Submit product, performance data, and control diagrams for review.
- C. Submit test reports as specified herein.
- D. Submit certificates as specified herein.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum eight years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 WARRANTY

- A. See Division 01 for additional warranty requirements.
- B. Provide five year manufacturer warranty for air valves and integral controls.

1.7 GUARANTEE

- A. Manufacturer guarantees resultant noise levels to be within NC rating published by manufacturer.

PART 2 - PRODUCTS

2.1 AIR VALVES (SUPPLY, RETURN, EXHAUST, FUME HOOD EXHAUST)

- A. Acceptable Manufacturer: Accutrol, Siemens, Price Industries (Antec Controls), or Phoenix Controls.
- B. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and shall not be custom designed especially for this project. All components shall have been thoroughly tested and proven in actual use.

- C. The system provided shall be by one manufacturer, complete in all respects, including required controller, accessories, hardware, software and peripheral devices necessary to execute the sequence of operations.
- D. The airflow control device shall be pressure independent over its specified differential static pressure operating range. An integral pressure independent assembly shall respond and maintain specific airflow within one second of a change in duct static pressure irrespective of the magnitude of pressure and/or flow change or quantity of airflow controllers.
- E. The airflow control device shall include factory-mounted digital controls to control flow without the need for an airflow measuring device in the airstream, and a factory-mounted high speed actuator. The valve shall provide electronic flow feedback.
- F. The airflow control device shall be linear type and maintain accuracy within $\pm 5\%$ of signal over an airflow turndown range of no less than 8 to 1.
- G. A maximum of two duct diameters entering the valve shall be provided to ensure accuracy and/or pressure independence.
- H. Air pressure drop is not to exceed 0.3" wg on any single valve, not including heating coil if applicable.
- I. Valve body material for fume hood air valves or other corrosive service shall be Type 304 stainless steel; 20 gauge for body and 16 gauge for blades.
- J. Valve body material for non-corrosive service such as for supply, return, and general exhaust shall be aluminum.
- K. Furnish labor, materials, tools, equipment, controls, and services for air valve system. The control system shall vary the amount of supply and return/exhaust air into the room to operate the space at the lowest possible airflow rates necessary to maintain temperature control, achieve minimum ventilation rates, and maintain room pressurization in relation to adjacent spaces (positive or negative as indicated on the drawings).
- L. For lab areas, the system provided shall be based on variable fume hood exhaust volume with sash position reset control of fume hoods (as applicable), on / off status of fume hoods, synchronization of supply and exhaust airflow, and control of lab room temperature via reheat coil(s) and airflow reset.
- M. Any changes required in the ductwork, air handling equipment or other mechanical systems, which would be required for the application of proposed equipment other than the specified basis of design shall be the responsibility of the laboratory airflow control system supplier. All changes shall be subject to prior approval by the Architect/Engineer.
- N. The laboratory airflow control systems shall digitally interface to the building automation system (BAS). The laboratory airflow control contractor shall be responsible to provide an interface device between the air valve airflow controls and the BAS via BACnet protocol.
- O. Coordinate work of this section with control drawings and sequences as indicated on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all units as indicated and in accordance with manufacturer's recommendations and instructions.
- B. Check connections to insure they are tight with all leakage of 1% or less.
- C. Provide insulation in accordance with Section Section 23 07 13 - Ductwork Insulation.

3.2 CLEANING, TESTING, START-UP, DEMONSTRATION

- A. Clean units in accordance with Section 23 00 00 - UTSW Mechanical Design Requirements, including flushing of connected piping and cleaning of water control valves.
- B. Start-up units, check for proper operation as a system with air handling unit, fans, and connected ductwork.
- C. Test units in accordance with Section .

- D. Prepare units for Test and Balance as required by Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC, correct any deficiencies found and retest.
- E. Demonstrate operation of units as a complete system to maintenance personnel and instruct them in the operation, adjustment and repair of the system.
- F. Air valve airflow control system shall be commissioned by provider and tested as required by commissioning agent under Division 01.
- G. The air valve airflow control contractor shall demonstrate to the Engineer the ability of the controls to maintain setpoints in all modes of operation.

END OF SECTION 23 36 10

SECTION 23 37 00

AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Diffusers.
- B. Diffuser Boots.
- C. Registers/Grilles.

1.3 RELATED REQUIREMENTS

- A. Section 09 91 23 - Interior Painting
- B. Section 23 00 00 - UTSW Mechanical Design Requirements
- C. Section 23 05 29 - Supports and Anchors
- D. Section 23 05 53 - Mechanical Identification
- E. Section 23 31 00 - Ductwork
- F. Section 23 33 00 - Ductwork Accessories

1.4 REFERENCE STANDARDS

- A. AHRI 885 - Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.
- B. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating.
- C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
- D. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005.

1.5 QUALITY ASSURANCE

- A. Test and rate performance of air outlets and inlets in accordance with AHRI 885.

1.6 REGULATORY REQUIREMENTS

- A. Conform to NFPA 90A.

1.7 SUBMITTALS

- A. Submit product data under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements for items required for this project.
- B. Submit schedule of outlets and inlets indicating type, size, location, application, and noise level.
- C. Review requirements of outlets and inlets as to size, finish, and type of mounting prior to submitting product data and schedules of outlets and inlets.
- D. Submit manufacturer's installation instructions under provisions of Section 23 00 00 - UTSW Mechanical Design Requirements.
- E. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

PART 2 - PRODUCTS

2.1 AIR SUPPLIES AND RETURNS

- A. Grilles, registers and ceiling outlets shall be as scheduled on the Drawings and shall be provided with sponge rubber or soft felt gaskets.
 - 1. If a manufacturer other than the one scheduled is used, the sizes shown on the Drawings shall be checked for performance, noise level, face velocity, throw, pressure drop, etc., before the submittal is made.
 - 2. Selections shall meet the manufacturer's own published data for the above performance criteria.
 - 3. The throw shall be such that the velocity at the end of the throw in the five foot occupancy zone will be not more than 50 FPM nor less than 25 FPM.

4. Noise levels shall not exceed those published in the ASHRAE Guide for the type of space being served (NC level). Grilles, registers and ceiling outlets shall be Titus, Metalaire, Price, or approved equal.
- B. Locations of outlets on Drawings are approximate and shall be coordinated with other trades to make symmetrical patterns and shall be governed by the established pattern of the lighting fixtures or architectural reflected ceiling plan.
 1. Where called for on the schedules, the grilles, registers and ceiling outlets shall be provided with deflecting devices and manual damper.
 2. These shall be the standard product of the manufacturer, subject to review by the Architect, and equal to brand scheduled.
- 2.2 SQUARE CEILING DIFFUSERS
- A. Provide square ceiling diffusers of architectural square panel type with sizes and mounting types shown on plans and schedules.
 - B. Provide frame type appropriate for ceiling type. For lay in ceilings, diffuser shall fit in inverted T-bar frame. For plaster ceilings, diffuser shall fit in plaster frame and ceiling frame.
 - C. The face panel of the diffuser shall be smooth, flat, and free of visible fasteners. The face panel shall project no more than 1/4 inch below the outside border of the diffuser back pan.
 - D. The diffuser face panel shall have an aerodynamically shaped, rolled edge to ensure a tight, horizontal discharge pattern across ceiling.
 - E. Fabricate of steel with baked enamel finish.
- 2.3 SUPPLY REGISTERS/GRILLES
- A. Provide grilles with streamlined and individually adjustable curved blades to discharge air along face of grille, with one-way or two-way deflection as scheduled.
 - B. Frames shall have 1-1/4 inch wide border on all sides. Screw holes on frames shall be countersunk so that screw heads sit flush with frame face.
 - C. Fabricate of aluminum extrusions with factory acrylic paint finish.
 - D. Provide integral, gang-operated opposed blade dampers with removable key operator, operable from face.
- 2.4 EXHAUST AND RETURN REGISTERS/GRILLES
- A. Grilles shall have fixed deflection blades and shall be of the sizes and mounting types scheduled.
 - B. Frames shall have 1-1/4 inch wide border on all sides. Screw holes on frames shall be countersunk so that screw heads sit flush with frame face.
 - C. Fabricate of aluminum extrusions with factory acrylic paint finish.
 - D. Provide integral, gang-operated opposed blade dampers with removable key operator, operable from face.
 - E. In gymnasiums, blades shall be front pivoted, welded in place or securely fastened to be immobile.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install items in accordance with manufacturers' instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement. Refer to Section 09 91 23 - Interior Painting.
- C. Install diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 09 91 23 - Interior Painting.

END OF SECTION 23 37 00

SECTION 23 82 19

FAN COIL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. The extent of fan coil unit work is shown on drawings and in schedules, (but not by way of limitation).
- B. Fan coil unit is defined to include, but not limited to, the following components and accessories:
 - 1. Water coil.
 - 2. Water control assembly.
 - 3. Vibration isolation.
 - 4. Return air grille.
 - 5. Return air plenum.
 - 6. Duct connections.
 - 7. Fan speed switch.
 - 8. Thermostat.
 - 9. Filter.
 - 10. Fan motor.

1.3 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

- A. Submit shop drawings and product data indicating unit dimensions, unit weight, required clearances, construction details, field connection details, capacities, ratings, fan performance, electrical characteristics and material gauges and finishes.
- B. Provide fan curves with operating point clearly plotted.
- C. In addition to A and B, if equipment is other than manufacturer specified, submit complete drawing showing that unit will fit space requirements with proper clearances for access and maintenance.
- D. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver products and materials to site in factory-fabricated protective containers with factory-installed shipping skids and lifting lugs.
- B. Store products in clean, dry space and protect from weather and construction traffic. Handle as required to avoid damage to components, enclosures, and finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Magic Aire.
- B. Airtherm Mfg Co.
- C. McQuay Corp.
- D. Trane Co.

2.2 MATERIALS

- A. Provide manufacturer's certification of fan coil unit capacity compliance with ARI Standard 441.
- B. Except as otherwise indicated, provide fan coil unit manufacturer's standard materials and components as indicated by his published product information, designed and constructed as recommended by the manufacturer, and as required for a complete installation.
- C. Coils:

1. Except as otherwise indicated, provide manufacturer`s standard coil of the indicated type and rated for the indicated capacity.
 2. Copper tube coils, mechanically expanded into aluminum plate fins; rated at 250 psig and leak tested at 350 psig min air pressure.
 - a. Air Vents: Provide manual type.
 3. Size coils for the indicated room sensible cooling load Btuh room total cooling load Btuh, entering air temperature wet-bulb and dry-bulb, water temperature change external static pressure in wg , and maximum coil-water pressure drop.
 4. Size coils for the indicated steam flow rate, room heating load Btuh, entering air temperature and entering water temperature.
- D. Water-flow control shall be factory-connected valve assemblies of the indicated operation.
- E. Fans:
1. Balanced statically and dynamically, and of the indicated capacity; designed and assembled to be easily removed for servicing.
 2. Construct fans of 22-gage minimum galvanized steel.
 3. Provide centrifugal, forward-curved type impeller.
- F. Motors:
1. Provide motors, of the indicated capacity, with automatic-reset thermal overload protection of one of the following types:
 - a. Split-capacitor motor.
 2. Motors shall be installed for easy removal.
- G. Cabinets: Fabricate of formed 18-gage (min) cold-rolled steel Include access panels with positive-locking, quarter-turn fasteners
1. Form cabinets to receive the indicated cabinet accessories
- H. Cabinet Accessories: Manufacturer`s standard of the following types:
1. Discharge duct collars; integral with unit and extending 1 inch minimum.
 2. Return air duct collar; integral with unit and extending 2 inches minimum.
- I. Cabinet Insulation:
1. Where not otherwise indicated, line cabinets with 1/2 inch coated glass fiber insulation
 2. Comply with NFPA No 90A, and arrange to minimize both heat and sound transmissions, and to prevent sweating.
- J. Drain Pans:
1. Provide galvanized steel drain pan designed to project under length and width of coil including heaters and return bends. Insulate pan and pitch for positive drainage with fan coil unit level.
 2. Provide overflow secondary drain connection; 1/2 inch pipe/tube size where not otherwise indicated.
 3. Design drain pans to extend under connecting piping and valves where fan coil units are indicated for ceiling suspension or overhead installation.
 4. Insulation: Manufacturer`s standard insulation material.
 5. Filters: Manufacturer`s standard; one of the following types:
 - a. Filter location must be accessible for filter changes. May be located in return grilles, if applicable.
 - b. Type: Throw-away filters of glass fiber; 2 inches thick.
- K. Vibration Isolation: Provide devices of the type and size recommended by the manufacturer, except as otherwise indicated.
- L. Factory Finish:
1. Manufacturer`s standard factory finish including metal surface cleaning before coating.
 2. Provide baked alkyd enamel metal finish paint coat of the indicated color on fan coil units, applied on exposed ferrous metal surfaces.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Except as otherwise indicated, install fan coil units, including components and controls required for operation, in accordance with manufacturer`s instructions.
- B. Locate each unit accurately in the position indicated in relation to other work Position unit with sufficient clearance for normal service and maintenance, including clearance for cabinet removal.

- C. Install units on vibration isolation mounts in accordance with manufacturer`s instructions, and as indicated.
- D. Level fan coil units to the tolerance recommended by the manufacturer.
- E. Install valves, including balancing valves to comply with these specifications.

END OF SECTION 23 82 19

SECTION 26 00 00

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. General Requirements specifically applicable to Division 26 in addition to Division 01 requirements.

1.3 GENERAL

- A. The Contractor shall execute work specified or indicated on accompanying Drawings.
- B. Contractor shall provide equipment necessary and usually furnished in connection with such work and systems whether or not mentioned specifically herein or on the Drawings.
- C. The Contractor shall be responsible for fitting material and apparatus into the building and shall carefully lay out work at the site to conform to the structural conditions, to avoid obstructions, to conform to the details of the installation and thereby to provide an integrated satisfactory operating installation.
- D. Mechanical, electrical, and plumbing Drawings are necessarily diagrammatic by their nature, and are not intended to show every connection in detail or every pipe or conduit in its exact location.
 - 1. These details are subject to the requirements of standards referenced elsewhere in these specifications, and structural and architectural conditions.
- E. Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work.
 - 1. Work shall be organized and laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted otherwise.
 - 2. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise note
- F. When the mechanical, electrical, and plumbing Drawings do not give exact details as to the elevation of pipe, conduit and ducts, the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with proper grades for the functioning of the system involved.
- G. Piping, exposed conduit, and the duct systems are generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner.
 - 1. The drawings do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas.
 - 2. All equipment indicators shall face main traffic pathways unless noted otherwise.

1.4 DEFINITIONS

- A. Concealed/Exposed: "Concealed" areas are those areas which cannot be seen by the building occupants. "Exposed" areas are all areas which are exposed to view by the building occupants, including under counters, inside cabinets and closets, plus all mechanical and electrical rooms.

1.5 RELATED REQUIREMENTS

- A. Section 01 77 00 - Closeout Procedures and Submittals
- B. Section 01 79 00 - Demonstration and Training
- C. Section 01 91 00 - General Commissioning Requirements
- D. Section 26 05 53 - Electrical Identification
- E. Section 26 08 00 - Commissioning of Electrical Systems

1.6 PERMITS, UTILITY CONNECTIONS AND INSPECTIONS

- A. General: Refer to Division 01 for construction phasing and time increments.
- B. Work performed on this project is under the authority of the State of Texas, therefore no local construction fees or construction permits will be required except as may be required for new service taps, or new or modified connections to City controlled services. Confirm with specific project contract requirements.

1. If inspections by City personnel are specifically required by this document, then the Contractor is responsible for any fees or permits in connection to those requirements.
 - C. Compliance:
 1. The Contractor shall comply in every respect with all requirements of National Fire Protection Association, local Fire Department regulations, and utility company requirements.
 2. In no case does this relieve the Contractor of the responsibility of complying with these Specifications and Drawings where specified conditions are of higher quality than the requirements of the above specified authorities.
 3. Where requirements of the Specifications and Drawings are more lenient than the requirements of the above authorities having jurisdiction, the Contractor shall make installations in compliance with the requirements of the above authorities with no extra compensation.
- 1.7 CONTRACT DOCUMENTS
- A. Dimensional information related to new structures shall be taken from the appropriate Drawings.
 1. All dimensional information related to existing facilities shall be taken from actual measurements made by the Contractor on the site.
 - B. The interrelation of the Specifications, the Drawings, and the schedules are as follows:
 1. Specifications determine the nature and setting of the several materials, Drawings establish the quantities, dimensions and details, and the schedules give the performance characteristics.
 2. If the Contractor requires additional clarification, request shall be made in writing, following the contractually prescribed information flow requirements.
 - C. Should the Drawings or Specifications conflict, the better quality, or greater size or quantity of work or materials shall be performed or furnished.
- 1.8 OWNER FURNISHED PRODUCTS
- A. Products furnished to the site and paid for by Owner will be noted on the drawings and utilities created/connected as required.
- 1.9 FUTURE WORK
- A. Future work will be noted on the Drawings.
- 1.10 ALTERNATES
- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at the Owner's option. Accepted Alternates will be identified in Owner-Contractor Agreement.
 - B. Coordinate related work and modify surrounding work as required.
 - C. Schedule of Alternates: See "Special Conditions" and Bid Form.
 - D. Any Alternate Proposals are summarized in Division 01 of the Specifications.
 - E. The Contractor is directed to refer to all Sections of the Specifications and Drawings for this project to determine the exact extent and scope of the various Alternate Proposals as each pertains to the work of all trades.
- 1.11 SUBMITTALS
- A. Refer to Division 01, UGC, and supplemental UGC's for specification requirements pertaining to timeliness of submission and review, quantity, and format.
 - B. Each specification section describes the content of the submittals and any submittals which must be approved prior to submission of others.
 - C. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.
 1. Mark dimensions and values in units to match those specified.
 - D. Submit Fabrication Drawings in accordance with the following:
 1. Equipment proposed varies in physical size and arrangement from that indicated on the Drawings, thus causing rearrangement of equipment space.
 2. Where tight spaces require extreme coordination between ductwork, piping, conduit, and other equipment.
 3. Where called for elsewhere in these Specifications.
 4. Where specifically requested by the Architect/Engineer.
 5. Fabrication Drawings shall be made at no additional charge to the Owner or the Architect/Engineer.

- E. All required Fabrication Drawings, except as noted otherwise, shall be prepared at a scale of not less than 1/4 inch = 1 foot.
 - 1. Fabrication Drawings for ductwork, air handling units, and sections in Mechanical or Electrical Rooms shall be drawn at a minimum scale of 3/8 inch = 1 foot.
 - 2. Submit digital and pdf prints of each Fabrication Drawing to the Architect/Engineer for review.
 - 3. Reproduction and submittal of the Construction Documents is not acceptable.
 - 4. The Architect/Engineer will review Drawings and return one print with comments.

1.12 SUBSTITUTION OF MATERIALS AND EQUIPMENT

- A. Refer to General Conditions for substitution of materials and equipment.
- B. General:
 - 1. Within thirty days after the date of contract award or work order, whichever is later, and before purchasing or starting installation of materials or equipment, the Contractor shall submit for review, a complete list of suppliers, contractors and manufacturers for all materials and equipment which will be submitted for incorporation into the project.
 - a. The list shall be arranged in accordance with the organization of the Specifications.
 - b. Initial list shall include the manufacturer`s name and type or catalog number as required to identify the quality of material or equipment proposed.
 - c. List will be reviewed by the Engineer and the Owner and will be returned to the Contractor with comments as to which items are acceptable without further submittal data and which items will require detailed submittal data for further review and subsequent approval.
 - d. Initial list shall be submitted as specified.
 - e. Materials and equipment requiring detailed submittal data shall be submitted with sufficient data to indicate that all requirements of these Specifications have been met and samples shall be furnished when requested.
 - f. Manufacturers data used as part of the submittal shall have all inapplicable features crossed out or deleted in a manner that will clearly indicate what is to be furnished.
- C. It is not the intent of the Drawings and/or Specifications to limit products to any particular manufacturer or to discriminate against an "APPROVED EQUAL" product as produced by another manufacturer.
 - 1. Some proprietary products are mentioned to set a definite standard for acceptance and to serve as a reference in comparison with other products.
 - 2. When a manufacturer`s name appears in these Specifications, it is not to be construed that the manufacturer is unconditionally acceptable as a provider of equipment for this project.
 - 3. The successful manufacturer or supplier shall meet all of the provisions of the appropriate specification(s).
 - 4. The specified products have been used in preparing the Drawings and Specifications and thus establish minimum qualities with which substitutes must at least equal to be considered acceptable.
 - 5. The burden of proof of equality rests with the Contractor.
 - 6. The decision of the designer is final.
- D. When requested by the Architect/Engineer, the Contractor shall provide a sample of the proposed substitute item. In some cases, samples of both the specified item and the proposed item shall be provided for comparison purposes.
- E. Timeliness:
 - 1. The burden of timeliness in the complete cycle of submittal data, shop Drawings, and sample processing is on the Contractor.
 - 2. The Contractor shall allow a minimum of 6 weeks time frame for review of each submission by the office of the design discipline involved after receipt of such submissions by that design discipline.
 - 3. The Contractor is responsible for allowing sufficient time in the construction schedule to cover the aforementioned cycles of data processing, including time for all re-submittal cycles on unacceptable materials, equipment, etc. covered by the data submitted.
 - 4. Construction delays and/or lack of timeliness in the above regard are the responsibility of the Contractor and will not be considered in any request for scheduled construction time extensions and/or additional costs to the Owner.
- F. Acceptance of materials and equipment:

1. This is based on the manufacturer`s published data and will be tentative subject to the submission of complete shop Drawings indicating compliance with the contract documents and that adequate and acceptable clearances for entry, servicing, and maintenance will exist.
 2. Acceptance of materials and equipment under this provision shall not be construed as authorizing any deviations from the Specifications, unless the attention of the Architect/Engineer has been directed in writing to the specific deviations.
 3. Data submitted shall not contain unrelated information unless all pertinent information is properly identified.
 4. Equipment installed on this project shall have local representation, local factory authorized service, and a local stock of repair parts.
- G. Certification: The Contractor shall carefully examine all data forwarded for approval and shall sign a certificate to the effect that the data has been carefully checked and found to be correct with respect to dimensions and available space and that the equipment complies with all requirements of the Specifications.
- H. Physical Size of Equipment: Space is critical; therefore, equipment of larger sizes than shown, even though of specified manufacturer, will not be acceptable unless it can be demonstrated that ample space exists for proper installation, operation, and maintenance.
- I. Materials and Equipment Lists:
1. Provide digital copies of the list of materials and equipment, the name of manufacturer, trade name, type, and catalog number shall be submitted to the Architect/Engineer.
 2. Lists shall be accompanied by digital sets of pictorial and descriptive data derived from the manufacturers` catalogs, sales literature, or incorporated in the Shop Drawings.
 3. Should a substitution be accepted, and should the substitute material prove defective, or otherwise unsatisfactory for the service intended within the guarantee period, this material or equipment shall be replaced with the material or equipment specified at no additional cost to the Owner.

1.13 MATERIALS AND WORKMANSHIP

- A. Materials, unless otherwise specified, shall be new, free from all defects, suitable for the intended use, and of the best quality of their respective kinds.
1. Materials and equipment shall be installed in accordance with the manufacturer`s recommendations and the best standard practice for the type of work involved.
 2. Execute work by mechanics skilled in their respective trades, and the installations shall provide a neat, precise appearance.
 3. Materials and/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 materials and/or equipment.
- B. Responsibility for the furnishing of the proper equipment and/or material installation as intended by the manufacturer, rests entirely upon the Contractor who shall request advice and supervisory assistance from the representative of the specific manufacturers during installation.

1.14 FLAME SPREAD PROPERTIES OF MATERIALS

- A. Materials and adhesives incorporated in this project shall conform to NFPA.
- B. The classification shall not exceed a flame spread rating of 25 for all materials, adhesives, finishes, etc., specified for each system, and shall not exceed a smoke developed rating of 50.

1.15 REGULATORY REQUIREMENTS

- A. Conform to applicable codes and ordinances.
- B. Obtain permits and request inspections from authorities having jurisdiction.
- C. Perform all work to comply with applicable codes, ordinances, and regulations of authorities having jurisdiction.
- D. In case of differences between the Contract Documents and applicable codes and ordinances, the more stringent shall apply.
- E. The "Authority Having Jurisdiction" for Fire and Life Safety related compliance in accordance with the rules and regulations promulgated by the Texas State Fire Marshal as an Agency of the State of Texas is UT Southwestern Medical Center Office of Safety and Business Continuity.
1. Plan reviews, installations, inspections, and approvals shall be done as a function of the Fire and Occupational Safety program under the direction of the Director of Fire and Occupational Safety (University Fire Marshal).

- F. It is required that the installation shall meet the minimum standards prescribed in the currently adopted editions as identified in Section 01 41 00 - Regulatory Requirements and listed in other Specification sections. Additional requirements include but not limited to:
1. National Fire Protection Association Standards (NFPA): Currently accepted edition.
 2. ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 3. American Gas Association Publications (AGA): Directory of Approved Gas Appliances and Tested Accessories.
 4. American Society of Mechanical Engineers (ASME): Boiler and Pressure Vessel Codes.
 5. Air Conditioning and Refrigeration Institute Standards (ARI): All standards related to refrigeration and air conditioning equipment and piping furnished under these Specifications.
 6. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA): All current editions of applicable manuals and standards.
 7. Air Moving and Conditioning Association (AMCA): All current editions of applicable manuals and standards.
 8. American Society of Testing Materials (ASTM): All current editions of applicable manuals and standards.
 9. American Water Works Association (AWWA): All current editions of applicable manuals and standards.
 10. National Electrical Manufacturers` Association (NEMA): All current editions of applicable manuals and standards.
 11. International Codes, current edition or as listed elsewhere in the contract.
 12. Texas Occupational Safety Act: All applicable safety standards.
 13. Occupational Safety and Health Act (OSHA).
 14. TAS, ADA, and ANSI Standards: All work shall be in accord with all regulations and requirements of the Standards and Specifications for Handicapped and Disabled for the Construction of Public Buildings and Facilities in the State of Texas Usable by Physically Handicapped and Disabled persons, ANSI Standards, and the requirements of the American Disabilities Act.
 15. ASME A13.1
- G. Materials and workmanship shall comply with applicable state and national codes, Specifications, and industry standards.
1. In all cases where Underwriters' Laboratories, Inc. has established standards for a particular type materials, such material shall comply with these standards.
 2. Evidence of compliance shall be the UL "label" or "listing" under Re-Examination Service.
- H. Contract Documents are intended to comply with the aforementioned rules and regulations; however, some discrepancies may occur.
1. Where such discrepancies occur, the Contractor shall immediately notify the Architect/Engineer in writing of said discrepancies and apply for an interpretation.
 2. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with said regulations shall be paid for as covered by Division 1 of these Contract Documents, providing no work of fabrication of materials has been accomplished in a manner of noncompliance.
 3. Should the Contractor fabricate and/or install materials and/or workmanship in such a manner that does not comply with the applicable codes, rules and regulations, the Contractor who performed such work shall bear all costs arising in correcting these deficiencies to comply with said rules and regulations.

1.16 COMMISSIONING

- A. Comply with project requirements for commissioning. Refer to Section 01 91 00 - General Commissioning Requirements and associated sections.

1.17 SCOPE OF WORK

- A. The work included consists of the furnishing of all materials, labor, tools, transportation, services, permits, fees, etc which are required and/or necessary for a complete and proper installation of the electrical system(s), which shall include:
1. Installation of branch circuit panelboards, breakers, and feeders.
 2. Connection of electric power to heating, ventilating, and air conditioning equipment.
 3. Interior lighting.

4. Connection of electric power to owner-furnished equipment and other equipment indicated on the Contract Documents.
5. Raceway with pull string for telecommunications, security, or other building systems cabling.
6. Special signaling and communication systems as described hereinafter.

1.18 WORK SEQUENCE

- A. Install work in phases to accommodate Owner's occupancy requirements during the construction period and as outlined in Division 01.

1.19 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

- A. Storage at Site: The Contractor shall not receive material or equipment at the job site until there is suitable space provided to properly protect equipment from rust, weather, humidity, dust damage, and vandalism.
- B. Capacities shall be not less than those indicated but shall be such that no component or system becomes inoperative or is damaged because of startup or other overload conditions.
- C. Conformance with Agency Requirements:
 1. Where materials or equipment are specified to be approved, listed, tested, or labeled by the Underwriters' Laboratories, Inc, or constructed and/or tested in accordance with the standards of the American Society of Mechanical Engineers or the Air Moving and Conditioning Association, the Contractor shall submit proof that the items furnished under this Section of the Specifications conform to such requirements.
 - a. The label of the Underwriters Laboratories, Inc, applied to the item will be acceptable as sufficient evidence that the items conform to such requirements.
 - b. The ASME stamp or the AMCA label will be acceptable as sufficient evidence that the items conform to the respective requirements.
- D. Nameplates:
 1. Refer to Section 26 05 53 - Electrical Identification for requirements.
 2. Each major component of equipment shall have the manufacturer's name, address, and catalog number on a plate securely attached to the item of equipment. Attachment shall be appropriate to the type of surface to ensure longevity of attachment.
 3. Data on nameplates shall be legible at the time of Final Inspection.
- E. Prevention of Rust:
 1. Standard factory finish will be acceptable on equipment specified by model number; otherwise, surfaces of ferrous metal shall be given a rust inhibiting coating.
 2. The treatment shall withstand 200 hours in salt spray fog test, in accordance with Method 6061 of Federal Standard No.141.
 3. Immediately after completion of the test, the specimen shall show no signs of wrinkling or cracking and no signs of rust creepage beyond 1/8-inch on either side of the scratch mark.
 4. Where rust inhibitor coating is specified hereinafter, any treatment that will pass the above test is acceptable unless a specific coating is specified except that coal tar or asphalt type coating will not be acceptable unless so stated for a specific item.
 5. Where steel is specified to be hot-dip galvanized, mill-galvanized sheet steel may be used provided all raw edges are painted with a zinc-pigmented paint conforming to Military Specification MIL-P-26915.
- F. Protection from Moving Parts:
 1. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts shall be fully enclosed or properly guarded for personnel protection.
 2. Guards shall be compliant with OSHA requirements.
- G. Verification of Dimensions:
 1. The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades.
 2. The Contractor shall visit the premises and become thoroughly familiarize with all details of the work and working conditions, to verify all dimensions in the field, and to advise the Architect/Engineer of any discrepancy before performing any work.
 3. Adjustments to the work required in order to facilitate a coordinated installation shall be made at no additional cost to the Owner or the Architect/Engineer.

1.20 WALL, FLOOR, AND CEILING PLATES

- A. Except as otherwise noted, provide C.P. (Chrome plated) brass floor and ceiling plates around all pipes, ducts, conduits, etc., passing exposed through walls, floors, or ceilings, in any spaces except underfloor and attic spaces.
 - 1. Plates shall be sized to fit snugly against the outside of the pipe or against the insulation on lines which are insulated and positively secured to such pipe or insulation.
 - 2. Plates will not be required for piping where pipe sleeves extend 3/4-inch above finished floor.
 - 3. Equipment rooms are classified as finished areas.
 - 4. Round and rectangular ducts shall have closure plates (NOT chrome plated) made to fit accurately at all floor, wall and ceiling penetrations.

1.21 SLEEVES, INSERTS, AND FASTENINGS

- A. General:
 - 1. Openings through all floors, walls, and roofs, etc., regardless of material for the passage of piping, ductwork, conduit, cable trays, etc., shall be sleeved.
 - 2. Penetrations must pass through sleeves except soil pipe installed under concrete slabs on fill.
 - 3. Sleeves shall be set in new construction before concrete is poured, as cutting holes through any part of the concrete will not be permitted unless acceptable to the Architect/Engineer.
 - a. If a penetration is cored into an existing solid concrete or stone structure, then the installation of a sleeve will not be necessary.
 - 4. Sleeves set in floors shall extend 4-inch above finished floor elevation and be sealed water tight to the floor.
- B. The minimum clearance between horizontal penetrations including insulation where applicable, and sleeve shall be 1/4-inch, except that the minimum clearance shall accommodate a Link-seal closure, by Garlock, an Enpro Company, where piping exits the building, or penetrates a wall below ground level.
- C. Contractor shall be responsible for the accurate location of penetrations in the slab for pipe, duct, etc.
 - 1. Penetrations shall be of ample size to accommodate the pipe, duct, etc. plus any specified insulation.
 - 2. Sleeve materials shall be rigid metal of adequate strength.
 - 3. Void between sleeve and pipe shall be filled with Nelson Flameseal Firestop or approved equal caulk or putty.
- D. Sleeves:
 - 1. Installation of sleeves in walls shall be the same as for floors.
 - 2. Refer to the details on the project drawings.
 - a. Where the details differ from these specifications, the drawings take precedence.
 - 3. Sleeves for penetrations passing through walls or floors on or below grade shall be removed, if practical, and after the pipes have been installed, the void space around the pipe shall be caulked with a suitable material to effect a waterproof penetration.
 - a. Note that the practicality of the removal of the sleeve shall be the decision of the Construction Inspector. The decision of the Inspector shall be final.
- E. Inserts:
 - 1. Where the construction schedule allows, suitable concrete inserts for pipe and equipment hangers shall be set and properly located for all pipe and equipment to be suspended from concrete construction
 - 2. If the inserts are later found not to be in the proper location for the placement of hangers, then drilled anchors shall be installed.
 - 3. Drilled anchors in concrete or masonry shall be submitted for approval.
- F. Fasteners: Fastening of pipes, conduits, etc., in the building shall be as follows:
 - 1. Wood members attached by wood screws.
 - 2. Masonry fastening by threaded metal inserts, metal expansion screws, or toggle bolts, as appropriate.
 - 3. Metal fastening by steel machine screws or welding (when specifically permitted or directed), or bolts.
 - 4. Concrete fastening by suitable inserts anchored to reinforcing steel, and poured in place unless other means are indicated on the plans.
 - 5. Power-actuated fasteners (shooting) will not be acceptable under any circumstances.

6. If it is necessary to install a method of fastening a hanger after the structure has been installed, then only clamps or drilled anchors shall be used.
7. Note: Plastic anchors or plastic expansion shields are prohibited.
- G. Rat-proofing: The open space around all ductwork, piping, etc., passing through the ground floor and/or exterior walls shall be rat-proofed in a manner acceptable to the Architect/Engineer.
- H. Weatherproofing: The annular space between a pipe and its sleeve in exterior walls or through floor to below grade shall be filled with polyurethane foam rods 50 percent greater in diameter than the space as backing and fill material and made watertight with a permanent elastic polysulfide compound.
 1. Seal both surfaces of wall or floor.
- I. Air Plenums: The space around piping, ductwork, etc., passing through air plenums shall be made airtight in a manner acceptable to the Architect/Engineer.
- J. Fireproofing:
 1. Each mechanical and electrical contractor shall seal all cable trays, pipe, conduit, duct, etc., penetrations through roof, fire rated walls and floors with a foam or sealant (as described below) that will form a watertight, vermin tight barrier capable of containing smoke and fire up to 2,000 degrees F for two hours.
 2. Sealing of cable trays and conduits that extend through rated walls from ends of cable tray shall be done after conductors have been installed.
 3. Refer to fireproofing and firestopping specifications in Division 07 for product requirements.

1.22 PROJECT/SITE CONDITIONS

- A. Install Work in locations shown on Drawings unless prevented by Project conditions.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections.
 1. Obtain permission of Owner before proceeding.
- C. In some cases the existing system(s) will be expanded or replaced.
 1. Contractor shall thoroughly familiarize themselves with the existing system(s) and bring to the attention of the Architect/Engineer any situations, which deviate from those, indicated in the Contract Documents.

1.23 MANUFACTURER`S RECOMMENDATIONS

- A. The manufacturer`s published directions shall be followed in the delivery, storage, protection, installation, piping, and wiring of all equipment and material.
 1. The Contractor shall promptly notify the Architect/Engineer, in writing, of any conflict between the requirements of the Contract Documents and the manufacturers` directions.
 2. The Contractor shall obtain the Architect/Engineer`s instructions before proceeding with the work.
 3. Should the Contractor perform any such work that does not comply with the manufacturers` directions or such instructions from the Architect/Engineer, the Contractor shall bear all costs arising in connection with the deficiencies.

1.24 SPACE AND EQUIPMENT ARRANGEMENT

- A. The size of electrical equipment indicated on the Drawings is based on the dimensions of a particular manufacturer.
 1. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment they propose to furnish will fit in the space.
 2. Fabrication Drawings shall be prepared when required by the Architect/Engineer or Owner to indicate a suitable arrangement.
- B. All equipment shall be installed in a manner to permit access to all surfaces.
 1. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.
 2. All indicators shall be installed to be readable from main traffic pathways.

1.25 PROTECTION

- A. The Contractor shall at all times take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of the work.
 1. This shall include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the

cribbing of any items above the floor of the construction; and the covering of items in the incomplete building with tarpaulins or other protective covering; the installation of electric heaters in electrical switchgear and similar equipment to prevent moisture damage.

2. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.
- B. Take particular care not to damage the building structure in performing work.
 1. All finished floors, step treads, and finished surfaces shall be covered to prevent any damage by workmen or their tools and equipment during the construction of the building.
 - C. Equipment and materials shall be protected from rust both before and after installation.
 1. Any equipment or materials found in a rusty condition at the time of final inspection must be cleaned of rust and repainted as specified elsewhere in these Specifications.
 - D. Storage of all equipment shall be per manufacturer's recommendations.
 - E. All pumps, fans and motors shall be rotated by hand when received and when stored to maintain bearing lubrication.

1.26 COOPERATION BETWEEN TRADES AND WITH OTHER CONTRACTORS

- A. Each trade, subcontractor, and/or Contractor must work in harmony with the various other trades, subcontractors and/or Contractors on the job as may be required to facilitate the progress to the best advantage of the job as a whole.
- B. Each trade, subcontractor, and/or Contractor must pursue its work promptly and carefully so as not to delay the general progress of the job.
- C. This Contractor shall work in harmony with Contractors working under other contracts on the premises.

1.27 SUPERVISION

- A. Each Contractor and subcontractor shall keep a competent superintendent or foreman on the job at all times (Refer to the Uniform General Conditions for additional information concerning supervision)
- B. It shall be the responsibility of each superintendent to study all Drawings and familiarize themselves with the work to be done by other trades.
- C. Coordinate with other trades and, before material is fabricated or installed, superintendent shall ensure that the work will not cause an interference with another trade.
- D. Where interferences are encountered, they shall be resolved at the job site by the superintendents involved.
- E. Where interferences cannot be resolved without major changes to the design, the matter shall be referred to the A/E for ruling.

1.28 PRECEDENCE OF MATERIALS

- A. The specifications determine the nature and setting of materials and equipment.
- B. The drawings establish quantities, dimensions and details
- C. The installation precedence of materials shall generally be as follows:
 1. Note that if interference is encountered, this shall guide the contractor in the determination of which trade shall be given the "Right-of-Way" This does not require elements with a lower preference to be relocated if such relocation is required to resolve interference or to provide better access.
 - a. Building lines.
 - b. Structural Members.
 - c. Soil and Drain Piping.
 - d. Vent Piping.
 - e. Supply, Return, and Outside Air Ductwork.
 - f. Exhaust Ductwork.
 - g. HVAC Water and Steam Piping.
 - h. Condensate Piping.
 - i. Fire Protection Piping.
 - j. Natural Gas Piping.
 - k. Domestic Water (Cold and Hot).
 - l. Refrigerant Piping.
 - m. Electrical Conduit.

1.29 SEQUENCING AND SCHEDULING

- A. Construct Work in sequence under provisions of Division 01.
- B. Work requiring a shutdown of an existing system shall be scheduled and approved by the Owner.
- C. Early in the construction process, and before beginning any electrical related work, Contractor shall submit both a written and oral discussion to the Engineer, Architect, and Owner representative a Sequencing and Scheduling Plan for all medium voltage circuit and switchgear work which will involve outages.
 - 1. It is critical that electric supply be maintained on all Campuses.
 - 2. Any special provisions or coordination with other disciplines as may be needed to meet these supply needs shall be provided by the Contractor and included in the contract.

1.30 WARRANTIES

- A. Refer to Division 01 for procedures and submittal requirements for warranties.
- B. Refer to individual equipment specifications for warranty requirements.
- C. Compile and assemble the warranties specified in Division 26 into a separated set of vinyl covered three ring binders, tabulated and indexed for easy reference.
- D. Provide complete warranty information for each item (product or equipment) to include:
 - 1. Date of beginning of warranty or bond.
 - 2. Duration of warranty or bond.
 - 3. Name, address, and telephone number of manufacturer.
 - 4. Procedures for filing a claim and obtaining warranty services.

1.31 RECORDS FOR OWNER

- A. The Contractor shall maintain a set of prints in the Field Office for the sole purpose of recording "installed" conditions.
 - 1. Daily note all changes made in these Drawings in connection with the final installation including exact dimensioned locations of all new underground utilities, services and systems and all uncovered existing active and inactive piping outside the building.
- B. At Contract completion, the Contractor shall provide a set of reproducible drawings and set of specifications in electronic format (PDF).
 - 1. The contractor shall transfer the information from the prints maintained as described above, and turn over this neatly marked set of reproducible Drawings and specifications representing the "as installed" work to the Architect/Engineers for verification and subsequent transmittal to the Owner.
 - 2. The Contractor shall refer to Division 01 of these Specifications, and to the Uniform General Conditions, for additional information.
 - 3. These Drawings and Specifications shall include as a minimum:
 - a. Addendum written drawing changes.
 - b. Addendum supplementary drawings.
 - c. Accurate, dimensioned locations of all underground utilities, services and systems.
 - d. Identification of equipment work shown on Alternates as to whether alternates were accepted and work actually installed.
 - e. Change Order written drawing changes.
- C. "As installed" PDF's shall bear a stamp or hand lettered title block generally located in lower right hand corner of Drawing entitled "AS INSTALLED DRAWING" with Company name of the installing trade Subcontractor and with a place for the date and the name of the responsible company representative.
- D. In addition to the above, the Contractor shall accumulate, during the progress of the job, the following data in electronic format (PDF) and turn over to the Architect/Engineer for review, and subsequent delivery to the Owner:
 - 1. All warranties and guarantees and manufacturers` directions on equipment and material covered by the Contract.
 - 2. Operating instructions and preventative maintenance procedures for heating and cooling and other mechanical and electrical systems.
 - 3. Valve tag charts and diagrams specified herein.
 - 4. Approved wiring diagrams and control diagrams representing "as installed" conditions.
 - 5. Copies of approved Shop Drawings.
 - 6. Any and all other data and/or drawings required as submittals during construction.

7. Repair parts list of all major items and equipment including name, address and telephone number of local supplier or agent.
- E. All of the above data shall be submitted to the Architect/Engineer for approval, and shall be corrected as instructed by the Architect/Engineer prior to submission of the final request for payment.
- F. Refer to additional requirements in the commissioning section of Division 01.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be acceptable to the authority having jurisdiction as suitable for the use intended.
- B. Furnish products listed and classified by Underwriter's Laboratory, Inc as suitable for purpose specified and shown.
- C. Unless otherwise specified materials shall be new and free from any defects.

2.2 ACCESS DOORS

- A. General: This Contractor shall provide wall, floor, or ceiling access doors for unrestricted access to all concealed items of mechanical, plumbing, or electrical equipment or devices including items requiring general maintenance or access.
- B. Utilize Section 08 31 13 - Access Doors and Frames for products and requirements.
- C. Access doors shall be a minimum of 24 by 24 inches in size unless approved by UTSW FM in writing. Location shall provide appropriate access.

PART 3 - EXECUTION

3.1 EXISTING FACILITIES

- A. The Contractor shall be responsible for loss or damage to the existing facilities caused by them and their workers, and shall be responsible for repairing or replacing such loss or damage.
 1. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and in service maintenance of all electrical, plumbing, heating, air conditioning, and ventilating services for the new and existing facilities.
 2. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.
- B. The Contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.
- C. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.
- D. Lighting fixtures to remain
 1. All lighting fixtures and luminaries to remain, refer to Section 26 05 01 - Electrical Demolition for required Cleaning and Repair.
- E. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, all Contractors shall remove and reinstall in locations approved by the Architect/Engineer all devices required for the operation of the various systems installed in the existing construction.
 1. This includes but is not limited to temperature controls system devices, electrical switches, relays, fixtures, piping, conduit, etc.
- F. Outages of services as required by the new installation will be permitted but only at a time approved by the Owner.
 1. The Contractor shall allow the Owner two weeks in order to schedule required outages.
 2. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner.
 3. All costs of outages, including overtime charges, shall be included in the contract amount.

3.2 DEMOLITION AND RELOCATION

- A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the Drawings or required by the installation of new facilities.

1. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage.
 2. Salvage materials shall remain the property of the Owner, and shall be delivered to such destination or otherwise disposed of as directed by the Owner.
 3. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition.
 4. The Contractor may, at their discretion, and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.
- B. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated.
1. The Contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order.
 2. All relocations shall be performed by workers skilled in the work and in accordance with standard practice of the trades involved.
- C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner to such items and receive further instructions before removal.
1. Items damaged in repositioning operations are the Contractor's responsibility and shall be repaired or replaced by the Contractor as approved by the Owner, at no additional cost to the Owner.
- D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the Drawings, specified, or acceptable to the Owner.
1. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain.
 2. Such services shall be sealed, capped, or otherwise tied off or disconnected in a safe manner acceptable to the Owner.
 3. Disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas.
 4. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as specified.

3.3 INSTALLATION METHODS

- A. Where to Conceal: All pipes, conduits, etc , shall be concealed in pipe chases, walls, furred spaces, or above the ceilings of the building unless otherwise indicated.
- B. Where to Expose:
1. In mechanical rooms, in electrical rooms, janitor's closets, tight against pan soffits in exposed "Tee" structures, or storage spaces, but only where necessary, piping may be run exposed.
 2. All exposed piping shall be run in the most aesthetic, inconspicuous manner, and parallel or perpendicular to the building lines.
- C. Support: All piping, ducts, and conduits shall be adequately and properly supported from the building structure by means of hanger rods or clamps to walls as herein specified.
- D. Maintaining Clearance:
1. Where limited space is available above the ceilings below concrete beams or other deep projections, pipe and conduit shall be sleeved through the projection where it crosses, rather than hung below them in a manner to provide maximum above-floor clearance.
 2. Sleeves shall be as herein specified
 3. Piping, ductwork and other installed materials shall be located so as to not obstruct maintenance clearance for mechanical components such as controls, filters and the like.
 4. Piping shall not create trip-hazards through floor-mounting but be routed in a manner overhead or below the floor.
- E. Piping:
1. Piping shall be identified with both color and labels as indicated in Section 26 05 53 - Electrical Identification.
 2. All pipe, conduits, etc , shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing.
 3. All ducts, pipes and conduits run exposed in machinery and equipment rooms shall be installed parallel to the building lines, except that piping shall be sloped to obtain the proper pitch.

4. Piping, ducts and conduits run in furred ceilings, etc , shall be similarly installed, except as otherwise shown All pipe openings shall be kept closed until the systems are closed with final connections.
5. All piping not directly buried in the ground shall be considered as "interior piping."
6. Prior to the installation of any ceiling material, gypsum, plaster, or acoustical board, the Contractor shall notify the construction inspector so that arrangement can be made for an inspection of the above ceiling area about to be "sealed" off.
 - a. The Contractor shall give as much advance notice as possible but no less than 10 working days.
7. All above ceiling areas will be subject to a formal inspection before ceiling panels are installed, or installation is otherwise concealed from view.
 - a. All electrical work at and above the ceiling, including items supported by the ceiling grid, such as air inlets or outlets, shall be complete and installed in accordance with contract requirements, including power to fans and other powered items.
 - b. Adequate lighting shall be provided to permit thorough inspection of all above-ceiling items.
 - c. The inspection will include representatives of the following: General Contractor and each Subcontractor having work above the ceiling, Facilities Management, Architect/Engineer, and the Resident Construction Manager's Construction Inspector Areas to be included and time of inspection shall be coordinated with the Construction Inspector.
 - d. The purpose of this inspection is to verify the completeness and quality of the installation of the air conditioning systems, the electrical systems, the plumbing systems, and any other special above ceiling systems such as pneumatic tube, vacuum systems, fire sprinkler piping and cable tray systems.
 - e. The ceiling supports (tee bar or metal framing) shall be in place so that access panel and light fixture locations are identifiable and so that clearances and access provisions may be evaluated.
 - f. No ceiling materials may be installed until the resulting deficiency list from this inspection is worked off and the Construction Inspector has given approval.
8. Proper accessibility to equipment may be required to be demonstrated by the commissioning agent or inspector.

3.4 CONNECTIONS FOR OTHERS

- A. The Contractor shall rough in for and make all gas, water, steam, sewer, etc connections to all fixtures, equipment, machinery, etc , provided by others in accordance with detailed roughing-in Drawings provided by the equipment suppliers, by actual measurements of the equipment connections, or as detailed.
- B. After the equipment is set in place, the Contractor shall make all final connections and shall provide all required pipe, fittings, valves, traps, etc.
- C. Shutoff Valves: In each service line connected to an item of equipment or piece of machinery, provide a shutoff valve.
- D. Traps: On each drain not provided with a trap, provide a suitable trap.
- E. Provide all air gap fittings required, using materials hereinbefore specified. In each service line connected to an item of equipment or piece of machinery, provide a shutoff valve. On each drain not provided with a trap, provide a suitable trap.
- F. All pipe fittings, valves, traps, etc , exposed in finished areas and connected to chrome plated lines provided by others shall be chrome plated to match.
- G. Provide all sheet metal ductwork, transition pieces, etc , required for a complete installation of vent hoods, fume hoods, etc , provided by others.

3.5 CUTTING AND PATCHING

- A. Cut and patch walls, floors, etc., resulting from work in existing construction.
- B. Make openings through masonry and concrete by core drilling in locations acceptable to the Owner's Agent.
 1. Restore openings to "as new" condition to match existing surrounding materials.
 2. Penetrations through fire-rated elements shall conform to applicable UL classifications.
 3. Cut and patch existing site roadways, parking areas, paved and unpaved areas to accommodate new construction; openings shall be restored as soon as possible after work is

complete. Coordinate with the Owner for cutting of roadways and parking areas prior to beginning work.

3.6 OPERATION PRIOR TO COMPLETION

- A. When any piece of electrical equipment is operable and it is to the advantage of the Contractor to operate the equipment, they may do so, providing that they properly supervises the operation, and has the Construction Inspector's written permission to do so.
- B. The warranty period shall, however, not commence until such time as the equipment is operated for the beneficial use of the Owner, or date of substantial completion, whichever occurs first.
- 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 deficiency list items before final acceptance by the Owner.
 - 1. The date of acceptance and performance certification will be the same date.
- D. Additional requirements for operation of equipment prior to completion found in the commissioning sections of Division 1 and Division 22 shall be followed.

3.7 WORKMANSHIP

- A. Arrange electrical work in a neat, well-organized manner:
 - 1. Do not block future connection points of electrical service.
 - 2. Locate equipment to provide easy access.
 - 3. Arrange electrical work to provide adequate access for operation and maintenance.
 - 4. Install work parallel or perpendicular to building lines, unless noted otherwise.
 - 5. Locate conduit and piping as high as possible or per the hierarchy drawings.
 - 6. Support work with appropriate fasteners and/or support systems.
 - 7. Conceal conduit and piping in finished spaces.
- B. Apply, install, connect, erect, use, clean, adjust and condition materials and equipment as recommended by the manufacturers in their published literature.

3.8 SLEEVES

- A. Generally, where pipes and conduits pass through non-fire rated walls or floors, use 18 ga galvanized sheet steel sleeves for mechanical items and E M T conduit for electrical items.
 - 1. Size sleeves to permit the subsequent insertion of pipe and to fill the annular space between the pipe and its sleeve with fire rated packing. Sleeves through floor shall extend 2 inches above finished floor.

3.9 CLEANING AND PAINTING

- A. All equipment, piping, conduit, ductwork, grilles, insulation, etc., furnished and installed in exposed areas under Divisions 22, 23 and 26 of these Specifications and as specified shall be cleaned, prepared, and painted according to the following specification. Color of finish painting in Mechanical or Electrical Rooms shall be painted in accordance with Color Schedule for machinery spaces using Sherwin Williams paint numbers, or approved equivalent.
 - 1. In the event of a conflict between the specifications referenced, the provisions of this specification shall prevail only for Divisions 22, 23 and 26 work.
 - 2. UTSW Approved paint colors: Refer to Section 26 05 53 - Electrical Identification
 - 3. Paint Specification: Refer to Section 09 96 00 - High-Performance Coatings
 - 4. Natural gas piping shall be painted in its entirety.
- B. Equipment furnished by the mechanical and electrical subcontractors shall be delivered to the job with a suitable factory protective finish and shall be painted, after installation, with the color hereinafter specified.
- C. The following materials shall not be painted:
 - 1. Materials: copper, galvanized metal, stainless steel, fiberglass, PVC, and PVDF.
 - 2. Aluminum jacketing on insulation .
 - 3. Nameplates on equipment shall be protected during painting to prevent damage.
- D. Before painting, materials and equipment surfaces shall be thoroughly cleaned of cement, plaster, and other foreign materials, and all oil and grease spots shall be removed.
 - 1. Such surfaces shall be carefully wiped and all cracks and corners scraped out.
 - 2. Exposed metal work shall be carefully brushed down with the steel brushes to remove rust and other spots and left smooth and clean.
- E. Painting:

1. Interior piping shall be primed before insulation installation.
 2. For painting purposes, the equipment and piping inside of built-up air handling units shall be painted the same as if they were within the walls of a Mechanical Room.
- F. Scope of painting for Divisions 22, 23, and 26 work in areas other than those defined as "exposed" is as follows:
1. In addition to painting in mechanical rooms, electrical rooms, materials, piping, ductwork, conduit, gear, supports, foundations, equipment and appurtenances installed by the mechanical and electrical subcontractors in exposed areas shall be finish painted with two coats enamel paint of color selected by the Architect/Engineer, refer to Section 09 96 00 - High-Performance Coatings.
 2. Additional areas to be defined as "exposed" for purposes of painting, are defined on the Drawings.
 3. The surfaces to be finish painted shall first be prepared as follows:
 - a. Electrical switchgear, disconnect switches, contactors, etc., with suitable factory applied finishes shall not be repainted; except for aesthetic reasons where located in finished areas as directed by the Architect/Engineer and in a color selected by the Architect/Engineer.
 - 1) Where factory applied finishes are damaged in transit, storage or installation, or before final acceptance, they shall be restored to factory fresh condition by competent refinishers using the spray process.
 - b. Ferrous metal surfaces without a protective finish and not galvanized in exposed and concealed areas including chases, underfloor and above ceilings shall be painted with two (2) coats of P&L zinc chromate primer as the construction progresses to protect against deterioration.

3.10 CHECKING AND TESTING MATERIALS AND/OR EQUIPMENT

- A. Before the work is accepted, an authorized representative of the manufacturer of the installed materials and/or equipment shall personally inspect the installation and operation of his materials and/or equipment to determine that it is properly installed and in proper operating order.
 1. The qualifications of the representative shall be appropriate to the technical requirements of the installation.
 2. The qualifications of the representative shall be submitted to the owner for approval.
 3. The decision of the owner concerning the appropriateness of the representative shall be final.
 4. Testing and checking shall be accomplished during the course of the work where required by work being concealed, and at the completion of the work otherwise.
 - a. In addition, the Contractor shall submit to the Architect/Engineer a signed statement from each representative certifying as follows:
 - 1) "I certify that the materials and/or equipment listed below have been personally inspected by the undersigned authorized manufacturer's representative and is properly installed and operating in accordance with the manufacturer's recommendations".
- B. Check inspections shall include electrical equipment, plumbing equipment, heating, air conditioning, insulation, ventilating equipment, controls, mechanical equipment and such other items hereinafter specified or specifically designated by the Owner or the Architect/Engineer.
- C. Refer to the commissioning sections of Division 1 and Division 26 for additional start-up, testing, and acceptance requirements.

3.11 TESTS

- A. The Contractor shall make, at no additional cost to the Owner, any tests deemed necessary by the inspection departments having jurisdiction, and in the National Fire Protection Association, ASTM, etc. Standards listed.
 1. The Contractor shall provide all equipment, materials, and labor for making such tests.
 2. Reasonable amounts of fuel and electrical energy costs for system tests will be paid by the Owner.
 3. Fuel and electrical energy costs for system adjustment and tests which follow beneficial occupancy by the Owner will be borne by the Owner.
- B. Additional tests specified under the various Specification Sections shall be made.
- C. The Construction Inspector shall be notified in writing at least 10 working days prior to each test and other Specification requirements requiring action on the part of the Construction Inspector.
- D. All equipment shall be placed in operation and tested for proper automatic control requirements before the balancing agency starts their work.
- E. Maintain Log of Tests as specified.

- F. See Specifications hereinafter for additional tests and requirements.
- G. All testing reports shall be submitted to UTSW Facilities Management for review and approval.

3.12 LOG OF TESTS

- A. All tests shall have pertinent data logged by the Contractor at the time of testing.
 - 1. Data shall include date, time, personnel, description, and extent of system tested, test conditions, test results, specified results, and other pertinent data
 - 2. Data shall be delivered to the Architect/Engineer and UTSW Facilities Management as specified under "Requirements for Final Acceptance" in Section 01 77 00 - Closeout Procedures and Submittals
 - 3. All Test Log entries shall be legibly signed by the Project Contractor or his authorized job superintendent.

3.13 COOPERATION AND CLEANUP

- A. It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the job site in a clean and safe condition.
- B. At the end of each day's work, each trade shall properly store all tools, equipment and materials and shall clean all debris from the job. Upon the completion of the job, each trade shall immediately remove all tools, equipment, any surplus materials, and all debris caused by that portion of the work.

3.14 CLOSEOUT ACTIVITIES

- A. As part of project punch list requirements per Section 01 77 00 - Closeout Procedures and Submittals include UTSW Electrical Shop, UTSW Utilities, UTSW Utilities Controls / Operations, UTSW Building Maintenance, UTSW PM, OSBC, and other associated teams.
- B. Provide revised Operation and Maintenance Data including final installed components schedule, maintenance manuals, and warranty documentation to UTSW PM and to UTSW Building Maintenance.

3.15 TRAINING

- A. Refer to Section 01 79 00 - Demonstration and Training as well as individual technical Sections for specific training requirements.
- B. Where training is called for in other sections provide a minimum of 8 hours on site training for Owner's representatives.
- C. Training shall be presented by a qualified instructor with training experience and technical knowledge of the product.
- D. Submit a training agenda, proposed date, and instructor qualifications to the Owner for approval.

END OF SECTION 26 00 00



DIVISION 26

ELECTRICAL



SECTION 26 00 10

UTSW ELECTRICAL DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 PURPOSE

- A. Design requirements for electrical projects on UTSW campus.
- B. Design criterion not specifically covered by the National Electric Code (NEC), or set requirements that may meet the minimum requirements of the NEC.
- C. Applicability:
 - 1. This document applies to all electrical projects designed and constructed by UTSW Facility Management personnel, outside Architect/Engineering (A/E) firms, and all construction contractors.
 - 2. No substitutions to the standard are acceptable without the written authorization of the UTSW Engineer.
- D. Terms and Definitions
 - 1. UTSW – University of Texas Southwestern Medical Center.
 - 2. Wet Lab – Any laboratory equipped with sinks, fume hoods, biological safety cabinets, or other equipment, which requires multiple utilities (such as gas, air or vacuum), and a greater degree of HVAC than a dry lab.
 - 3. Dry Lab – Laboratories that are not equipped with multiple utilities but require a greater degree of electrical power and HVAC than an office area.
 - 4. CDAS – Central Data Acquisition System. CDAS is the campus-wide central monitoring station located in the Facility Management Office.
 - 5. ENGINEER – UTSW Engineer
 - 6. INSPECTOR – UTSW Inspector

1.3 ELECTRICAL CIRCUIT DESIGN FOR LABORATORIES

- A. Laboratory Wall Receptacles (Wet or Dry Lab) – Any wall mounted duplex receptacles (Bryant 5362 receptacles only) serving a piece of equipment such as a centrifuge, freezer, shaker, refrigerators, autoclaves, sterilizers, etc shall be provided a dedicated circuit.
- B. Chemical fume hoods shall be hard-wired to a dedicated 20A circuit.
- C. Biological safety cabinets shall be provided with a dedicated 20-amp receptacle unless noted otherwise.
- D. Receptacles rated for less than 20 amps are prohibited.
- E. Laboratory Plugmold Receptacles (Wet Lab) – Non-specific laboratory plugmold duplex receptacles (not prewired) shall be field wired in a staggered fashion with a maximum of four (4) duplex receptacles per circuit.
- F. Plugmolds shall be mounted tight to backsplash unless otherwise specified.
 - 1. For example, if three circuits are assigned to a counter top, plug mold installed on the counter top shall be wired receptacle#1 – circuit#1, receptacle #2 – circuit #2, receptacle #3 – circuit#3, receptacle #4 – circuit #1, receptacle #5 – circuit #2, etc
- G. Plugmold varies between each campus, and shall match the existing style.
- H. Each Laboratory peninsula equipped with a sink shall have a GFIC duplex receptacle with a dedicated circuit mounted 72 inches above finished floor.
 - 1. The receptacle is for future installation of filtration units.
 - 2. The receptacle shall be mounted centerline in the vertical electrical chase directly above the sink.
- I. Laboratory Four-plex Receptacles (Dry Lab or PC Lab):
 - 1. All laboratory four-plex receptacles shall be wired with a maximum of two (2) four-plex receptacles per circuit.
 - 2. Receptacles shall be mounted 18 inches Above Finished Floor (AFF) unless otherwise specified.
- J. UPS or surge suppressors are generally provided at point-of-use by the end user.

1.4 ELECTRICAL CONDUIT HOME RUNS

- A. All wiring on UTSW campus shall be rated for 90 degrees C service.
- B. Electrical conduit home run diameter shall not be less than 3/4 inch diameter for any circuit.
- C. Metal Clad (MC) cable is prohibited for use on UTSW campus, except in special cases.
 - 1. Written approval of the Engineer and Inspector is required before MC can be installed.
 - 2. Unlike rigid metallic conduit, a new set of wires cannot be pulled through MC cable making it unsuitable for renovation purposes.

1.5 ELECTRICAL BRANCH PANELS

- A. Electrical branch panels rated less than 225 amps and less than 42 circuits shall not be used, unless special circumstances require a lower rated panel.

1.6 APPROVAL IS REQUIRED FROM THE ENGINEER

- A. Branch panels shall be equipped with main circuit breaker, and designed for 4-wire, three-phase use. A door-in-door hinged factory cover is required. See Specification 26 24 17 - Branch Circuit Panelboards
- B. It is common practice to convert lab to offices. Therefore, branch panels shall not be located inside laboratories.
- C. MLO panels shall not to be used.
- D. EPO switches are not desired by UTSW in laboratories not dedicated to electronic component use. The switches shall not be installed unless required by code, and then only with written permission of the Engineer.

1.7 ELECTRICAL MOTORS

- A. The supplier of any component driven by an electrical motor shall provide the motor and motor starter correctly sized for the component.
- B. Components:
 - 1. Components and motors shall be sized for 120 percent of design.
 - 2. With the introduction of the premium efficiency motors, a new problem has arisen which is generally unknown by many end users.
 - 3. Designs of premium efficiency motors vary by manufacturers.
 - 4. In short, designing a motor with improved efficiency has resulted in a lower X/R ratio, causing higher inrush currents.
 - 5. These higher currents can cause circuit breaker trip when using a full voltage starter.
- C. Motors greater than 5 HP shall be premium efficiency TEFC and IEEE 841 (severe duty) rated.
- D. Motors greater than 75 HP shall additionally use a Cutler-Hammer (IT) soft starter if a VFD is not specified.

1.8 ELECTRICAL DISCONNECTS

- A. Disconnects shall be located in plain view of the electrical load (within six feet).
 - 1. Where the electrical load is less than 1/8 Horsepower or 300 volt amperes, a toggle switch rated for the load may be used as the disconnect if it is fully visible from the load (within six feet) or is capable of being locked.
- B. Electrical disconnects for above the ceiling equipment shall be located within 6 feet of the equipment.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION 26 00 10

SECTION 26 05 00

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1- GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Enclosures and cabinets.
- B. Contactors.
- C. Control relays.
- D. Terminal blocks and accessories.
- E. Penetration sealing systems (fire stops).
- F. Electrical/control portion of HVAC work covered by Division 23 pertaining to basic electrical materials and methods shall follow the requirements set forth by this specification.

1.3 RELATED REQUIREMENTS

- A. Section 01 79 00 - Demonstration and Training
- B. Section 01 91 00 - General Commissioning Requirements.
- C. Section 07 84 00 - Firestopping.
- D. Section 07 84 43 - Joint Firestopping.
- E. Section 09 96 00 - High-Performance Coatings.
- F. Section 23 00 00 - UTSW Mechanical Design Requirements.
- G. Section 26 00 00 - Basic Electrical Requirements.
- H. Section 26 05 53 - Electrical Identification.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NFPA 70, National Electrical Code (latest edition).
- C. American National Standard, National Electrical Safety Code, (latest edition).
- D. Applicable publications of NEMA, ANSI, IEEE, and ICEA.
- E. Underwriters Laboratories, Inc Standards (UL).
- F. Federal, city, state, and local codes and regulations having jurisdiction.
- G. OSHA requirements.
- H. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.
- I. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
- J. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- K. NEMA WD 1 – General-Color Requirements for Wiring Devices.
- L. UL 98 - Enclosed and Dead-Front Switches.

1.5 INTENT

- A. This Section is not, and shall not be interpreted to be, a complete listing of all materials or equipment that is Contractor furnished and erected.
 - 1. It is intended to clarify and further define the Contractor scope of work, procurement, and responsibilities for those incidental materials that are not specified by other specifications, but important to a complete and operational system.
- B. The Contractor shall furnish all equipment and materials, whether or not specified in other Sections of specification and on drawings, for installation and connection required to place equipment into satisfactory operating service.

1. The Contractor shall review the Drawings and Specifications for clarification of their responsibility in the handling and installation of equipment and material.
 2. Where applicable, and not in contradiction with the Drawings and Specifications, the Contractor shall install and connect the equipment in accordance with the manufacturer's recommendations and instructions.
- C. Materials and equipment shall be of types and manufacturer specified wherever practical.
1. Should materials or equipment so specified be unattainable, the Contractor shall submit the description and manufacturer's literature, reason for substitution request and shall secure the approval of the Engineer before substitution of other material or equipment is purchased.
 2. This Section establishes performance requirements and the quality of equipment acceptable for use and shall in no way be construed to limit procurement from other manufacturer.

1.6 SUBMITTALS

- A. Provide submittals in addition and in accordance with Section 26 00 00 - Basic Electrical Requirements, and Division 01 for submittal requirement.
- B. Submit manufacturer's literature and specification data sheets for each type of basic material, which is applicable to the project.
- C. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Provide factory-wrapped waterproof flexible barrier material for covering materials, where applicable, to protect against physical damage in transit.
 1. Damaged materials shall be removed from project site.
- B. In their factory-furnished coverings, store materials in a clean, dry indoor space, which provides protection against the weather.

PART 2- PRODUCTS

2.1 ENCLOSURES AND CABINETS

- A. Enclosures and cabinets for all Contractor furnished electrical equipment and devices shall be suitable for the location and environmental conditions and shall be of the NEMA type as shown in Table 25 05 00-1. Exceptions shall be specifically designated on Drawings:

Table 26 05 00 - 1 Enclosures		
Location	Environment	Enclosure Type
Indoor Utility	Dry, subject to dust, falling dirt, and dripping non-corrosive liquids	NEMA 12
Indoor	Clean, Dry	NEMA 1
Outdoor	Subject to windblown dust and rain, splashing water, and hose-directed water	NEMA 4
Indoor	Wet, subject to hose-directed water	NEMA 4
Outdoor	Subject to falling rain, sleet, and external ice formation	NEMA 3R
Indoor or Outdoor	Subject to corrosion, windblown dust and rain, splashing water and hose-directed water	NEMA 4X

- B. Enclosures shall have the following properties:
 1. Hinged Cover Enclosures: NEMA 250
 - a. Type 1: Steel.
 - b. Type 3R: Steel.
 - c. Type 4: Steel with gasket door, rain tight.
 - d. Type 4X: Stainless steel, (polycarbonate or fiberglass reinforced polyester (FRP) in corrosive areas).
 - e. Type 12: Steel with gasketed door, dust-tight.
- C. Finish: Exterior, manufacturer's standard gray enamel finish; interior, white enamel finish.

- D. Covers: Continuous hinge, held closed by flush latch operable by hasp and staple for padlock.
 - 1. Where required for NEMA ratings, gaskets shall be neoprene rubber.
- E. Interior Panel for Mounting Terminal Blocks or Electrical Components: 14 gauge steel, white enamel finish.
- F. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.
- G. Forced Ventilation:
 - 1. Where indicated, provide 115V single-phase fan motor, filtered with air plenum, finger guard, and stainless steel grille.
 - 2. Washable aluminum filter, accessible for cleaning from outside the enclosure; 20,000-hour continuous operation without lubrication or service.
 - 3. Provide matching exhaust grille assembly.
 - 4. Mount fan in lower side corner, exhaust grille in opposite upper side corner.

2.2 CONTACTORS

- A. Acceptable Manufacturers:
 - 1. ABB/GE.
 - 2. Schneider Electric; Square D Products.
 - 3. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in Section 26 00 00 - Basic Electrical Requirements and Division 01 for substitution requirement.
- B. Contactors:
 - 1. NEMA ICS 2; electrically held or mechanically held as indicated on Drawings.
 - 2. Two-wire control for electrically held contactors and three-wire control for mechanically held contactors.
- C. Enclosure: NEMA 1 unless indicated otherwise on Drawings.
- D. Control Transformer:
 - 1. Provide when indicated on Drawings.
 - 2. Minimum capacity shall be 100 VA.
 - 3. Provide primary and secondary fuse protection.
- E. Coil operating voltage; 110 volts, 60 Hz or as per drawings.
- F. Size: NEMA ICS 2; size as indicated on Drawings.
- G. Contacts: As indicated on Drawings; 600 Volts, 60 Hz.
- H. Provide solderless pressure wire terminals on bus terminals suitable for mounting in panelboard as indicated on Drawings.

2.3 CONTROL RELAYS

- A. Acceptable Manufacturers
 - 1. ABB/GE, CR120A.
 - 2. Eaton Corporation, Type M-300.
 - 3. Schneider Electric; Square D Products.
 - 4. Allen-Bradley/Rockwell Automation.
 - 5. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in Section 26 00 00 - Basic Electrical Requirements and Division 01 for substitution requirement.
- B. Provide magnetic control relays, NEMA Class A: A300 (300 volts, 10 amps continuous, 7,200 VA make, 720 VA break), industrial control type with field-convertible contacts, and meeting the requirements of NEMA ICS 2 .
- C. Where time delay relays are specified or required, unless otherwise noted, provide magnetic control relays with a solid-state timer attachment adjustable from 2 to 60 seconds (minimum) or with range as indicated.
 - 1. Provide with field convertible from ON delay to OFF delay and vice versa.
- D. Where latching (mechanically held) relays or motor thermal detector relays are specified, provide magnetic control relays with mechanical latch attachment with unlatching coil and coil clearing contacts.

2.4 TERMINAL BLOCKS AND ACCESSORIES

- A. Acceptable Manufacturers
 - 1. Phoenix Contact.
 - 2. Buchanan.
 - 3. Weidmüller.
 - 4. Entrelec.
 - 5. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 23 00 00 - UTSW Mechanical Design Requirements and Division 01 for substitution requirement.
 - B. Signal and Control Terminals:
 - 1. Modular construction type, DIN 46 277/3 channel mounted; screw clamp compression connectors, rated 300 volts.
 - 2. Minimum terminal width of 0.24 inch, capable of holding two No 12 or two No 14 AWG conductors in each connector.
 - 3. Terminal identification numbers shall be thermoset characters (black) on a white background.
 - 4. Provide 25 percent spare terminals.
 - C. Power Terminals:
 - 1. Acceptable Manufacturers
 - a. Buchanan.
 - b. IISCO, Corp..
 - c. Schneider Electric; Square D Products.
 - d. Burndy, a Hubbell Company.
 - e. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 26 00 00 - Basic Electrical Requirements and Division 01 for substitution requirement.
 - 2. Unit construction type, closed back type, with tubular pressure screw connectors, rated 600 volts, size as required Provide 25 percent spare terminals.
- 2.5 PENETRATION SEALING SYSTEMS (FIRE STOPS)
- A. Provide penetration sealing where conduit, cable tray, etc pass through rated walls, ceilings, and floors See Section 07 84 00 - Firestopping, and Section 07 84 43 - Joint Firestopping, for sealing requirements and systems.
- 2.6 UL LISTING
- A. All equipment and materials shall be new and conform to the requirements of this Section.
 - B. All equipment and materials shall be UL listed, and shall bear their label whenever standards have been established and level service is regularly furnished.
 - C. All equipment and materials shall be of the best grade of their respective kind for the purpose.

PART 3- EXECUTION

3.1 FABRICATION - CONTROL ENCLOSURES AND CABINETS

- A. Shop assemble enclosures and cabinets housing terminal blocks or electrical components in accordance with NEMA ICS 6

3.2 INSTALLATION - ENCLOSURES AND CABINETS

- A. Install cabinets and enclosures plumb; anchor securely to wall and structural supports at each corner, minimum.
 - 1. Direct attachment to dry wall is not permitted.
- B. Provide accessory feet for freestanding equipment enclosures.
- C. Install trim plumb to enclose all gaps.

3.3 ERECTION OF EQUIPMENT

- A. Manufacturer`s Installation Instructions:
 - 1. Where furnished or called for by the manufacturer equipment manufacturer`s installation instructions shall be considered a part of this specification and fully complied with.
 - 2. Where the Contractor damages the finishing coat of paint in existing or completed areas, he shall refinish with matching paint.

- B. Mounting Heights: Individual safety switches and buttons and devices shall normally be installed at the following mounting heights, when not specified on the Drawings.
1. Safety Switches: 6 feet 7 inches (above floor, to center), per NEC 240.
 2. Pushbuttons: 4 feet 0 inches (to center).
 3. Control Panels: 6 feet 0 inches (to top).

C. Mounting:

1. Equipment and control devices shall be supported independent of conduit connections.
2. Panels or cabinets shall be mounted on metal frame supports independently of equipment.
3. Control devices and metal enclosures shall be bolted or welded to steel channel or steel plate.
4. All electrical equipment and devices not covered by the above, such as miscellaneous switches, thermostats, duct switches, temperature switches, floats, photoelectrical devices, and similar electrical devices shall be located and set as suitable for the application.
5. Where control panels are provided as part of the equipment racks mounted on the floor, they shall be provided to support conduits and flexible connections to control panels.

3.4 COORDINATION

- A. Exact location of all electrical equipment, devices and fixtures shall be determined in field by contractor and verified by Engineer`s field representative prior to installation.

END OF SECTION 26 05 00

SECTION 26 05 01

ELECTRICAL DEMOLITION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Electrical demolition for remodeling.

1.3 RELATED REQUIREMENTS

- A. This Section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total requirements for minor electrical demolition for remodeling.
 - 1. Section 26 00 00 - Basic Electrical Requirements.
- B. In the event of conflict regarding minor electrical demolition requirements between this Section and any other section, the provisions of this Section shall govern.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 SUBMITTALS

- A. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.
- B. Provide submittals for materials and equipment necessary for work as indicated in Section 26 00 00 - Basic Electrical Requirements and under provisions of Division 01.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work as specified in individual sections.
- B. Provide all materials necessary for work.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify field measurements and circuiting arrangements.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition drawings are based on casual field observation Report discrepancies to Engineer before disturbing existing installation
- D. Beginning of demolition means Contractor accepts existing conditions.
- E. All abandoned wiring must be removed.

3.2 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
 - 1. Provide temporary wiring and connections to maintain existing systems in service during construction.
- B. Existing Electrical Service:
 - 1. Maintain existing system in service until new system is complete and ready for service.
 - 2. Disable system only to make switchovers and connections.
 - 3. Obtain written permission from Owner at least (2) weeks before partially or completely disabling system.
 - 4. Minimize outage duration.
 - 5. Make temporary connections to maintain service in areas adjacent to work area.
- C. Existing Fire Alarm System:
 - 1. Disable system only to make switchovers and connections.

2. Obtain written permission from Owner at least (2) weeks before partially or completely disabling system.
 3. Minimize outage duration.
 4. Make temporary connections to maintain service in areas adjacent to work area.
- D. Existing Telephone System:
1. Maintain existing system in service until new system is complete and ready for service.
 2. Disable system only to make switchovers and connections.
 3. Obtain written permission from Owner at least (2) weeks before partially or completely disabling system.
 4. Minimize outage duration.
 5. Make temporary connections to maintain service in areas adjacent to work area.
- 3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK
- A. Remove existing installations to accommodate new construction.
 - B. Remove abandoned conductors to source of supply.
 - C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes.
 1. Cut embedded or concealed conduit flush with walls and floors, and patch surfaces.
 - D. Disconnect abandoned outlets and remove devices.
 1. Remove abandoned outlets if conduit servicing them is abandoned and removed.
 2. Provide blank cover for abandoned outlets that are not removed.
 - E. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
 - F. Disconnect and remove abandoned luminaires Remove brackets, stems, hangers, and other accessories.
 - G. Repair adjacent construction and finishes damaged during demolition and extension work.
 - H. Maintain access to existing electrical installations that remain active Modify installation or provide access panel as appropriate.
 - I. Existing installations shall not be extended for this project except as noted.
- 3.4 CLEANING AND REPAIR
- A. Clean and repair existing materials and equipment that remain or are to be reused.
 - B. Panelboards:
 1. Clean exposed surfaces and check tightness of electrical connections.
 2. Replace damaged circuit breakers and provide closure plates for vacant positions.
 3. Provide typed circuit directory showing revised circuiting arrangement.
 - C. Luminaries Indicated to be Reused:
 1. Remove existing luminaries for cleaning.
 2. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry.
 3. Replace lamps, ballasts, and broken electrical parts.
- 3.5 DISPOSITION OF MATERIAL AND EQUIPMENT
- A. Review with the Owner materials that have been removed and are no longer required, to determine any which the Owner may desire to keep.
 1. Deliver those materials that the Owner desires to the Owner's specified location.
 - B. For materials not required by the Owner, dispose of them in accordance with applicable regulations.

END OF SECTION 26 05 01

SECTION 26 05 19

BUILDING WIRE CABLE AND CONNECTORS (600V AND BELOW)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Requirements for the following:
 - 1. Building wire.
 - 2. Remote control and signal cable.
 - 3. Wiring connectors.

1.3 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ANSI - American National Standards Institute.
- C. NFPA 70 - National Electrical Code.
- D. UL - Underwriters Laboratories, Inc.

1.4 SUBMITTALS

- A. Submit under provisions of Division 01.
- B. Product Data: Provide for each cable assembly type.
- C. Test Reports: Indicate procedures and values obtained.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.
- E. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed by UL as suitable for purpose specified and shown.

1.7 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Conductor sizes are based on copper.
- C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.
- D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.8 COORDINATION

- A. Coordinate Work under provisions of Division 01.
- B. Determine required separation between cable and other work.
- C. Determine cable routing to avoid interference with other work.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Building wire:
 - 1. AFC Cable Co.
 - 2. American Insulated Wire Corp., Southwire Co.

3. Belden Wire & Cable Co.
4. Houston Wire & Cable Co.
5. Substitutions: Under provisions of Division 01.

2.2 BUILDING WIRE

- A. Description: Single conductor, soft drawn stranded copper insulated wire.
- B. Conductor: Copper (Aluminum wire is not acceptable).
- C. Insulation Voltage Rating: 600 Volts.
- D. Insulation: NFPA 70; Type THWN, THHN, or XHHW insulation for feeders and branch circuits larger than 8 AWG; Type THWN, or THHN insulation for feeders and branch circuits 10 AWG and smaller.
- E. No conductor smaller than No 12 wire shall be used for lighting or power purposes.
 1. In the case of "home runs" over 50 feet in length (100 feet for 277 volt) no conductor smaller than a No 10 wire shall be used.
 2. The sizing of all wire except remote control wire shall be accomplished in the case of both feeder and branch circuits by conforming to the following provisions.
 - a. 480/277 Volt Branch Circuits: The voltage drop in the case of /277 volt circuits shall not exceed 1.0 percent at maximum load and 70.0 percent power factor.
 - b. 208/120 Volt Branch Circuits: The voltage drop in the case of /120 volt circuits shall not exceed 2.0 percent at maximum load and 70.0 percent power factor.
- F. Remote control wires shall be no smaller than No 14 conductors. Control wires shall be run in separate conduits. The National Electrical Code may require the use of larger conductors.

2.3 REMOTE CONTROL AND SIGNAL CABLE

- A. Control Cable for Class 1 Remote Control and Signal Circuits: 98 percent conductivity copper conductor, 600 Volt insulation, rated 60 degrees C, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.
- B. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: 98 percent conductivity copper conductor, 300 Volt insulation, rated 60 degrees C, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.
- C. Plenum Cable for Class 3 Remote Control and Signal Circuits: 98 percent conductivity copper conductor, 300 Volt insulation, rated 60 degrees C, individual conductors twisted together, shielded, and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

2.4 WIRING CONNECTORS

- A. Solderless Pressure Connectors:
 1. 3M Scotchlok Spring Connectors.
 2. Buchanan model B-1 through B-4.
 3. Ideal Industries, Inc. model 71-B through 76-B.
 4. Substitutions: Under provisions of Division 01.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that mechanical work likely to damage wire and cable has been completed.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 WIRING METHODS

- A. Use wiring methods indicated on Drawings.

3.4 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install all line voltage cable in conduit.
- C. Use only stranded conductors for feeders and branch circuits.
- D. Use stranded conductors for control circuits and all circuits.
- E. Use conductor not smaller than 12 AWG for power and lighting circuits.

- F. Use conductor not smaller than 14 AWG for control circuits.
- G. Use 10 AWG conductors for 20 ampere, 120 Volt branch circuits longer than 50 feet.
 - 1. The voltage drop of any 120/208 Volt branch circuit shall not exceed 2 percent at maximum load and 70 percent power factor.
- H. Use 10 AWG conductors for 20 ampere, 277 Volt branch circuits longer than 100 feet
 - 1. The voltage drop of any 277/480 Volt branch circuit shall not exceed 1 percent at maximum load and 70 percent power factor.
- I. Pull all conductors into raceway at same time.
- J. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
 - 1. Do not use compound containing petroleum or other products that may deteriorate insulation.
- K. Install exposed wire and cable parallel and perpendicular to surface or exposed structural members and follow the surface contours, where possible.
 - 1. Protect exposed cable from damage.
- L. Support cables in conduit above accessible ceiling using spring metal clips or metal cable ties.
- M. Do not rest cable/conduit on ceiling panels.
- N. Use suitable cable fittings and connectors.
- O. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- P. Clean conductor surfaces before installing lugs and connectors.
- Q. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- R. Use NSI Polaris connectors for copper conductor splices and taps 6 AWG and larger.
 - 1. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
- S. Use solderless pressure connectors with insulating covers for copper conductor splices and taps 8 AWG and smaller.

3.5 INTERFACE WITH OTHER PRODUCTS

- A. Identify wire and cable under provisions of all applicable Division 26 sections.
- B. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.6 FIELD QUALITY CONTROL

- A. Perform field inspection and testing under provisions of Division 01.
- B. Inspect wire and cable for physical damage and proper connection.
- C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.
- D. Verify continuity of each branch circuit conductor Verify proper phasing connections.
- E. Conductors in vertical conduits or raceways shall be supported in a manner set forth in the appropriate section of the latest revision of the National Electrical Code.
- F. Conductors may be run in parallel on sizes 1/0 to 500 KCMIL inclusive provided all paralleled conductors are the same size, length, and type of insulation.
 - 1. Except as otherwise shown on Drawings, no more than three conductors may be run in parallel, and they shall be so arranged and terminated to ensure equal division of the total current between all conductors involved.
 - a. Where parallel connection is contemplated, approval of the Owner's representative must be obtained before installation is made.
- G. Test feeder conductors clear of faults, high resistance connections, and megger test same at 600 Volts DC Test results below 30 megohms shall be cause for rejection of the wiring installation.
 - 1. Replace and retest all such rejected conductors.
- H. At the completion of this project, the Contractor shall provide for the Owner three (3) complete and finally corrected sets of working drawings.
 - 1. These sets of working drawings shall be new, unused, and in good condition, and shall include the nature, destination, path, size, and type of wire and all other characteristics for complete identification of each and every conduit and circuit.

3.7 COLOR CODE

- A. Color code all conductors in accordance with NEC

- B. Refer to the following table for color-coding of lighting and power wiring:

	120/208V	277/480V
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green
Isolated Ground	Green/Yellow	Green/Yellow

- C. Color coding of ends only will be acceptable for feeder phase conductors Use 1 inch wide band of colored tape.
- D. Color coding of ends only will be acceptable for neutral and grounding conductors No 4 and larger.

END OF SECTION 26 05 19

SECTION 26 05 24
TEMPERATURE CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. The furnishing of the temperature controls is, in general, not within the scope of Division 26. However, wiring and connecting of all equipment operator controls and indication equipment provided and set in place by others that is not performed under other Division of Work shall be a part of this Division of Work.

1.3 RELATED REQUIREMENTS

- A. Basic Electrical Requirements are hereby made a part of this section of the work
 - 1. Refer to Section 26 00 00 - Basic Electrical Requirements
 - 2. Refer to Division 23 00 00 - UTSW Mechanical Design Requirements
 - 3. Refer to Sections 26 05 33 - Conduits and Boxes for materials to be furnished and installed

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 SUBMITTALS

- A. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Raceways as specified elsewhere.
- B. Wire and cable as specified elsewhere.
- C. Pull Boxes, Junction Boxes, Cabinets, and Outlet Boxes as specified elsewhere.
- D. Hangers and Supports as specified elsewhere.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Furnish and install all conduit, wire, boxes and common wiring materials necessary for the work unless specifically excluded elsewhere in the Specifications or on the Drawings.
- B. The Owner or other Contractors or other Divisions of Work will furnish the exact locations of equipment, and instructions and wiring diagrams necessary to select the materials required install equipment properly.

END OF SECTION 26 05 24

SECTION 26 05 26

GROUNDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Requirements for the following:
 - 1. Power system grounding.
 - 2. Electrical equipment and raceway grounding and bonding.

1.3 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

- A. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.5 SYSTEM DESCRIPTION

- A. Ground the electrical service system neutral at service entrance equipment to supplementary grounding electrodes.
- B. Ground each separately-derived system neutral to nearest effectively grounded building structural steel member or separate grounding electrode.
- C. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Grounding system components shall be as required to comply with the design and construction of the system indicated
 - 1. Components shall be as indicated in manufacturer's submittal data.
- B. Ground conductors shall be stranded tinned, annealed copper cable in RMC or IMC conduit for #6 AWG or larger:
 - 1. Bond both ends of metallic conduit.
- C. Ground Rods shall be copper-encased steel, 3/4 inch diameter, minimum length 10 feet.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Redundant Ground: Grounding of receptacles and fixed electrical equipment in patient care spaces shall comply with 517.13(A) and (B).
- B. Install grounding conductors continuous, without splice or connection, between equipment and grounding electrodes.
 - 1. Where splices cannot be avoided, splices using exothermic welding may be used with permission of the Engineer.
- C. In all feeder and branch circuits, provide a separate, insulated equipment grounding conductor.
 - 1. Terminate each end on a grounding lug, bus, or bushing.
- D. Ground each outlet by the use of an approved grounding pig tail attached to the junction box.
- E. No strap grounding clamps shall be used; connections requiring bolting shall be made up with Monel metal bolts, washers and nuts.
 - 1. Connections shall be made only after surfaces have been cleaned, or ground to expose virgin metal.

- F. Conductor connections shall be made by means of solderless connectors such as serrated bolted clamps or split bolt and nut type connectors
 - G. Terminate equipment ground conductor at disconnects and other electrical equipment using a factory equipment ground bar.
 - 1. Field installed lugs are not acceptable.
 - H. Provide a UL listed ground bar in all enclosures containing overcurrent protective devices:
 - 1. Ground bars shall be provided by the manufacturer of the equipment and may be field installed.
 - 2. Individual equipment ground bar shall accept at least two conductors.
 - 3. Individual conductor lugs are not acceptable.
- 3.2 FIELD QUALITY CONTROL
- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

END OF SECTION 26 05 26

SECTION 26 05 29

SUPPORTING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.3 RELATED REQUIREMENTS

- A. Section 05 50 00 - Metal Fabrications.
- B. Basic Electrical Requirements are hereby made a part of this section of the work.
- C. Refer to Section 26 00 00 - Basic Electrical Requirements.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings and Iron and Steel Products.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- D. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
- E. MFMA-4 - Metal Framing Standards Publication.
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
 - 2. Coordinate work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
 - 4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Architect of conflicts with or deviations from Contract Documents.
 - 6. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00 - Cast-in-Place Concrete.

1.6 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for products.
- B. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
- C. Installer's Qualification Statement: Include evidence of compliance with specified requirements.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of products.
- E. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements

1.7 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.
- C. Maintain a copy of each referenced document that prescribes execution requirements at project site.
- D. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.
- E. Installer Qualifications for Field-Welding: As specified in Section 05 50 00 - Metal Fabrications.
- F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Supports for single runs of conduit shall be one-hole pipe straps, beam clamps, steel rod hangers, or trapeze hangers.
- B. Pipe straps for rigid conduit shall be malleable iron and plated.
- C. Pipe straps for EMT may be plated stamped steel.
- D. Rod hangers shall be rust inhibited and selected for weight supported but shall not be smaller than No. 8.
- E. Rod hangers for conduits shall be with bolted fastening equal to Minerallac conduit hangers.
- F. "Caddy Clips" are not allowed.
- G. Supports for multiple runs of conduit and other raceways shall be continuous channel inserts or trapeze hangers of steel framing channel and attached with single bolt channel pipe straps.
- H. Supports of vertical runs of conduit of more than 12 feet shall be galvanized U-bolts or Kindorf C-210 riser pipe clamps on channel iron bearing plates.
- I. Supports for panelboards, cabinets, terminal boards, junction and pull boxes shall be angle iron or framing channel equal to B-Line B22 galvanized.
- J. Attachments to concrete for supports shall be equal to B-Line B22-I galvanized continuous inserts, B-Line B2500 spot inserts, Phillips carbon steel Type WS wedge anchors, or Phillips concrete fasteners selected for support required.
- K. Attachment to structural steel for supports shall be equal to Grinnell 131 I-beam clamps, 226 channel clamps and 93 C-clamps selected for support required.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Securely fasten and support conduits, raceways of all types and all electrical boxes, devices, and equipment from the main building structure except as specifically indicated otherwise.
 - 1. Cable, strap, or wire hangers or fasteners shall not be used.
- D. Maintain horizontal and vertical alignment of raceways and to not adversely effect the building structure in strength or appearance.

3.3 CONDUIT SUPPORTS

- A. Support conduits within 3 feet of each end of each bend, of each termination and at intervals along the run that will maintain true raceway alignment without sag or deformation during pull-in of conductors and after conductors are in place.
 - 1. Support vertical run conduits at not more than 10 feet on center in addition to the above.

2. Place conduits running exposed on and adjacent to walls after wall surface is installed and on spacers to allow wall to be painted after conduit is installed.
 - B. Support runs of flexible conduits that are more than 30 inches long at 36 inch on center and such that flexible conduit does not rest on any equipment, pipes, ductwork, walls, floors, or ceilings.
 - C. Support cabinets and boxes to the floor and to the structure above independent of all raceways entering the boxes.
 1. Structural walls or columns may be used to support cabinets or boxes only after specific permission is given by the Architect.
 - D. Mount devices such as cabinets, boxes, panelboards, disconnects, and motor controls indicated other than at walls on channel iron racks fastened to the floor and the structure above.
 1. Plywood backboards of 3/4 inch thickness and BC grade painted to match the equipment finish may be used as a part of the rack.
 2. Plywood shall be fire retardant/rated.
 - E. Support outlet boxes and junction boxes 100 cubic inches and smaller independently from but equal to supports specified for raceways.
 1. Locate outlet and junction boxes above accessible ceilings so they will not interfere with the installation of a lay-in type lighting fixture in any space in the ceiling.
 - F. Arrange that all supports for boxes, devices, cabinets or equipment that are flush mounted to be concealed behind the walls or ceiling where mounted.
- 3.4 ATTACHMENT TO STRUCTURE
- A. Hangers and other supports from structures shall be of type and design that will safely support the materials and equipment in its operating state without interfering with the physical requirements of the structure.
 - B. Supports shall be from concrete from proper inserts, or after set fittings that are located such they will not interfere with the structural requirements or the oxidizing or other deterioration of the reinforcement and concrete.
 - C. Hangers and other supports from steel structure shall be chosen to clamp to the steel and not to weaken or deface the steel with drilling, welding or other similar marks.
 1. Attach the support as required by the device chosen in the manner prescribed by the device manufacturer.
 - D. The type and location of each support shall be subject to review by the structural engineer and any support that may, in the engineer's sole opinion, reduce the quality of the structure, shall be removed and the structure repaired.
- 3.5 HANGERS
- A. Rod hangers shall be of proper size to handle the weight of the materials being supported, shall be vertical aligned, maintained straight and shall be length required for the support height and trimmed off immediately below the support.
 - B. Threaded rod hangers for trapeze supports shall have nuts and washers above and below the trapeze to secure the trapeze in position.
 1. Trapeze hangers shall be level and rods shall be trimmed of excess length immediately below the bottom nut.
- 3.6 PROTECTION
- A. Rust inhibit all supports by galvanizing or other acceptable means.
 1. Supports shall be job rust inhibited at all cuts, breaks, welds, or other points where rust inhibitor coating is broken.
- 3.7 FIELD QUALITY CONTROL
- A. Inspect support and attachment components for damage and defects.
 - B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
 - C. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 26 05 29

SECTION 26 05 33

CONDUITS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Conduit:
 - 1. Rigid metal conduit and fittings.
 - 2. Intermediate metal conduit and fittings.
 - 3. Electrical metallic tubing and fittings.
 - 4. Flexible metal conduit and fittings.
- B. Boxes:
 - 1. Wall and ceiling outlet boxes.
 - 2. Pull and junction boxes.

1.3 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated.
- C. NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
- D. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
- E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.4 SUBMITTALS

- A. Submit manufacturer's product data floor boxes, outlet boxes, surface metal raceways, multi-outlet assemblies and wireways.
- B. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.5 STORAGE AND HANDLING

- A. Handle raceways carefully to avoid damage, breaking, denting and scoring.
 - 1. Damaged equipment or materials shall not be installed.
- B. Store raceways in a clean dry space and protected from the weather.

PART 2 - PRODUCTS

2.1 CONDUIT AND FITTINGS

- A. Conduit and fittings for all electrical systems shall include the following:
 - 1. Electrical power and lighting feeders.
 - 2. Electrical power and lighting circuits.
 - 3. Fire alarm and signaling systems.
 - 4. Other electrical systems.
- B. For each electrical wireway system indicated, provide a complete assembly of conduit, tubing or duct with fittings including, but not necessarily limited to, connectors, nipples, couplings, locknuts, bushings, expansion fittings, other components and accessories as needed to form a complete system of the type indicated.
- C. Conduit fittings shall be designed and approved for the specific use intended.
 - 1. Conduit fittings, including flexible, shall have insulated throats or bushings.
 - 2. Rigid conduits shall have insulated bushings, unless grounding bushings are required by NEC Article 250-92.
 - 3. Grounding bushings shall have insulated throats.

- D. Rigid and intermediate metal conduit shall be hot-dipped galvanized.
 - 1. Fittings shall be threaded type.
 - 2. Expansion fittings shall be OZ Type DX.
- E. Electrical metallic tubing shall be galvanized.
 - 1. Fittings shall be all steel compression type.
 - 2. Expansion fittings shall be OZ Type TX.
- F. Flexible metal conduit shall be heavy-duty zinc-coated steel.
 - 1. Fittings shall be heavy-duty zinc-coated malleable steel.
 - 2. Flexible metal conduit fittings shall have external grounding lugs for installations other than lighting whips.
 - 3. Provide an external bonding conductor connected to both flexible connectors.
- G. Crimp or set-screw type fittings are not acceptable.
- H. Minimum conduit size shall be 3/4 inch, except for:
 - 1. 1/2 inch flexible metallic conduit may be used as fixture whips.
 - 2. 1/2 inch EMT conduit may be used for individual drops to outlets with one #12 AWG circuit.
 - a. Each box shall have a separate drop.
 - 3. 1/2 inch EMT conduit may be used for individual drops to lighting switches with four maximum #12 AWG current carrying conductors.
 - a. Each box shall have a separate drop.
 - 4. 1/2 inch EMT conduit may be used for individual drops to low voltage thermostats and similar HVAC controls.
 - a. Each box shall have a separate drop.
- I. MC Conduit is not allowed.

2.2 WALL AND CEILING OUTLET BOXES

- A. Galvanized steel interior outlet wiring boxes of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices.
 - 1. Outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes, compatible with outlet boxes being used and meeting requirements of individual situations.

2.3 PULL AND JUNCTION BOXES

- A. Boxes shall be galvanized sheet metal with screw-on cover and welded seams, stainless steel nuts, bolts, screws and washers.
- B. Boxes larger than 12 inches in any dimension shall be panelboard code gasketed galvanized steel with hinged cover.
- C. Boxes shall be sized in accordance with NEC.

PART 3 - EXECUTION

3.1 INSTALLATION - CONDUIT

- A. Install products as indicated, in accordance with the applicable requirements of NEC, NEMA and the National Electrical Contractors Association's "Standard of Installation".
- B. Install raceway and conduit system from point of origin in outlets shown, complete with offsets, pull boxes, junction boxes and fittings.
- C. Install rigid wall hot-dipped galvanized steel conduit or hot-dipped galvanized Intermediate metal conduit.
 - 1. The following exceptions permitted:
 - a. EMT:
 - 1) In sizes up to and including 4 inches, may be used inside dry locations where not subject to mechanical damage.
 - 2) EMT may be used in air conditioned spaces, such as accessible ceilings, dry wall partitions and exposed where 6 feet above the floor.
 - 3) EMT may not be used outside, in concrete, underground, in underfloor spaces, in masonry walls, in locations likely to be damp, or exposed within 6 feet of the floor.
 - 4) EMT shall not be used for medium voltage circuits.

- b. Where used for feeder circuits, receptacle branch circuits, and motor branch circuits, EMT shall also contain a NEC equipment grounding conductor.
 - 2. Flexible Metal Conduit
 - a. Install standard flexible metal conduit (not liquid-tight) with internal ground wire, in spaces above ceilings.
 - 1) Install flexible conduit connection such that vibration is not transmitted to adjoining conduit or building structure.
 - 2) Maximum length shall be 6 feet minimum of 3 feet, minimum size shall be 3/4 inch except for lay-in light fixtures where it may be 1/2 inch.
 - 3. Each wall box shall have a separate drop extending up to accessible ceiling.
 - a. Conduit shall not be installed horizontally to serve more than one box unless noted on plans.
 - D. 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.
 - E. Wire ties are not permitted.
 - F. Fasten conduit with the following material:
 - 1. Wood screws on wood.
 - 2. Toggle bolts on hollow masonry.
 - 3. Bolts and expansion anchors in concrete or brick.
 - 4. Machine screws, threaded rods and clamps on steel.
 - 5. " x " penta-treated pine installed in pitch pans on roof, spaced at intervals not to exceed 5 feet.
 - G. Metal conduit fittings shall be approved for grounding purposes or shall be jumpered with copper grounding conductors of appropriate ampacity.
 - 1. Leave termination of such jumpers exposed.
 - H. Install expansion fittings in metal and PVC conduit as follows:
 - 1. Conduit Crossing Building Expansion Joints:
 - a. EMT all sizes.
 - b. IMC all sizes.
 - c. RMC all sizes.
 - 2. Conduits entering environmental rooms and other locations subject to thermal expansion and as required by NEC.
 - 3. Unless expansion fitting has an integral bonding braid, as in Crouse-Hinds Type XC, a green insulated grounding conductor shall be pulled in the conduit.
 - a. Both ends of this green grounding conductor shall be accessible for inspection.
 - I. Expansion fittings are not required where offsets, expansion loops, or flexible conduit are placed in conduit runs.
 - J. Install conduit concealed in walls, partitions and above ceilings:
 - 1. Install conduit exposed in ceiling area (at structure) of boiler rooms, mechanical rooms and in other similar rooms where ceilings are not called for
 - K. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
 - L. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.
 - M. Provide 200 lb nylon cord in empty conduit.
 - N. Where conduit penetrates fire-rated walls and floors, provide mechanical fire-stop fittings with UL listed fire-rating.
- 3.2 INSTALLATION - SURFACE METAL RACEWAY AND MULTI-OUTLET
- A. Use suitable insulating bushings and inserts at connections to outlets and corner fittings on multi-outlet assembly.
 - B. Maintain grounding continuity between raceway components to provide a continuous grounding path.
- 3.3 INSTALLATION - BOXES
- A. Provide electrical boxes as shown in Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
 - B. Provide outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual situations.

- C. Electrical box locations shown on Contract Drawings are approximate unless dimensioned.
 - 1. Verify location of outlets prior to rough-in.
- D. Locate and install boxes to allow access.
- E. Do not install boxes back-to-back in walls.
 - 1. Provide a minimum 6-inch separation.
 - 2. Boxes mounted within 24-inches of each other and on both sides of walls shall have a minimum 6-inch separation and each box shall have a listed acoustic rated "putty pack" installed.
- F. Boxes serving the same side of a wall shall have a minimum 6-inch separation without a requirement for listed acoustic putty packs when not installed within 24-inches of boxes on the other side of the wall
- G. Secure boxes rigidly to the substrate upon which they are being mounted, or solidly imbed boxes in concrete or masonry.
 - 1. Boxes shall not be permitted to move laterally.
 - 2. Boxes shall be secured between two studs.
 - 3. Boxes connected to one stud are not permitted.
- H. Boxes mounted to millwork panels shall be secured rigidly to a mounting bar attached to the boxes and to the panel with a minimum of two wood screws on each side of the box(es).
- I. Use multiple-gang boxes where more than one device is mounted together; do not use sectional boxes Provide barriers to separate wiring of different voltage systems.
- J. Sectional boxes shall not be used individually or in gangs without written permission of the Engineer or as allowed by these specifications.
- K. Install boxes in walls without damaging wall insulation.
- L. Provide knockout plugs for unused openings.
- M. Outlet boxes in plaster partitions shall be "shallow-type" set flush in wall so there is at least 5/8 inch plaster covering back of box.
- N. Switch boxes shall not be used as junction boxes.
- O. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes.
 - 1. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.
- P. Outlet boxes supporting fixtures shall be securely anchored in place in an approved manner.
 - 1. Support outlet boxes and fixtures in acoustic ceiling areas from building structures, not from acoustic ceilings and no more than 3 feet above lay-in ceilings.
 - 2. Lighting fixture outlets shall be coordinated with mechanical and architectural equipment and elements to eliminate conflicts and provide a workable neat installation.
- Q. Set floor boxes level and flush with finish flooring material.
- R. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.
 - 1. Support pull and junction boxes independent of conduit.
- S. For each outlet box containing a lighting switch or controller, provide a neutral for each circuit contained.
- T. Cut-In Switch Box Installation by UTSW Personnel.
 - 1. This option shall not be allowed in: laboratories; hospitals; clinics, or other patient care areas in hospitals and office buildings; and other similar locations.
- U. Sectional switch boxes shall be allowed for minor work performed by UTSW Shop personnel.
 - 1. Switch boxes shall be three (3) inches deep minimum with ears.
 - 2. Switch boxes shall be secured to the wall using two "sheet rock clamps".
 - 3. Conduit drops may be 1/2 inch flexible conduit with equipment ground conductor.
 - 4. Provide one (1) drop for each box.
 - 5. Switch boxes shall not be ganged.
 - 6. Switch boxes shall be tight in cut hole without any "wobble."
 - 7. Cut in switch boxes shall not be allowed unless explicit notes are on construction documents.
- V. Cut-In Switch Box Installation by Contractor:
 - 1. This option shall not be allowed in laboratories, hospitals, clinics, or other patient care areas in hospitals and office buildings and other similar locations.
 - 2. Sectional switch boxes shall be allowed for minor work performed when there are less than ten (10) total devices installed. This shall include device outlets, switch locations and data locations.

END OF SECTION 26 05 33

SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. The extent of the electrical systems and equipment requiring identification is shown on the Drawings, and the extent of identification required is specified herein and in individual sections of work requiring identification.
- B. The types of electrical identification specified in this section include the following:
 - 1. Conductor color coding.
 - 2. Operational instructions and warnings.
 - 3. Equipment/system identification signs.

1.3 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

- A. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

PART 2 - PRODUCTS

2.1 IDENTIFICATION MATERIALS

- A. Provide engraving stock melamine plastic laminate, complying with FS L-P-387, engraved with engraver's standard letter style unless otherwise indicated.
 - 1. Plastic laminate shall be 1/16 inch thick up to 20 sq. inch and 1/8 inch for larger size.
 - 2. Letters shall be 1/2 inch high, black on white background.
 - 3. Nameplates on emergency panels shall be red with white letters.
- B. Underground-type plastic line markers shall be permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6 inches wide by 4 mils thick.
 - 1. Provide tape with printing which most accurately indicates the type of service of the buried cable.

2.2 LETTERING AND GRAPHICS

- A. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as required for proper identification and operation/maintenance of the electrical systems and equipment.

2.3 CEILING LABELS

- A. Description: 1/2 inch minimum diameter color sticker with separate clear label, identifying item above ceiling, attached to ceiling grid.. Lettering on label shall be black and all capital letters.
 - 1. Color code as follows:
 - a. Black letters on white background - Normal Power.
 - b. Black letters on red background - Emergency Power.
- B. Labels required for "Lighting Power Pack" locations.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

- A. Where identification is to be applied to surfaces which require finish, install identification after completion of finishing.
- B. Install ceiling labels in accordance with manufacturer's instructions.
- C. Comply with governing regulations and the requests of governing authorities for the identification of electrical work.

3.2 CONDUCTOR COLOR CODING

- A. Conductors #10 and Smaller: Insulation continuously colored throughout.
- B. Conductors Larger than #10:
 - 1. Three continuous wraps of 1/2 inch wide 3M #191 tape at each end and at pull and junction boxes.
- C. 120 volt, 3 phase, 4 wire system:
 - 1. Phase A - black.
 - 2. Phase B - red.
 - 3. Phase C - blue.
 - 4. Neutral - white.
 - 5. Ground - green.
- D. 277 volt, 3 phase, 4 wire system:
 - 1. Phase A - brown.
 - 2. Phase B - orange.
 - 3. Phase C - yellow.
 - 4. Neutral – gray.
 - 5. Ground - green.
- E. Conductors installed with color different than that indicated above are not acceptable.
- F. Control and special systems, 600 volt and less, #14 AWG and larger:
 - 1. Colors other than green and white.
 - 2. Include tracer color for identification.
 - 3. Keep colors selected continuous throughout project.
 - 4. Isolated systems, as required by NEC Section 517.
- G. Note colors on record drawings, including switch leg and traveler colors.

3.3 EQUIPMENT/SYSTEM IDENTIFICATION SIGNS

- A. Identify with engraved laminated nameplates, designating load served, on each electrical item on the project. Items to be identified and location of nameplates are as follows:
 - 1. Each main switch/fuse unit or circuit breaker adjacent to switch/fuse or circuit breaker.
 - 2. Each switch/fuse unit or circuit breaker in each distribution panel-- adjacent to switch/fuse unit or circuit breaker.
 - 3. Spares shall be labeled "Spare".
 - 4. Each lighting and appliance panel -- panel name on panel trim cover immediately above panel door. Circuit numbers shall be permanently labeled at factory.
 - a. Stick-on decals for field installation are not acceptable.
 - 5. Each safety switch -- on outside of cover.
 - 6. Each relay cabinet -- on outside of cover.
 - 7. Each motor starter -- on outside of cover.
- B. Nameplates shall be securely attached with an approved mechanical fastener. Adhesive attachment shall not be permitted.

3.4 PAINTING

- A. J-boxes shall be painted as follows:
 - 1. Fire System - Red.

3.5 J-BOX AND DEVICE PLATES

- A. The appropriate panel and circuit number shall be written in indelible ink on the back of all switch and receptacle faceplates.
 - 1. J-boxes for circuiting distribution shall also indicate panel and circuit numbers on front of cover plate where J-boxes are above ceiling and on back for exposed J-boxes.
- B. Device cover plates for receptacles and lighting switches shall also have the panel and circuit number affixed to the outside of the cover plate with 3/8 inch high, clear tape, and black lettering.

END OF SECTION 26 05 53

SECTION 26 08 00

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes commissioning process requirements for Electrical systems, assemblies, and equipment.
 - 1. This project will have selected building systems commissioned. The equipment and systems to be commissioned are specified in Section 01 91 00 - General Commissioning Requirements.

1.2 RELATED REQUIREMENTS

- A. Section 01 91 00 - General Commissioning Requirements.
- B. Section 21 08 00 - Commissioning of Fire Protection Systems.
- C. Section 22 08 00 - Commissioning of Plumbing Systems.
- D. Section 23 08 00 - Commissioning of HVAC Systems.

1.3 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 DEFINITIONS

- A. Refer to Section 01 91 00 - General Commissioning Requirements.

1.5 SUBMITTALS

- A. Certificate of Readiness, signed by the Contractor, certifying that systems, assemblies, equipment, components, and associated controls are ready for testing.
- B. Manufacturer's completed start-up reports for equipment and systems.
- C. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.6 CONTRACTOR'S RESPONSIBILITIES

- A. Reference Project Specification Section 01 91 00 - General Commissioning Requirements for details of Electrical contractor's responsibilities related to commissioning.
- B. Attend commissioning meetings.
- C. Provide information requested by the CxA for functional testing and for final commissioning documentation.
- D. 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.
- E. Functional testing of systems will be carried out solely by Electrical contractor's personnel, under the direction of CxA. Provide experienced personnel, familiar with the systems being installed under this project.

1.7 COMMISSIONING AUTHORITY RESPONSIBILITIES

- A. Reference Project Specification Section 01 91 00 - General Commissioning Requirements.
- B. CxA will direct commissioning testing.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 GENERAL TESTING REQUIREMENTS

- A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in Division 26 Sections. Provide submittals, test data, inspector record, and certification to the CxA.
- B. Reference Project Specification Section 01 91 00 - General Commissioning Requirements for detailed requirements of commissioning of Electrical systems.
- C. Perform commissioning tests at the direction of the CxA.
- D. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

- E. 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.
- F. Tests will be performed using design conditions whenever possible.

3.2 SYSTEM START-UP

- A. Contractor is solely responsible for system start-up. CxA may, at his discretion, witness start up procedures, but will not perform any Functional Testing of systems until Contractor has completed start-up and resolved all operating deficiencies, and has so certified.

3.3 TESTING PREPARATION

- A. Certify that Electrical systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that Electrical 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. Set 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).
- D. Inspect and verify the position of each device and interlock identified on checklists.
- E. Check safety cutouts, alarms, and interlocks with life-safety systems during each mode of operation.

3.4 FUNCTIONAL TESTING

- A. Reference Project Specification Section 01 91 00 - General Commissioning Requirements for detailed requirements of commissioning of Electrical systems.
- B. Provide measuring instruments and logging devices to record test data as directed by the CxA.

3.5 DEFERRED TESTING

- A. Initial commissioning will be done as soon as contract work is completed, though building may not be at full occupancy and equipment may not be at full loading.
- B. If adequate load may be artificially placed upon heating or cooling equipment, CxA, at his discretion, may perform functional testing during non-peak load periods. If testing cannot be carried out under these conditions to adequately verify system performance, testing will be deferred until such time as conditions are more satisfactory.
 - 1. Contractor is to provide services of personnel and participate in deferred or seasonal testing process in the same manner as he would in non-seasonal testing.
 - 2. If tests cannot be completed because of a deficiency outside the scope of the Electrical system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

3.6 RE-TESTING

- A. Reference Project Specification Section 01 91 00 - General Commissioning Requirements for detailed requirements of re-testing of Electrical systems.

3.7 SYSTEMS TO BE COMMISSIONED

- A. Reference Project Specification Section 01 91 00 - General Commissioning Requirements for list of Electrical systems to be commissioned.

END OF SECTION 26 08 00

SECTION 26 09 23
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Occupancy sensors.
- B. Lighting contactors.
- C. Accessories.

1.3 RELATED REQUIREMENTS

- A. Section 26 05 00 - Basic Electrical Materials and Methods.
- B. Section 26 05 19 - Building Wire Cable and Connectors (600V and Below).
- C. Section 26 05 26 - Grounding.
- D. Section 26 05 29 - Supporting Devices.
- E. Section 26 05 33 - Conduits and Boxes.
- F. Section 26 05 53 - Electrical Identification.
- G. Section 26 27 26 - Wiring Devices and Floor Boxes.
- H. Section 26 51 00 - Interior Lighting.

1.4 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- C. NECA 130 - Standard for Installing and Maintaining Wiring Devices.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts.
- F. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.
- G. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
- H. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
- I. NFPA 70 - National Electrical Code.
- J. UL 916 - Energy Management Equipment.
- K. UL 917 - Clock-Operated Switches.
- L. UL 1472 - Solid-State Dimming Controls.
- M. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules.
- N. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters.
- O. State Energy Conservation Office (SECO) Energy and Water Conservation Design Standards for State Agencies, New Construction and Major Renovation must comply with 34 Tex. Admin. Code 19.32

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
 - 3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.

4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
 5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.
- B. Sequencing:
1. Do not install lighting control devices until final surface finishes and painting are complete.
- 1.6 SUBMITTALS
- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
 - B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
 1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
 - C. Shop Drawings:
 1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
 - D. Field Quality Control Reports.
 - E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
 - F. Operation and Maintenance Data: Include detailed information on device programming and setup.
 - G. Project Record Documents: Record actual installed locations and settings for lighting control devices.
- 1.7 QUALITY ASSURANCE
- A. Comply with requirements of NFPA 70.
 - B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
 - C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.
 - D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- 1.8 DELIVERY, STORAGE, AND PROTECTION
- A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.
- 1.9 FIELD CONDITIONS
- A. Maintain field conditions within manufacturer's required service conditions during and after installation.
- 1.10 WARRANTY
- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
 - B. Provide five year manufacturer warranty for all occupancy sensors.
 - C. Provide five year manufacturer warranty for utility grade locking receptacle-mounted outdoor photo controls.
 - D. Provide five year manufacturer warranty for all daylighting controls.
- 1.11 ATTIC STOCK
- A. Provide 6 percent or a minimum of 10 relays.

PART 2 PRODUCTS

2.1 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.
- C. All lighting control devices shall fail "ON" unless specifically noted otherwise in the drawings.

2.2 OCCUPANCY SENSORS

- A. Basis of Design: nLight; Acuity Brands, Inc.
- B. Alternate Manufacturers: Substitutions must be approved in writing by UTSW.

1. Substitutions: 01 25 00 - Substitution Procedures .
 2. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
- C. All Occupancy Sensors:
1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
 2. Sensor Technology:
 - a. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
 3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
 4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
 5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
 6. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
 7. Sensitivity: Field adjustable.
 8. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
 9. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, ratings as required for interface with system indicated.
 10. Where wired sensors are indicated, wireless sensors are not acceptable without prior approval of Architect.
- D. Ceiling Mounted Occupancy Sensors:
1. All Ceiling Mounted Occupancy Sensors:
 - a. Description: Low profile occupancy sensors designed for ceiling installation.
 - b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
 - c. Provide field selectable setting for disabling LED motion detector visual indicator.
 - d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
 - e. Finish: White unless otherwise indicated.
 2. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
 - a. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet (111.5 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
- E. Power Packs for Low Voltage Occupancy Sensors:
1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
 2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
 3. Input Supply Voltage: Dual rated for 120/277 V ac.
 4. Load Rating: As required to control the load indicated on drawings.
- F. Accessories:
1. Provide heavy duty coated steel wire protective guards compatible with specified occupancy sensors where indicated.
- 2.3 LIGHTING CONTACTORS
- A. Manufacturers:
1. Schneider Electric, Square D Products.
- B. Description: Magnetic lighting contactors complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; noncombination type unless otherwise indicated; ratings, configurations and features as indicated on the drawings.
1. Basis of Design: Square D 8903L.
- C. Short Circuit Current Rating:

1. Provide contactors with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
 - D. Enclosures:
 1. Comply with NEMA ICS 6.
 2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1 or Type 12.
 3. Finish: Manufacturer's standard unless otherwise indicated.
- 2.4 ACCESSORIES
- A. Auxiliary Contacts:
 1. Comply with NEMA ICS 5.
 2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each lighting contactor, minimum.
 - B. Control and Timing Relays:
 1. Comply with NEMA ICS 5.
 2. Provide number and type of relays indicated or required to perform necessary functions.
 3. Timing Relays: Electronic.
 - a. Adjustable Timing Range: As required for application.
 - C. Fire-Rated Device Enclosures:
 1. Provide as required to preserve fire resistance rating of building elements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
- G. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Install lighting control relays furnished under manufacturer's instructions.
- C. Coordinate locations of outlet boxes provided under Section 26 05 33 - Conduits and Boxes as required for installation of lighting control devices provided under this section.
 1. Mounting Heights: Unless otherwise indicated, as follows:
 - a. Wall Switch Occupancy Sensors: 48 inches (1.2 m) above finished floor.
 2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
 3. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches (80 mm) from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
- D. Install lighting control devices in accordance with manufacturer's instructions.
- E. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

- F. Install lighting control devices plumb and level, and held securely in place.
- G. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 27 26 - Wiring Devices and Floor Boxes.
- H. Provide required supports in accordance with Section 26 05 29 - Supporting Devices.
- I. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- J. Identify lighting control devices in accordance with Section 26 05 53 - Electrical Identification.
- K. Occupancy Sensor Locations:
 - 1. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for complete coverage of respective room or area based on manufacturer's recommendations for installed devices.
 - 2. Locate dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet (1.2 m) from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.
- L. Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.
- M. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling, within 1'-0" of door or above access panel in inaccessible ceiling near the sensor location.
- N. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.
- O. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.
- P. Where indicated or required, provide cabinet or enclosure in accordance with Section 26 05 33 - Conduits and Boxes for mounting of lighting control device system components.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 45 00 - Project Quality Control, for additional requirements.
- B. Inspect each lighting control device for damage and defects.
- C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area.
- D. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.
- C. Adjust position of directional occupancy sensors to achieve optimal coverage as required.
- D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on dual technology occupancy sensor lenses to block undesired motion detection.
- E. Adjust daylighting controls under optimum lighting conditions after all room finishes, furniture, and window treatments have been installed to achieve desired operation as indicated or as directed by Architect. Readjust controls calibrated prior to installation of final room finishes, furniture, and window treatments that do not function properly as determined by Architect.

3.6 COOPERATION AND CLEANUP

- A. It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the job site in a clean and safe condition.
- B. At the end of each day's work, each trade shall properly store all tools, equipment and materials and shall clean all debris from the job. Upon the completion of the job, each trade shall immediately remove all tools, equipment, any surplus materials, and all debris caused by that portion of the work.

3.7 COMMISSIONING

- A. See Section 01 91 00 - General Commissioning Requirements for commissioning requirements.

3.8 CLOSEOUT ACTIVITIES

- A. As part of project punch list requirements per Section 01 77 00 - Closeout Procedures and Submittals include UTSW Electrical Shop, UTSW Utilities, UTSW Utilities Controls / Operations, UTSW Building Maintenance, UTSW PM, OSBC, and other associated teams.
- B. Provide revised Operation and Maintenance Data including final installed components schedule, maintenance manuals, and warranty documentation to UTSW PM and to UTSW Building Maintenance.

3.9 TRAINING

- A. Refer to Section 01 79 00 - Demonstration and Training as well as individual technical Sections for specific training requirements.
- B. Where training is called for in other sections provide a minimum of 8 hours on site training for Owner's representatives.
- C. Training shall be presented by a qualified instructor with training experience and technical knowledge of the product.
- D. Submit a training agenda, proposed date, and instructor qualifications to the Owner for approval.

END OF SECTION 26 09 23

SECTION 26 24 17

BRANCH CIRCUIT PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Lighting and appliance branch circuit panelboards.

1.3 RELATED REQUIREMENTS

- A. Section 26 00 00 - Basic Electrical Requirements
- B. Section 26 00 10 - UTSW Electrical Design Requirements

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. UL 489 - Molded Case Circuit Breakers.
- C. NEMA PB 1 - Panelboards.
- D. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
 - 4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 5. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents.
 - a. Obtain direction before proceeding with work.

1.6 SUBMITTALS

- A. Submit manufacturer's product data.
- B. Submit dimensioned drawings showing size, circuit breaker and equipment arrangement and ratings, including but not limited to, voltage, main bus ampacity, integrated short circuit ampere rating.
- C. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts with Governmental Entity requirements.

1.7 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver panelboards in factory-fabricated water-resistant wrapping.

- B. Handle panelboards carefully to avoid damage to material components, enclosure, and finish.
- C. Store in a clean, dry space and protected from the weather.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Schneider Electric; Square D Products.
- B. Other manufacturers equal in design and function will be considered upon submittal of manufacturer's data.

2.2 PANELBOARD CONSTRUCTION

- A. Provide circuit breaker type panelboards as scheduled.
 - 1. Do not provide main lug only (MLO) panelboards.
- B. Enclosure shall be NEMA Type 1 unless shown otherwise on the drawings.
- C. Provide cabinet front with door in door:
 - 1. One door over interior and additional door over wiring gutters.
 - 2. Front cover hinged to box with concealed trim clamps.
 - 3. Provide a flush lock on the inner door.
 - 4. The outer door shall not have a flush lock.
- D. Bus shall be copper and braced for the maximum available fault current.
- E. Minimum bus capacity shall be 225 amp.
- F. Units with bus ratings over 225 amp shall be considered.
- G. Provide copper ground bus in all panelboards.
- H. Neutral bars shall be full capacity copper.
- I. Exterior and interior steel surfaces shall be cleaned and finished with gray enamel over a rust inhibiting phosphatized coating.
 - 1. Color shall be ANSI 61 gray.
- J. Panelboard electrical ratings and configurations as scheduled on the drawings.
- K. Panelboards shall be provided with a minimum of 25 percent of actual circuit requirements as single pole, 20 amp spares.
 - 1. All spaces shall contain a breaker, 20 amp minimum.
- L. Provide fully rated feed-through lugs.
- M. Circuit directory shall be typewritten and mounted behind clear plastic, in metal frame on inside of each panel door.
- N. Panelboards shall be full bussed, entire length of panel, 42 spaces, or number of indicated spaces on plans.
- O. Non-ferrous magnetic material shall be used in magnet areas such as: fiberglass, aluminum, copper, or stainless steel.

2.3 SWITCHING AND OVERCURRENT PROTECTIVE DEVICES

- A. Provide molded case circuit breakers of manufacturer's standard industrial construction, bolt-on type, integral inverse time delay thermal and instantaneous trip.
- B. Multi-pole breakers shall be two or three pole with internal trip and factory installed handle tie as specified.
 - 1. Field installed handle ties are not permitted.
- C. Overcurrent protective device interrupting capacity shall be 22,000 Amps Interrupting Capacity (AIC) minimum or as noted on the drawings if a higher AIC is indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install panelboards in accordance with manufacturer`s written instructions and the applicable requirements of the NEC, NEMA, ANSI and the National Electrical Contractors Association`s "Standard of Installation".
- B. Anchor enclosures firmly to concrete walls and structural surfaces, ensuring that they are permanently and mechanically secured.
- C. Enclosures designed for floor mounting shall be anchored to 4-inch concrete pad without support to bottom of structure above.
- D. Enclosures not designed for floor mounting shall be supported heavy duty "unistrut" type channels anchored to floor and extending to structure above at a minimum.
- E. At the completion of the electrical system this Contractor shall check each phase of all panels under full load and arrange so that all phases shall carry the same load as near as possible.
- F. Contractor shall provide one typewritten and one photocopy of the as-built Panelboard schedule to the Project Manager.

3.3 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.
- C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.4 CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 24 17

SECTION 26 27 26

WIRING DEVICES AND FLOOR BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Wiring Devices:
 - 1. Wall switches.
 - 2. Receptacles.
 - 3. Device plates and box covers.
 - 4. Wall dimmers.
 - 5. Occupancy sensors.

1.3 RELATED REQUIREMENTS

- A. Section 26 00 00 - Basic Electrical Requirements.
- B. Section 26 00 10 - UTSW Electrical Design Requirements .

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NEMA WD 1 – General Color Requirements for Wiring Devices.

1.5 SUBMITTALS

- A. Submit manufacturer`s product data for wiring devices and floor boxes.
- B. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver wiring devices individually wrapped in factory-fabricated containers.
- B. Handle wiring devices carefully to avoid damage, breaking and scoring.
- C. Store in a clean dry space and protected from the weather.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide factory fabricated wiring devices in the type and electrical rating for the service indicated
 - 1. Where type and grade are not indicated, provide proper selection to correspond with branch circuit wiring and overcurrent protection.
 - 2. Attachment of all conductors to devices shall be by binding screws and a pressure plate.
 - 3. Arrangements depending on spring pressure or tension are not acceptable.
 - 4. All binding screws shall be brass or bronze.

2.2 ACCEPTABLE MANUFACTURERS - WALL SWITCHES

- A. Hubbell.
- B. Bryant 5362.
- C. Leviton.
- D. Other manufacturers equal in design and function will be considered upon submittal of manufacturer`s data.

2.3 WALL SWITCHES

- A. General Requirements:
 - 1. Colors: White receptacles are standard. Ivory when matching existing devices.

- B. Wall switches for lighting circuits and motor loads under 1/3 hp shall be AC general use snap switch with toggle handle, White, 20 amperes and 120/277 volt AC with number of poles as required, equal to Hubbell 1221.
- C. Horsepower rated switch shall be 30 ampere, equal to Arrow-Hart number3999I (number of poles as required).
- D. Use horsepower rated switches approved for motor control or disconnect service when controlling or disconnecting motor loads in excess of 1/3 hp.
- E. Switch terminal screws or connectors shall be designed to accommodate No 10 solid conductor.

2.4 ACCEPTABLE MANUFACTURERS - RECEPTACLES

- A. Hubbell.
- B. Bryant.
- C. Pass & Seymour.
- D. Arrow-Hart.
- E. Leviton.
- F. Other manufacturers equal in design and function will be considered upon submittal of manufacturer`s data.

2.5 RECEPTACLES

- A. General Requirements:
 - 1. Specific-use receptacles shall have volts, amps, poles and NEMA configuration as noted on drawings.
 - 2. GFCI receptacles installed in wiremold type wire way shall be Decora type. Color white or ivory.
 - 3. Colors: White receptacles are standard. Ivory only when matching existing devices.
 - 4. Adjustable Brackets: Secure boxes from stud to stud with adjustable bracket for lab, hospital, heavy use receptacles, equivalent to Caddy TSGB.
 - 5. All devices to be pressure plate type terminations including the equipment ground. Individual 120/20A outlets within wiremolds shall be tapped off the #10AWG stranded home run conductors using #12 AWG stranded wire.
 - 6. Grounding shall be terminated using a Sta-kon loop or fork if device does not have a pressure plate.
- B. Convenience duplex receptacles, 20 amperes and 125 volt AC, equal to Hubbell 5362.
- C. Dedicated circuit duplex receptacles, 20 amperes, 125 volt AC, equal to Hubbell 5362.
- D. NEMA 5-20R, 120V receptacle, equal to Hubbell no. HBL 5361, no color preference.
- E. Simplex 120V receptacle, equal to Hubbell no. 5362.
- F. GFCI receptacles for all new/remodeled areas equal to Arrow-Hart Industrial Grade Receptacles.
 - 1. Do not use feed through feature.
- G. Wall Mounted Wiremold
 - 1. Power and Data:
 - a. Acceptable Manufacturers:
 - 1) Legrand, ALA4800 Basis of Design.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements .
 - b. Finish: Aluminum.

2.6 ACCEPTABLE MANUFACTURERS - WALL PLATES

- A. Arrow-Hart.
- B. Hubbell.
- C. Pass & Seymour.
- D. Leviton.
- E. Other manufacturers equal in design and function will be considered upon submittal of manufacturer`s data.

2.7 WALL PLATES

- A. Decorative wall plates shall be smooth plastic, 0.1 inch thick, color White, equal to Arrow-Hart number 72071 Series with cutouts required for devices indicated on drawings.
 - 1. Where switches or outlets are shown adjacent to each other, they shall be ganged with partitions between different type services and covered by a single custom wall plate.

- 2. Use ivory only when needed to match existing.
 - B. Telephone, computer and CCTV wall plates, single 5/8 inch hole equal to Arrow-Hart number 71181 Series.
 - C. Jumbo plates are not permitted.
- 2.8 LIGHTING OCCUPANCY SENSORS
- A. Lighting occupancy sensors shall be installed as a functioning system per the Contract Documents and manufacturer's installation instructions.
 - B. Dual technology type that operate using Passive Infrared (PIR) and Ultrasonic (US) shall be provided unless otherwise noted.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Installer must examine the areas and conditions under which wiring devices and floor boxes are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Inspect devices for physical damage.
 - 1. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wiring devices and floor boxes as indicated, in accordance with the applicable requirements of the NEC, NEMA, ANSI and the National Electrical Contractors' Association's "Standard of Installation."
- B. The approximate location of switches, power outlets, floor boxes, etc., is indicated on the drawings.
 - 1. These drawings, however, may not give complete and accurate information in regard to locations of such items.
 - 2. Determine exact locations by reference to the general building drawings and by actual measurements during construction of the building before rough-in, subject to the approval of the Constructor Inspector.
- C. Install wall switches 48 inches above floor, OFF position down.
- D. Install wall dimmers 48 inches above floor; derate ganged dimmers as instructed by manufacturer; do not use common neutral.
- E. Where shown near doors, install switches and dimmers not less than 2 inches and not more than 12 inches from door trim.
- F. Verify all door swings before rough-in and locate switches and dimmers on strike side of door.
- G. Install convenience, telephone computer and CCTV outlets 18 inches above floor, 6 inches above counters, or at the backsplash level.
- H. Install specific-use receptacles at heights shown on Drawings.
- I. Install devices and wall plates flush and level.
- J. Proper commissioning of occupancy sensors shall be completed prior to Substantial Completion.

3.3 INSTALLATION - SURFACE METAL WIREMOLD AND MULTI-OUTLET

- A. Use suitable insulating bushings and inserts at connections to outlets and corner fittings on multi-outlet assembly.
- B. Maintain grounding continuity between raceway components to provide a continuous grounding path.

3.4 INSTALLATION - WIREMOLD

- A. Bolt wireways to steel channels fastened to the wall or in self-supporting structure:
 - 1. Install level.
- B. Gasket each joint in oil-tight wireway:
- C. Mount raintight wireway in horizontal position only.

END OF SECTION 26 27 26

SECTION 26 28 13

FUSES, 600 VOLT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Dual-element, current limiting Class R fuses for loads up to 600 volts, 0-600 Amps.

1.3 RELATED REQUIREMENTS

- A. Section 26 00 00 - Basic Electrical Requirements
- B. Section 26 00 10 - UTSW Electrical Design Requirements

1.4 REFERENCE STANDARDS

- A. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses.
- B. Where application of local codes, trade association standard or publications appears to be in conflict with the requirements of this section, the Architect/Engineer shall be asked for an interpretation.

1.5 SUBMITTALS

- A. Submit in accordance with Section 26 00 00 - Basic Electrical Requirements.
- B. Submit manufacturer's data on fuses.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Store fuses in a clean and dry space and protected from weather.
- B. When necessary to store outdoors, elevate materials well above grade and enclose with durable, waterproof wrapping.

PART 2 - PRODUCTS

2.1 MATERIAL AND EQUIPMENT

- A. Furnish fuses manufactured by Buss, or equal, in accordance with the following:
 - 1. Motors, 0 to 600 Amp:
 - a. 250 volt - Buss LPN-RK, UI Class RK1.
 - b. 600 volt - Buss LPS-RK, UI Class RK1.
 - B. Size fuses serving motor loads as specifically recommended by motor or equipment manufacturer or in the range of 150 to 175 percent of motor nameplate rating per NEC in accordance to type of motor.
 - C. Interrupting Rating: 200,000 RMS Amps.
 - D. Maintenance Stock, Fuses:
 - 1. Furnish the following:
 - a. Three spare fuses of each size and type for a spare set.
 - b. Furnish spare fuses of each size and type for a spare set.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.
- B. Verify that mounting surfaces are ready to receive spare fuse cabinet.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install fuses where indicated, in accordance with the manufacturer's written instructions, the applicable requirements of NEC and the National Electrical Contractors Association's "Standard of Installation"
- B. Do not install fuses until circuits are ready to be energized.
- C. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION 26 28 13

SECTION 26 28 16

DISCONNECT SWITCHES - HEAVY DUTY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Disconnect switches, fusible and non-fusible.
- B. Enclosures.
- C. Switches shall be furnished and installed at locations as shown on the Drawings.

1.3 RELATED REQUIREMENTS

- A. Section 26 00 00 - Basic Electrical Requirements.
- B. Section 26 05 53 - Electrical Identification.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NEMA 250 – Enclosures for Electrical Equipment.
- C. NEMA KS 1 - Enclosed Switches.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 70E - Electrical Safety Requirement for Employee Workplaces.
- F. UL 98 – Enclosed and Dead Front Switches; Current Edition, Including All Revisions.

1.5 SUBMITTALS

- A. Provide submittals in accordance with and in addition to Section 26 00 00 - Basic Electrical Requirements and Division 01.
- B. Submit manufacturer's product data. Submit dimensioned drawings and equipment ratings for voltage, capacity, horsepower, and short circuit.
- C. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver switches individually wrapped in factory-fabricated water-resistant type containers.
- B. Handle switches carefully to avoid damage to material components, enclosure and finish. Damaged switches shall not be installed on project.
- C. Store switches in a clean and dry space and protected from weather.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Schneider Electric, Square-D Products.
- B. Other manufacturers equal in design and function will be considered upon submittal of manufacturer's data.

2.2 SWITCH INTERIOR

- A. All switches shall have switch blades which are visible when the switch is OFF and the cover is open.
- B. Lugs shall be front removable and UL Listed for 75 degrees C conductors.
- C. All current carrying parts shall be plated to resist corrosion.
- D. Switches shall have removable arc suppressors to facilitate easy access to line side lugs.
- E. Switches shall have provisions for a field installable electrical interlock.
- F. Voltage rating: 240VAC or 600VAC as per drawings.
- G. Use fuse clips that are rejecting type to accept Class RK or L fuses only.

H. Use switches that have number of poles required as per drawings.

2.3 SWITCH MECHANISM

- A. Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.
 - 1. Switch mechanism shall conform to NEMA KS 1.
- B. The operating handle shall be an integral part of the box, not the cover.
- C. Provisions for padlocking the switch in the OFF position with at least three padlocks shall be provided.
- D. All switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open.
 - 1. The cover interlock mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism.
 - 2. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

2.4 SWITCH ENCLOSURES

- A. Switch covers shall be attached with welded pin-type hinges for: Type 1, 12, 12K, 4-4X-5 stainless steel; top hinged, attached with removable screws and securable in the open position for Type 3R; attached by molded hinges and type 316 stainless steel hinge pins for Type 4X polyester; or attached by type 316 stainless steel bolts for Type 7/9.
- B. The enclosure shall be finished with gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated steel for Type 1, gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated galvanized steel for Type 3R, 12, 12K, brush finish on type 304 stainless steel for Type 4-4X-5 stainless steel, or gray baked enamel on copper free cast aluminum alloy for Type 7/9.
- C. The enclosure shall have permanent ON and OFF markings.
- D. Identify switches, as to equipment served, with engraved laminated plastic plates. Refer to Section 26 05 53 - Electrical Identification.

2.5 SWITCH RATINGS

- A. Switches shall be horsepower rated for ac and/or dc as indicated on the plans.
- B. The UL Listed short circuit current rating of the switches shall be 200,000 rms symmetrical amperes minimum.
- C. All current carrying parts shall be plated to resist corrosion.
- D. Switches shall be Underwriters approved for duty shown and enclosure type per drawings.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Installer shall examine the areas and conditions under which safety and disconnect switches are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work.
 - 1. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF SAFETY AND DISCONNECT SWITCHES

- A. Provide switches: where required by NEC; where indicated on drawings; and where required by equipment manufacturer; in a location convenient for maintenance on switch; and adjacent equipment being protected.
- B. Install switches in accordance with manufacturer's written instructions and the applicable requirements of the NEC, NEMA, ANSI, and the National Electrical Contractors Association's "Standard of Installation".
- C. Install fuses in fusible disconnect switches.
 - 1. Provide permanent marking inside switch enclosure for fuse type.
- D. Provide fused disconnect switches whether or not indicated on drawings and when required to maintain equipment manufacturer's warranty.
 - 1. Coordinate with Division 23 for warranty requirements of equipment approved by submittal.
- E. Wall mount switches, where possible, or mount on unistrut supports. Switches shall not be mounted on equipment without written permission of the Engineer of Record.
- F. For equipment with motors larger than 1/8 Hp, install disconnect switches within sight of the motor.

- G. Install a UL approved equipment ground bar in each switch.
 - 1. The individual equipment ground bar shall accept at least two conductors.
 - 2. Individual conductor lugs are not acceptable.
- H. Install a UL approved neutral bar in each switch where a neutral is present.

END OF SECTION 26 28 16

SECTION 26 29 20

MOTORS, CONTROLLERS, AND ELECTRIC POWERED EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Requirements to furnish and install all wiring necessary to completely connect all motors, electric powered equipment and electric control equipment that is furnished by the Owner, other contractors, or other Divisions of Work.
 - 1. This includes HVAC equipment, plumbing equipment, elevators, hoists, signs, door operators, and similar items that are furnished and installed by others.
- B. The Owner, other contractors, or other Divisions of the Work will furnish locations of equipment and instructions and wiring diagrams necessary to select the materials required to install this equipment properly.
 - 1. Furnish and install all conduit, wire, boxes and common wiring materials to complete the installation and place the equipment in operation.

1.3 RELATED REQUIREMENTS

- A. Section 26 00 00 - Basic Electrical Requirements.
- B. Section 26 00 10 - UTSW Electrical Design Requirements.
- C. Section 26 05 53 - Electrical Identification.
- D. Section 26 28 16 - Disconnect Switches - Heavy Duty.
- E. Refer to other Divisions of the Drawings and Specifications for information as to the scope of this work. All notations for electrical work to be "By Electrical" or "See Electrical" shall be deemed instructions for work in Division 26.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 SUBMITTALS

- A. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

PART 2 – PRODUCTS

2.1 FURNISHED EQUIPMENT

- A. The Owner or other contractors will furnish and deliver to the job site the motors, controllers, switches, and other controls for the equipment they furnish except as indicated otherwise.

2.2 START-STOP STATIONS

- A. Start-stop stations indicated remote from motor controllers shall, unless otherwise indicated, be flush mounted momentary contact push button and pilot units with stainless steel plate.
 - 1. Units shall be equal to Schneider Electric / Square D 9001-BF308.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set in place all controllers, switches, and control devices in accordance with manufacturer's written instructions.
 - 1. Furnish and install all supports, conduit, wire, boxes and common wiring materials, etc., as required.
 - 2. Furnish and install all interlocks and interconnecting wiring for equipment controls and safeties and make all other electrical connections for proper operation.

- B. Furnish and install a suitable disconnect switch for each motor and electric powered equipment which does not have such a disconnect as an integral part of the equipment or which is not within sight of a feeding branch circuit protective device which meets the requirements of a disconnect.
- C. Furnish and install remote start-stop stations.
 - 1. Verify the control voltage and specified hook-up and provide suitable unit to interface with starter and other controls.

3.2 EQUIPMENT CONNECTIONS

- A. The Contract Documents indicate electrical connection to equipment.
 - 1. Refer to the other trade construction requirements and make connections to and hook-up of the equipment and devices by furnishing all common wiring materials necessary to complete the wiring of and make ready for the electrical operation of the equipment.
- B. Locate outlet boxes, conduit stubs, and connections for the equipment and its related devices to suit the power, control and signal wiring of the equipment and devices.

3.3 LABELING

- A. Refer to Section 26 05 53 - Electrical Identification for requirements.
- B. Provide an engraved plastic identification nameplate on each motor controller and disconnect.

END OF SECTION 26 29 20

SECTION 26 29 21

MOTOR AND CIRCUIT DISCONNECTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Disconnect switches, fusible and nonfusible.
- B. Enclosures.

1.3 RELATED REQUIREMENTS

- A. Section 26 00 00 - Basic Electrical Requirements
- B. Section 26 00 10 - UTSW Electrical Design Requirements

1.4 REFERENCE STANDARDS

- A. Federal Spec. W-S-865 - Switch, Box (Enclosed), Surface-Mounted.
- B. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).
- C. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005.

1.5 SUBMITTALS

- A. Submit manufacturer's product data.
- B. Submit dimensioned drawings and equipment ratings for voltage, capacity, horsepower, and short circuit.
- C. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver switches individually wrapped in factory-fabricated water-resistant type containers.
- B. Handle switches carefully to avoid damage to material components, enclosure and finish. Damaged switches shall not be installed on project.
- C. Store switches in a clean and dry space and protected from weather.

PART 2 - PRODUCTS

2.1 FABRICATED SWITCHES

- A. Depending upon the service indicated, use 250 or 600 volt switches, single throw, fusible, or nonfusible, horsepower rated, heavy duty, designed for locking in "ON" or "OFF" position, in code gauge steel cabinets.
- B. Use switches that have number of poles required, dependent upon phases serving equipment.
- C. Switches shall be Underwriters' Laboratories approved for duty shown and NEMA 3R where exposed to weather. NEMA 3R switches shall have weatherproof threaded hubs for all conduit entries into switch.
- D. Use fuse clips that are rejecting type to accept Class RK or L fuses only.
- E. Identify switches, as to equipment served, with engraved laminated plastic plates. Refer to the Section 26 05 53 - Electrical Identification.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Installer shall examine the areas and conditions under which safety and disconnect switches are to be installed and notify the Contractor 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.

3.2 INSTALLATION OF SAFETY AND DISCONNECT SWITCHES

- A. Install safety or disconnect switches where indicated, in accordance with the manufacturer's written instructions, the applicable requirements of NEC and the National Electrical Contractors Association's "Standard of Installation."

B. For equipment with motors larger than 1/8 hp, install disconnect switches within sight of the motor.

END OF SECTION 26 29 21

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Emergency power supply units.
- E. Accessories.

1.3 SCOPE OF WORK

- A. Furnish and install a lighting fixture of the type indicated by designator at each location shown on the drawings. All materials, accessories, components and any other equipment necessary for the complete and proper installation and operation of the lighting fixtures shall be furnished by the Contractor, including those not usually indicated on the drawings or specified, but that are necessary for the proper installation and operation of the fixtures.
- B. Specifications and drawings are intended to convey the main features, function, and character of the fixtures only, and do not necessarily illustrate or set forth every item or detail necessary for completion of the work.
- C. Where design intent is unclear in the documents, the Contractor shall contact the Architect in writing for clarification prior to proceeding with the item in question.
- D. Where Contractor's BIM is used to produce, document, or otherwise coordinate the locations of lighting fixtures, it is the Contractor's responsibility to confirm that all lighting products to be provided for construction will fit into the intended locations.

1.4 RELATED REQUIREMENTS

- A. Section 26 05 00 - Basic Electrical Materials and Methods.
- B. Section 26 05 26 - Grounding.
- C. Section 26 05 29 - Supporting Devices.
- D. Section 26 05 33 - Conduits and Boxes.
- E. Section 26 05 53 - Electrical Identification.
- F. Section 26 09 13 - Networked Lighting Control System.
- G. Section 26 09 23 - Lighting Control Devices.
- H. Section 26 27 26 - Wiring Devices and Floor Boxes: Manual wall switches and wall dimmers.

1.5 REFERENCE STANDARDS

- A. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information.
- B. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products.
- C. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- E. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems.
- F. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts.
- G. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility.
- H. NFPA 70 - National Electrical Code.
- I. NFPA 101 - Life Safety Code.

- J. UL 844 - Luminaires for Use in Hazardous (Classified) Locations.
- K. UL 924 - Emergency Lighting and Power Equipment.
- L. UL 1598 - Luminaires.
- M. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products.
- N. ASHRAE/IESNA Standard 90.1 - Energy Standard for Buildings (current version or most recent approved version by the local authority.)
- O. IECC - International Energy Conservation Code (current version or most recent approved version by the local authority.)

1.6 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
 2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
 3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
 4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.7 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Shop Drawings:
 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
 3. Review of shop drawings or samples does not waive contract requirements. Review of the shop drawings, submittals or samples does not relieve the Contractor from responsibility for deviations from the specifications or drawings, unless a letter is provided noting such deviations at the time of submission and received written acceptance for such deviations from the Architect and/or the Lighting Designer. Approval of shop drawings or samples does not relieve the Contractor from responsibility for errors in the shop drawings or samples. Contractor shall be fully responsible for lighting fixtures that are manufactured or installed without reviewed shop drawings and for fixtures not manufactured in accordance with the requirements of the Architect and/or the Lighting Designer shop drawing review to the extent that they may need to be removed and replaced entirely.
 4. The design team reserves the right to make minor modifications to the specifications at the time of submittal review such that there is either no change in cost or any cost changes can be carried by a contingency or as otherwise acceptable to the Owner.
 5. Preliminary lighting controls submittals shall be submitted simultaneously with lighting fixtures indicating compatibility between the fixture type control method, driver type, load, and control method.
- C. Product Data: 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. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 - b. Include IES LM-79 test report upon request.
 - c. Include electrical characteristics: input voltage in volts, input in current in amps, input power in watts.
 - d. Include data for total light output in lumens, luminaire efficacy in lumens per watt.
 - e. Include power supply, thermal, optical, and fixture losses.
 2. LED Drivers: Include wiring diagrams and list of compatible source units.

- 3. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.
 - 4. Emergency Power Supply Unit: Include list of compatible lamp configurations and associated lumen output.
 - D. Sustainable Design Documentation: Submit manufacturer's product data on lamp mercury content and rated lamp life, showing compliance with specified requirements.
 - E. Certificates for Dimming: Manufacturer's documentation of compatibility with dimming controls to be installed.
 - F. Field quality control reports.
 - G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
 - H. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
 - I. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.
- 1.8 QUALITY ASSURANCE
- A. Comply with requirements of NFPA 70.
 - B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
 - C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.
 - D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- 1.9 DELIVERY, STORAGE, AND PROTECTION
- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
 - B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.
- 1.10 FIELD CONDITIONS
- A. Maintain field conditions within manufacturer's required service conditions during and after installation.
- 1.11 WARRANTY
- A. See Section 01 77 00 - Closeout Procedures and Submittals, for additional warranty requirements.
 - B. Provide 3-year manufacturer warranty for LED luminaires, including drivers.
 - C. Provide 3-year pro-rata warranty for batteries for emergency lighting units.
- 1.12 ATTIC STOCK
- A. Provide 1 percent attic stock for all light fixtures.
 - B. Provide 2 percent attic stock for drivers.

PART 2 PRODUCTS

2.1 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.
- B. Substitutions:
 - 1. Any substitution request must comply with Section 01 25 00 - Substitution Procedures.
 - 2. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
 - 3. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
 - 4. Agrees to provide the same warranty for the substitution as for the specified product.
 - 5. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
 - 6. Waives claims for additional costs or time extension that may subsequently become apparent.

2.2 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.

- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including sources, drivers, power supplies, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Recessed Luminaires:
 - 1. Ceiling Compatibility: Comply with NEMA LE 4.
 - 2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
 - 3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.
- H. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.
- I. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.3 EXIT SIGNS

- A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.
 - 1. Number of Faces: Single- or double-face as indicated or as required for installed location.
 - 2. Directional Arrows: As indicated or as required for installed location.
- B. Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.
 - 1. Self-Powered Exit Signs:
 - a. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
 - b. Battery: Sealed, maintenance-free, nickel cadmium unless otherwise indicated.
 - c. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
 - d. Provide low-voltage disconnect to prevent battery damage from deep discharge.

2.4 LED DRIVERS

- A. LED Drivers:
 - 1. Manufacturer limitations: All LED drivers shall be supplied by the light fixture manufacturer and specifically paired with each light source so that the LED driver combination will operate per published performance and is compatible with control method indicated. Where possible, all fixture drivers shall be of the same family/series and shall be supplied by a single manufacturer.
 - 2. General Requirements:
 - a. Driver shall operate for at least 50,000 hours at maximum case temperature and 90 percent non-condensing relative humidity.
 - b. For some LED fixture, remote drivers are required.
 - 1) It is the contractor responsibility to properly size and otherwise 'engineer' the complete LED system to account for wire size, voltage drop, ambient conditions (dry/wet, temperature, dimmability, etc.).
 - 2) Each manufacturer should be contacted regarding confirmation of final installation details and arrangements. Contract documents may or may not indicate anticipated locations for remote drivers, but final locations will be subject to field conditions and are the responsibility of the contractor.
 - 3. Wherever available, provide dual voltage (120/277V) driver units.

4. Integral thermal protection to automatically reduce power output to protect LED drive and LED light engine/fixture from damage due to over-temperature conditions that exceed the LED driver's maximum operating temperature at the calibration point.
5. Drivers shall be designed and tested to withstand electrostatic discharges incurred during manufacturing, installation, or field troubleshooting without impairment of performance when tested according to IEC 61000-4-2.
6. Drivers shall be designed and tested to withstand Category A surges of 4,000V according to IEEE C62.41.2 without impairment of performance.
7. Drivers shall be Class A sound rating, inaudible in a 27 dBA ambient noise condition.
8. Meet NEMA 410 inrush requirements for mitigating inrush currents with solid state lighting sources.
9. Dimming Range:
 - a. Refer to UTSW Design Guideline "Recommend Commonly Used Light Schedule" and "Lighting Control Matrix." where dimming range is not indicated, request clarification from the architect prior to submitting bid.
 - b. As a minimum, one percent relative light output unless dimming capability to lower level is indicated, without flicker.
10. Control Compatibility: Fully compatible with the dimming controls to be installed.
11. Product(s):
 - a. Where a specific manufacturer or model is indicated elsewhere in the luminaire schedule or on the drawings, substitutions are not permitted unless explicitly indicated.

2.5 LED EMERGENCY POWER SUPPLY UNITS

- A. Description: Self-contained LED emergency power supply units suitable for use with indicated luminaires, complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Compatibility:
 1. Drivers: Compatible with standard LED drivers operating 20-50V DC, or as indicated for associated fixture model.
- C. Operation: Upon interruption of normal power source, solid-state control automatically switches connected lamp(s) to the LED emergency power supply for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- D. Universal input 120-277 VAC, 50/60 Hz.
- E. Diagnostics: Provide accessible and visible multi-chromatic combination test switch/indicator light to display charge, test, and diagnostic status and to manually activate emergency operation.
- F. Operating Temperature: From 32 degrees F (0 degrees C) to 122 degrees F (50 degrees C) unless otherwise indicated or required for the installed location.
- G. Five (5) Year Warranty.
- H. Accessories:
 1. Provide compatible accessory remote combination test switch/indicator light where indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 05 33 - Conduits and Boxes as required for installation of luminaires provided under this section.

- B. Perform work in accordance with NECA 1 (general workmanship).
 - C. Install products in accordance with manufacturer's instructions.
 - D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).
 - E. Provide required support and attachment in accordance with Section 26 05 29 - Supporting Devices.
 - F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
 - G. Suspended Ceiling Mounted Luminaires:
 - 1. Do not use ceiling tiles to bear weight of luminaires.
 - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
 - 3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
 - 4. Secure pendant-mounted luminaires to building structure.
 - 5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
 - 6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gauge, connected from opposing corners of each recessed luminaire to building structure.
 - 7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
 - H. Recessed Luminaires:
 - 1. Install trims tight to mounting surface with no visible light leakage.
 - 2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
 - I. Install accessories furnished with each luminaire.
 - J. Bond products and metal accessories to branch circuit equipment grounding conductor.
 - K. Exit Signs:
 - 1. Unless otherwise indicated, connect unit to unswitched power from circuit indicated. Bypass local switches, contactors, or other lighting controls.
 - L. Identify luminaires connected to emergency power system in accordance with Section 26 05 53 - Electrical Identification.
 - M. Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.
- 3.4 FIELD QUALITY CONTROL
- A. See Section 01 45 00 - Project Quality Control, for additional requirements.
 - B. Inspect each product for damage and defects.
 - C. Operate each luminaire after installation and connection to verify proper operation.
 - D. Test self-powered exit signs and emergency lighting units to verify proper operation upon loss of normal power supply.
 - E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.
- 3.5 ADJUSTING
- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
 - B. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.
- 3.6 LIGHTING FIXTURES TO REMAIN
- A. All lighting fixtures and luminaries to remain, refer to Section 26 05 01 - Electrical Demolition for required Cleaning and Repair.
- 3.7 COOPERATION AND CLEANUP
- A. It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the job site in a clean and safe condition.
 - B. At the end of each day's work, each trade shall properly store all tools, equipment and materials and shall clean all debris from the job. Upon the completion of the job, each trade shall immediately remove all tools, equipment, any surplus materials, and all debris caused by that portion of the work.

3.8 COMMISSIONING

- A. See Section 01 91 00 - General Commissioning Requirements for commissioning requirements.

3.9 CLOSEOUT ACTIVITIES

- A. As part of project punch list requirements per Section 01 77 00 - Closeout Procedures and Submittals include UTSW Electrical Shop, UTSW Utilities, UTSW Utilities Controls / Operations, UTSW Building Maintenance, UTSW PM, OSBC, and other associated teams.
- B. Provide revised Operation and Maintenance Data including final installed components schedule, maintenance manuals, and warranty documentation to UTSW PM and to UTSW Building Maintenance.

3.10 TRAINING

- A. Refer to Section 01 79 00 - Demonstration and Training as well as individual technical Sections for specific training requirements.
- B. Where training is called for in other sections provide a minimum of 8 hours on site training for Owner's representatives.
- C. Training shall be presented by a qualified instructor with training experience and technical knowledge of the product.
- D. Submit a training agenda, proposed date, and instructor qualifications to the Owner for approval.

3.11 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION 26 51 00



DIVISION 27

COMMUNICATIONS



SECTION 27 05 00

COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Requirements for common work results for communications systems.
- B. Structured Cabling System Manufacturer Solution.
 - 1. Provide a complete manufacturer's solution for all UTP installations. A single manufacturer's solution shall be used throughout the project.
 - 2. For UTP cable, provide a Category 6A UTP solution for all UTSW new construction.
 - a. Acceptable solutions are:
 - 1) CommScope 2091SD M2400A-1U-GS/760118349 GigaSPEED X10D U/UTP Angled Single-Row Modular Panel, 24 port fitted with GigaSPEED X10D MGS600-262; white in color.
 - 3. For UTP cable, provide a Category 6 UTP solution for lease buildings or to match existing environment.
 - a. CommScope 2071 Blue in color with GigaSPEED XL MGS400-262.
 - 4. For Single Mode cable, provide a zero water peak single mode solution
 - a. CommScope SYSTIMAX TeraSPEED Solution
 - 5. For multi-mode cable, provide an OM4 solution
 - a. CommScope SYSTIMAX LazrSPEED Solution
- C. Structured Cabling System: Provide complete Structured Cabling System (SCS) with accessories.
 - 1. SCS: Serve as vehicle for transport of data, video, and voice telephony signals throughout network from designated demarcation points to outlets located at various desk, workstation and other locations as indicated on Drawings and Specifications.
 - 2. Applications and Link Standards: Include, but not be limited to, IEEE 802.3-2002 (Ethernet), 1000BASE-T (Gigabit Ethernet).
 - 3. Gigabit Cable Performance: Capable of supporting applications including 1000Base-T Gigabit Ethernet.
- D. Data and Voice: Provide:
 - 1. Free standing equipment racks, or enclosed cabinets located at Telecommunications Rooms (TR).
 - 2. Wiring utilized for data and voice communications originating in equipment racks, or enclosed cabinets.
 - 3. Wiring, terminations and patch bays between these designated demarcation points and outlet locations.
 - 4. Work Area Outlets (WAO).

1.3 RELATED REQUIREMENTS

- A. Related Sections include but may not be limited to the following:
 - 1. Section 01 10 00 - Summary.
 - 2. Section 01 25 00 - Substitution Procedures.
 - 3. Section 01 31 00 - Project Management and Coordination.
 - 4. Section 01 33 00 - Submittal Procedures.
 - 5. Section 01 42 00 - References.
 - 6. Section 01 60 00 - Product Requirements.
 - 7. Section 01 70 00 - Execution and Closeout Requirements.
 - 8. Section 01 73 00 - Execution for coordination for cutting and patching.
 - 9. Section 07 84 13 - Penetration Firestopping.
 - 10. Section 07 92 00 - Joint Sealants.
 - 11. Section 07 84 13 - Penetration Firestopping.

12. Section 27 05 26 - Grounding and Bonding for Communications Systems.
13. Section 27 05 28.29 - Hangers and Supports for Communications Systems.
14. Section 27 05 28.33 - Conduits and Boxes for Communication Systems.
15. Section 27 05 53 - Identification for Communications Systems.
16. Section 27 07 00 - Communications Testing.
17. Section 27 11 13 - Communications Entrance Protection.
18. Section 27 11 19 - Communications Termination Blocks and Patch Panels.
19. Section 27 11 23 - Communications Cable Management.
20. Section 27 13 13 - Communications Copper Backbone Cabling.
21. Section 27 13 13.13 - Communications Copper Cable Splicing and Terminations.
22. Section 27 13 23 - Communications Optical Fiber Backbone Cabling, Exterior.
23. Section 27 13 23.13 - Communications Optical Fiber Splicing and Terminations.
24. Section 27 13 33 - Communications Coaxial Backbone Cabling.
25. Section 27 13 33.13 - Communications Coaxial Splicing and Terminations.
26. Section 27 13 43 - Communications Cabling, Exterior Cameras.
27. Section 27 15 13 - Communications Copper Horizontal Cabling.
28. Section 27 15 33 - Communications Coaxial Horizontal Cabling.
29. Section 27 15 43 - Communications Faceplates and Connectors.
30. Section 27 16 19 - Communications Patch Cords and Station Cords.
31. Section 27 41 00 - Common Work Results for Audiovisual Systems and Equipment.
32. Section 27 53 13 - Clock Systems.
33. Section 27 53 17 - Wireless Temperature Monitoring System.
34. Section 27 53 18 - WLAN.
35. Communication Firestopping Guidelines and Products.

1.4 REFERENCE STANDARDS

- A. Reference Standards: See Section 01 42 00 - References. In addition to requirements shown or specified, comply with applicable provisions of following for design, materials, fabrication, and installation of component parts:
 1. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 2. AASHTO H-20 Load Rating.
 3. ANSI C80.1 - Specification for Rigid Steel Conduit, Zinc Coated.
 4. ANSI C80.3 - Electrical Metallic Tubing; Zinc Coated.
 5. ANSI C80.6 - Intermediate Metal Conduit; Zinc Coated.
 6. ANSI/NECA/BICSI-568 - Installing Commercial Building Telecommunications Cabling.
 7. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
 8. ASTM A193/A193M - Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
 9. ASTM A475 - Standard Specification for Zinc-Coated Steel Wire Strand.
 10. ASTM A510/A510M - Standard Specification for General Requirements for Wire Rods and Course Round Wire, Carbon Steel.
 11. ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
 12. ASTM C33/C33M - Standard Specification for Concrete Aggregates.
 13. ASTM C587 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
 14. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 15. ASTM D1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³(2,700 kN-m/m³).
 16. AWPA E12 - Standard Method of Determining Corrosion of Metal in Contact with Treated Wood.
 17. BICSI Customer-Owned Outside Plant Design Manual, 4th edition including all subsequent addenda/errata.
 18. BICSI Telecommunications Distribution Methods Manual, 12th edition including all subsequent addenda/errata.
 19. City and State Ordinances, as applicable to location.
 20. Factory Mutual and/or Owner's Representative's Insurance Carrier.
 21. FCC Part 15 – Radiated Emission Limits.

22. FCC Part 68 – Connection of Terminal Equipment to the Telephone Network.
23. IEEE C2 - National Electrical Safety Code®, 2007 edition including all subsequent addenda/errata.
24. ISO/IEC 11801 Ed.2:2002, Information Technology – Generic Cabling for Customer Premises.
25. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
26. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
27. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
28. NEMA TC 6&8 - PVC Plastic Utilities Duct for Underground Installations.
29. NEMA TC 9 - Fittings for PVC Plastic Utilities Duct for Underground.
30. NEMA VE 1 – Metal Cable Tray Systems.
31. NEMA VE 2 - Cable Tray Installation Guidelines.
32. NFPA 70 - National Electrical Code.
33. NFPA 72 - National Fire Alarm Code.
34. NFPA 101 - Life Safety Code.
35. NSTISSI No. 7003 – Protected Distribution Systems.
36. NSTISSAM TEMPEST/2-95 – Red/Black Installation Guidance.
37. TIA-526-7 – OFSTP-7; Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant.
38. TIA-526-14A – OFSTP-14; Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.
39. TIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises.
40. TIA-568-C.1 – Commercial Building Telecommunications Cabling Standard.
41. TIA-568-C.2 – Balanced Twisted-Pair Telecommunications Cabling and Components Standards.
42. TIA-568-C.3 – Optical Fiber Cabling Components Standard.
43. TIA-569-B - Commercial Building Standard for Telecommunications Pathways and Spaces
44. TIA-569-B-1 - Commercial Building Standard for Telecommunications Pathways and Spaces, Addendum 1 – Temperature and Humidity Requirements for Telecommunications Spaces.
45. TIA-570-B – Residential Telecommunications Infrastructure Standard.
46. TIA-570-B-1 – Residential Telecommunications Infrastructure Standard, Addendum 1 – Additional Requirements for Broadband Coaxial Cabling.
47. TIA-598-C - Optical Fiber Cable Color Coding.
48. TIA-606-A - Administration Standard for Commercial Telecommunications Infrastructure.
49. TIA-606-A-1 - Administration Standard for Commercial Telecommunications Infrastructure, Addendum 1 – Administration of Equipment Rooms and Data Center Computer Rooms.
50. TIA J-STD-607-A - Commercial Building Grounding (Earthing) and Bonding Requirements For Telecommunications.
51. TIA-758-A - Customer-Owned Outside Plant Telecommunications Infrastructure Standard.
52. TIA/EIA-862 – Building Automation Systems Cabling Standard for Commercial Buildings.
53. TIA-942 – Telecommunications Infrastructure Standard for Data Centers.
54. TIA-942-1 – Data Center Coaxial Cabling Specifications and Application Distances.
55. TIA-1005-1 – Telecommunications Infrastructure Standard for Industrial Premises, Addendum 1 – Industrial Pathways and Spaces.
56. TIA-TSB-155-A – Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T.
57. TIA-TSB-185 – Environmental Classification (MICE) Tutorial.
58. UL 6 - UL Standard for Safety for Electrical Rigid Metal Conduit – Steel.
59. UL 797 - Electrical Metallic Tubing- Steel.
60. UL 1242 - Type IMC threaded and unthreaded conduit, nipples, bends, and couplings in 1 to 4 inch trade size.

1.5 DEFINITIONS

- A. Definitions: See Section 01 42 00 - References for additional definitions.
 1. Code Requirements: Minimum requirements.
 2. Final Acceptance: Owner's Representative's acceptance of project from Contractor.
 3. Furnished by Others: Receive delivery at job site or where called for and install.
 4. Labeled: Classification by standards agency.
 5. Owner's Representative: Architect, Engineer, or Designer having contract directly with Owner for professional services.

6. Relocate: Disassemble, disconnect, and transport equipment to new locations, then clean, test, and install ready to use.
7. Replace: Remove and provide new item.
8. Rough-in: Pipe, duct, conduit, equipment layout and installation.
9. Structured Cabling Systems (SCS): Equipment and cabling including hardware, termination blocks, cross connect wire or cordage, patch panels, patch cords, telecommunication outlets, work area cords, UTP and fiber cable installed and configured to provide computer data and voice connectivity from each data or voice device to network file server or voice network/switch designated as service point of local area network.

B. Acronyms:

1. ACR: Attenuation-to-Crosstalk Ratio.
2. ADA: Americans with Disabilities Act.
3. ANSI: American National Standards Institute.
4. ASTM: American Society for Testing Materials.
5. ATM: Asynchronous Transfer Mode.
6. AWG: American Wire Gauge.
7. BD: Building Distributor (replacing Intermediate Cross-Connect (IC)).
8. BDF: Building Distribution Facility.
9. BICSI®: Building Industry Consulting Services International.
10. BTU: British Thermal Unit.
11. CATV: Community Antenna Television (cable television).
12. CCITT: The International Telegraph and Telephone Consultative Committee.
13. CCTV: Closed Circuit Television.
14. CD: Campus Distributor (replacing Main Cross-Connect [MC]).
15. dB: Decibel.
16. EF: Entrance Facility.
17. EIA: Electronics Industry Alliance.
18. ELFEXT: Equal Level Far-End Crosstalk.
19. EMC: Electromagnetic Compatibility.
20. EMI: Electromagnetic Interference.
21. ER: Equipment Room.
22. FCC: Federal Communications Commission.
23. FD: Floor Distributor (replacing Horizontal Cross-Connect [HC]).
24. FDDI: Fiber Distribution Data Interface.
25. FEXT: Far-End Crosstalk.
26. FM: Factory Mutual Insurance Company.
27. FOTP: Fiber Optic Test Procedure.
28. Freq: Frequency.
29. GE: Grounding Equalizer.
30. GND: Ground.
31. HC: Horizontal Cross-Connect (replaced with Floor Distributor [FD]).
32. HH: Handhole.
33. HVAC: Heating, Ventilation, and Air Conditioning.
34. Hz: Hertz.
35. IC: Intermediate Cross-Connect (replaced with Building Distributor [BD]).
36. ICEA: Insulated Cable Engineers Association.
37. IDC: Insulation Displacement Contact.
38. IDF: Intermediate Distribution Frame.
39. IEEE: Institute of Electrical and Electronic Engineers.
40. IRI: Industrial Risk Insurers.
41. ISD: Information Systems Division.
42. ISO: International Organization for Standardization.
43. ITU: International Telecommunications Union.
44. Mbps: Megabits per second.
45. MC: Main Cross-Connect (replaced with Campus Distributor [CD]).
46. MDF: Main Distribution Frame.

47. MH: Maintenance Hole.
48. MHz: Megahertz.
49. MM: Multimode.
50. MTR: Main Technology Room.
51. MUTO: Multi-user Telecommunication Outlet.
52. NEC: National Electrical Code, NFPA 70.
53. NEMA: National Electrical Manufacturers Association.
54. NESC: National Electrical Safety Code, IEEE C2.
55. NFPA: National Fire Protection Association.
56. NR: Network Room.
57. OSHA: Occupational Safety and Health Administration.
58. OSP: Outside Cable Plant.
59. OTDR: Optical Time Domain Reflectometer.
60. PIC: Plastic Insulated Conductor.
61. POTS: Plain Old Telephone Service.
62. PR: Pair.
63. PVC: Polyvinyl Chloride.
64. RCDD®: Registered Communications Distribution Designer.
65. RFI: Radio Frequency Interference.
66. RH: Relative Humidity.
67. SCS: Structured Cabling System.
68. SM: Single-mode.
69. SMDF: Strategic Main Distribution Frame.
70. SNR: Signal-to-Noise Ratio.
71. SONET: Synchronous Optical Network.
72. SW: Station Wire.
73. TB: Terminal Block.
74. TBB: Telecommunication Bonding Backbone.
75. TC: Telecommunications Closet (replaced with Telecommunications Room ~[TR]).
76. TGB: Telecommunications Grounding Busbar.
77. TIA: Telecommunications Industry Association.
78. TMGB: Telecommunications Main Grounding Busbar.
79. TO: Telecommunications Outlet.
80. TR: Technology room (replacing Telecommunications Closet (TC)).
81. UL: Underwriters Laboratory.
82. µm: Micron.
83. UPS: Uninterruptible Power Supply.
84. USOC: Universal Service Order Code.
85. WAO: Work Area Outlet.

1.6 SUBMITTALS

- A. General: Comply with Section 01 33 00 - Submittal Procedures and Section 01 60 00 - Product Requirements.
 1. Submittal Schedule and Log: Comply with Section 01 33 00 - Submittal Procedures.
 2. Proposed Products List: Comply with Section 01 33 00 - Submittal Procedures.
 3. Product Data: Comply with Section 01 33 00 - Submittal Procedures.
 4. Shop Drawings: Comply with Section 01 33 00 - Submittal Procedures.
 5. Test Reports: Comply with Section 01 33 00 - Submittal Procedures and Section 27 07 00 - Communications Testing.
 6. Operation and Maintenance Data: Comply with 01 70 00 - Execution and Closeout Requirements.
 - a. Submit operation and maintenance manuals for communications systems and equipment. Use manuals during demonstrations and instruction of Owner's personnel.
 7. Warranty: Comply with Section 01 70 00 - Execution and Closeout Requirements.
- B. Project Record Documents:
 1. Maintain timely and accurate records of actual device locations.
 2. Carefully documents major deviations in work as actually installed.

3. Include notations reflecting as-built conditions of any additions to or variation from original Drawings.
 4. Include actual locations of installed conduits and cable tray.
 5. Include following intra-building wiring information for each specified media prior to final acceptance:
 - a. Location and identification of distribution cabinets and of equipment located inside cabinets and equipment rooms.
 - b. Terminal information, outlet numbering, and pair count information at each distribution frame.
 - c. Schematic drawings of backbone.
 - d. Routing of cable and termination information.
 6. Include complete listing of pair assignment records for copper wiring, optical fiber cabling and coaxial cabling.
 - a. Copper Cable Records: Include status of each copper pair.
 - b. Optical Fiber Cable Records: Include strand allocation, test results, and identification of media and protocol used.
 7. Project Record Drawings; Submit electronic drawings. Confirm format with Owner's Representative.
- C. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firms regularly and currently engaged in production of equipment and accessories provided.
 1. Equipment: In satisfactory and efficient operation on at least three installations for not less than three years.
 2. Suppliers: Factory or manufacturer trained and authorized personnel for installation and service of equipment provided.
- B. Installer Qualifications:
 1. Certified by SCS manufacturer, adhere to engineering, installation and testing procedures and utilize authorized manufacturer components and distribution channels in provisioning this Project.
 2. The Contractor shall have been active in bidding, being awarded, and performing work consistent with that indicated on the Contract Documents for a period of 5 years or longer. In addition, the Contractor shall have installation experience in a hospital or clinical environment.
 3. The Contractor shall employ or subcontract a certified AutoCAD/Revit professional for the purposes of creating record documentation. Contractor shall submit a copy of this individual's qualifications along with all relevant AutoCAD certificates and/or diplomas.
 4. Utilize and maintain tools and equipment necessary for successful installation and testing of optical fiber and Category 6/6A metallic premise distribution systems and have personnel adequately trained in use of such tools and equipment.
 5. Labor: Competent, skilled and certified by systems manufacturer. The Contractor shall maintain an installation staff whose sole function is the installation of Structured Cabling and associated equipment and shall not utilize additional personnel obtained by means of a temporary placement or staffing agency.
 - a. Contractor: Employ competent superintendent, satisfactory to Owner's Representative, on Work during progress of Work. Not remove approved Superintendent from Work without approval of Owner's Representative, unless that Superintendent leaves employ of Contractor.
 - b. Project Manager: Employ full-time Project Manager registered by BICSI as current RCDD.
 - 1) Installer's representative, speak and respond for Installer.
 - 2) Make at least one visit per week visit to construction site to determine progress of construction and be available to resolve contract issues.
 - 3) May not be a subcontractor to the Contractor.
 - 4) Shall provide regular project updates to the Owner's Representative as to percentage of job completed broken down by category of work, for example, horizontal cabling, backbone copper, backbone fiber, system A, system B, etc., the status of any unforeseen circumstances, and/or changes to the project design necessitated by field conditions.
 - c. Superintendent: Represent Contractor and communications given to superintendent shall be as binding as if given to Contractor. Shall be a registered BICSI Technician.
 - d. Installers:

- 1) All installation personnel assigned to the task of pulling, terminating and testing cabling shall possess a current certification by BICSI and the manufacturer of the cabling products being installed.
 - 2) The Contractor shall not utilize apprentice or trainee personnel for the pulling or termination of Structured Cabling. Furthermore, apprentices or trainees may only assist in the pulling of Structured Cabling. The primary laborer for the pulling of Structured Cabling must be a certified installer.
 - 3) The Contractor's installation staff shall consist of 100 percent certified installation personnel. The remaining shall be either apprentice installation personnel or laborers under full time employment by the Contractor. Of the certified staff, 40 percent shall be Journeymen/BICSI Technicians. The remainder shall be BICSI Level I or Level II Installers. The Owner's Representative or OSUMC reserves the right to wave these requirements. Contractor shall submit a list of certified installers to be assigned to the project.
6. The contractor must have a comprehensive Safety Program that includes weekly safety meetings covering all aspects of installation and jobsite safety training. The contractor shall have in place a dedicated Safety Director/Manager to oversee compliance with the safety policy. The contractor shall submit with its proposal, documents detailing the Safety Program, weekly toolbox topics and outlines of the various training topics. Regulatory Requirements: Comply with Section 01 41 00 – Regulatory Requirements. Comply with following:
- a. Applicable rules and regulations of federal and state and local governmental agencies.
- C. Project Meetings: Comply with Section 01 31 00 - Project Management and Coordination.
1. Pre-Construction Meeting: Attend meeting when requested by Contractor. Come prepared with questions and prepared to answer questions about communications work.
 2. Progress Meetings: Attend meetings when requested by Contractor. Come prepared with questions and prepared to answer questions about communications work.
- D. Intent of Documents:
1. Drawings: Diagrammatic. See Section 01 31 00 - Project Management and Coordination.
 - a. Due to small scale of Drawings, it is not possible to indicate offsets, fittings, changes in elevation, etc. Prior to rough-in, verify exact locations for installation with field measurements and with equipment being connected.
 - b. If field conditions or equipment require significant change to original documents, contact Owner's Representative before proceeding.
 - c. Exact locations of equipment and fixtures subject to approval of Owner's Representative.
 - d. Coordination Drawings: Prepare in accordance with Section 01 31 00 - Project Management and Coordination.
 2. Omissions from Drawings or Specifications, or incorrect description of details of Work which are necessary to carry out intent of Drawings and Specifications, or which are customarily performed, shall not relieve Contractor from performing such omitted or incorrect described detail of Work. Perform such Work as if verified field measurements, field construction criteria, materials, catalog numbers and similar data, or will do so, and that he has checked and coordinated each shop drawing and sample with requirements of Work and of Contract Documents.
- E. Review of Contract Documents: Comply with Section 01 31 00 - Project Management and Coordination.
1. Verify dimensions locating work and its relation to existing work, existing conditions and their relation to work and man made obstructions and conditions, etc. affecting completion and proper execution of work as indicated in Contract Documents.
- F. Coordination: Coordinate work of this section with requirements of local telephone exchange carrier, requirements of Owner's telephone equipment supplier, workstation, and local area network (LAN) equipment suppliers, furniture suppliers and other sub-contractors as required.
1. Meet with representatives of above organizations and Owner's Representative to exchange information and agree on details of equipment arrangements and installation interfaces.
 2. Record agreements reached in meetings and distribute record to other participants.
 3. Adjust arrangements and locations of distribution frames, patch panels, and cross connects in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

- G. Methods of construction not specifically described or indicated in Contract Documents subject to control and approval of Owner's Representative.
 - H. Owner: Desires showcase cable plant following installation. Install, pathways, dressing and organization of cable plant in neat and well-engineered manner.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. General: Comply with Section 01 60 00 - Product Requirements.
 - 1. Cable Storage: Do not roll or store cable reels without appropriate underlay.
 - 2. Pre-installation Inspection: Visually inspect cables, cable reels, and shipping cartons to detect possible cable damage incurred during shipping and transport. Replace visibly damaged goods at no additional cost to Owner.
- 1.9 PROJECT CONDITIONS
- A. Use of Premises: Comply with Section 01 10 00 - Summary.
 - 1. Plant Services: Schedule necessary shutdowns of plant services with Owner's Representative, and obtain written permission from Owner's Representative.
 - B. Work Restrictions: Hours of Work: As defined by project documents.
 - C. Special Procedures: Apply to restricted areas such as operating rooms, labs, research areas and other public spaces. Adhere to special procedures.
 - D. Continuity of Services and Scheduling: Building: In use during construction operations. Maintain existing systems in operation within rooms of building at all times
 - 1. Coordinate planned disruption of existing systems and services, two weeks in advance, with Owner's Representative. No additional compensation shall be allowed for these shutdown periods even though premium-time work may be required. Provide temporary services to equipment or systems that cannot be shutdown, as determined by UTSW.
 - 2. Disruption of Critical Services: After hour or weekend working constraints.
 - 3. Certain Areas of Building: Access restricted or regulated due to strict environmental control for experimentation, fabrication, testing, or personnel safety. Owner's Representative: Attempt to identify such areas for advanced scheduling and admittance permission.
 - 4. Make every effort to minimize disruption and expedite work through coordination and cooperation.
 - 5. For areas under renovation, coordinate installation activities with Owner's Representative and updated drawings detailing proposed modifications to Architectural, Mechanical or Electrical facilities.
 - 6. Existing systems that are within the immediate proximity of work areas and TRs shall be protected from interference, damage, and accidental disconnection of cables, including power, during access to facilities. If any question arises, the Owner's Representative shall be contacted immediately for inquiry. In case of interference, damage, or accidental disconnection of cables, notify Construction Manager.
 - 7. Adjust work schedule within reason, as per direction of Owner's Representative, and coordinate with work of other trades in order to make portions of project available to Owner as soon as possible.
 - 8. Contractor: Responsible for expenses due to untimely or improperly coordinated work.
- 1.10 SEQUENCING AND SCHEDULING
- A. General: Sequence and schedule work in accordance with Section 01 31 00 - Project Management and Coordination.
 - B. Progress Schedule: Prepare and submit in accordance with Section 01 33 00 - Submittal Procedures.
- 1.11 WARRANTY
- A. Special Warranty: Prepare and submit in accordance with Section 01 60 00 - Product Requirements.
 - 1. Cable Integrity and Associated Terminations: Warrant to be free from defects, transpositions, opens-shorts, kinks, damaged jacket insulation, etc.
 - 2. SCS: Submit project paperwork for a 20 year CommScope Extended Product Warranty. Repair or replace elements of SCS as required to deliver specified performance of complete system. The Contractor, within 10 business days of project completion shall fully complete and submit all documentation to the manufacturer as required to implement the extended warranty period. Coordinate guarantee and warranty requirements with Division 01 Specifications.
 - 3. One Year Correction Period: For period of one year from Substantial Completion, replacement of defective equipment will commence within 24 hours of first notification.

- a. Complete repairs to equipment within 72 hours. If repairs cannot be completed during this time period, or if ordering of parts is required, forward to Owner's Representative every 72 hours documentation of progress of repairs.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. General: Comply with Section 01 60 00 - Product Requirements.
- B. Materials and Equipment: New and unused, clean, free of defects, and free of damage and corrosion.
 1. Used equipment or damaged material not allowed.
 2. Standard products of manufacturer unless otherwise specified.
 3. Materials: Bear UL label where applicable. Application and Installation: In accordance with labeling and listing.
 4. Electrical Equipment and Systems: UL Standards, NEC, and CSA. This listing requirement applies to entire assembly. Perform modifications to equipment to suit intent of specifications in accordance with these requirements.
 5. All floor mounted devices for the termination of cable shall be flush with floor and readily accept Systimax outlets without modification to device.
- C. Contract documents are prepared on basis of acceptable manufacturer(s).
 1. If Contractor proposes to use products other than specified equipment, submit detailed drawings indicating proposed installation of equipment.
 2. If substitution submittal is rejected, revise and resubmit specified equipment that conforms to Contract Documents.
 3. If acceptable manufacturer is no longer available, submit equivalent manufacturer and/or product.
- D. Additional Engineering Services: If Consultant provides additional engineering services as result of substitute materials or equipment by Contractor, or changes by Contractor in dimension, weight, power requirements, etc., of equipment provided, then Contractor shall pay Owner for cost of such additional services.
- E. Installed Equipment and Materials: Compatible with other items being provided and with existing items so that complete and fully operational system results.

2.2 CABLES

- A. Cable Passing through Two or More Floors: Suitable, listed and marked for use in riser application.
 1. Riser Cable: CMR or OFNR rated per NEC and comply with other applicable codes.
- B. Cable in Plenums: Rated, listed and marked for use in plenum application.
 1. Plenum Cable: CMP rated per NEC and comply with other applicable codes.
- C. If cable leaves riser then it must be plenum.
- D. All horizontal cable shall be CMP, plenum rated.

2.3 FACTORY-ASSEMBLED PRODUCTS

- A. Provide maximum standardization of components to reduce spare part requirements.
- B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.
 1. Components of assembled unit need not be products of same manufacturer.
 2. Alike Constituent parts: Product of single manufacturer.
 3. Components: Compatible with each other and with total assembly for intended service.
- C. Components of Equipment: Bear manufacturer's name or trademark, model number and serial number on name plate securely affixed in conspicuous place, or cast integral with, stamped or otherwise permanently marked upon components of equipment.
- D. Equipment that Serves Same Function: Same make and model. Exception allowed if performance requirements cannot be met.

2.4 TOOLS AND EQUIPMENT

- A. Miscellaneous Equipment: Provide screws, anchors, clamps, tie wraps, distribution rings, wire molding, miscellaneous grounding and support hardware, etc., necessary to facilitate installation of communications system.

- B. Special Equipment and Tools: Provide special installation equipment or tools necessary to properly complete system. This may include, but is not limited to, tools for terminating cables, testing equipment for copper/fiber cables, communication devices, jack stands for cable reels, or cable wenchers.
- C. Lifting Attachments: Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting Attachments: Withstand handling conditions that might be encountered without bending or distortion of shape, such as rapid lowering and braking of load.

2.5 MISCELLANEOUS

- A. Miscellaneous Support: Metal Bars, Plates, Tubing: ASTM Standards:
 - 1. Steel Plates, Shapes, Bars, and Grating: ASTM A36/A36M .
 - 2. Cold-Formed Steel Tubing: ASTM A500/A500M.
 - 3. Hot-Rolled Steel Tubing: ASTM A501/A501M.
 - 4. Steel Pipe: ASTM A53/A53M, Schedule 40, welded.
 - 5. Provide clevis hangers, riser clamps, conduit straps, threaded c-clamps with retainers, ceiling trapeze hangers, wall brackets and spring steel clamps as applicable.
 - 6. Protected with zinc coating or treatment of equivalent corrosion resistance using approved alternative treatment, finish or inherent material characteristic.
 - 7. Products for Outdoor Applications: Hot dipped galvanized.
- B. Metal Fasteners: Zinc-coated (type, grade and class as required).
- C. Access Doors: Provide in accordance with Section 08 31 13 - Access Doors and Frames.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General: Perform in accordance with Division 01 10 00 - Summary.
- B. Examination of Premises: Visit Site to become familiar with local conditions under which work is to be performed and correlate observations with requirements of Contract Documents. No allowance made for claims for concealed conditions which Contractor, in exercise of reasonable diligence in its observations of site and local conditions should have learned of.
- C. Before ordering any materials or doing Work, verify measurements and be responsible for correctness of same.
 - 1. No extra charge or compensation allowed for duplicate work or material required because of unverified difference between actual dimension and measurement indicated on Drawings.
 - 2. Submit discrepancies found in writing to Owner's Representative for consideration before proceeding with Work.
- D. Facility Review: Conduct walk through with Owner's Representative of work areas, describing specific work methods and proposed schedules, before commencing work, enabling Owner's Representative to identify areas of concern, desired installation timetables and review important procedural and safety precautions.
- E. Prior to start of installation, meet at project site with Construction Manager and other trades performing related work to coordinate efforts. Review areas of potential interference and resolve conflicts before proceeding with work. Plan crucial scheduled completions of equipment room, data center, workstation outlets and meeting rooms.
- F. Examine areas and conditions under which system is to be installed. Do not proceed with work until satisfactory conditions have been achieved.
 - 1. Beginning of installation means installer accepts existing conditions.

3.2 PREPARATION

- A. Protection: Protect Owner's facilities, equipment, and materials from dust, dirt, and damage during construction.
 - 1. Remove protection at completion of work.

3.3 ROUGH-IN

- A. Before construction work commences, visit site and identify exact routing for horizontal and backbone pathways. Identify required core locations.
- B. Equipment Locations: Coordinated with other trades, other renovation projects, and existing conditions to eliminate interference with required clearances for equipment maintenance and inspections.

1. Provide easy, safe, and code mandated clearances at equipment racks and enclosures, and other equipment requiring maintenance and operation.
 - a. If it is determined that ample maintenance and passage space has not been provided, rearrange work and/or provide other equipment as required for maintenance space.
 2. Coordinate work with other trades and existing conditions to determine exact routing of cable tray, hangers, conduit, etc., before fabrication and installation.
 - a. Where more than one trade is involved in area, space or chase, cooperate to utilize space appropriately in relation to their individual requirements.
 3. Bring changes in size or location of material or equipment necessary to meet field conditions or in order to avoid conflicts between trades to immediate attention of Owner's Representative before such alterations are made.
 4. Verify with Owner's Representative exact location and mounting height of equipment in finished areas, such as equipment racks, communication and electrical devices.
 5. Additional Engineering Services: If Consultant provides additional engineering services for following, then Contractor shall pay Owner for cost of such additional services:
 - a. To examine and evaluate changes proposed by Contractor for convenience of Contractor.
 - b. As result of Contractor's errors, omissions or failure to conform to requirements of Contract Documents.
- C. Access Doors: Provide in accordance with Section 08 31 13 - Access Doors and Frames when necessary to provide proper access to communication system components.

3.4 INSTALLATION

- A. General: Comply with Section 01 31 00 - Project Management and Coordination and Section 01 60 00 - Product Requirements.
1. Install materials and equipment in accordance with manufacturers' recommendations. Refer conflicts between manufacturer's recommendations and Contract Documents to Owner's Representative for resolution.
 2. Coordinate ordering and installation of equipment with long lead times or having major impact on work by other trades so as not to delay job or impact schedule.
 3. Where mounting heights not detailed or dimensioned, install systems, materials and equipment to provide maximum headroom possible.
 4. Equipment: Not hidden or covered up prior to observation by Owner's Representative.
 5. Contractor: Responsible for damage to any surfaces or work disrupted as result of his work. Repair surfaces, including painting. Replace damaged ceiling tiles.
- B. Installation: In accordance with TIA-568-C.0, TIA-568-C.1, TIA-568-C.2, and TIA-568-C.3 standards and manufacturer's design and installation guidelines.
1. Ensure maximum pulling tensions of specified distribution cables not exceeded and cable bends maintain proper radius during placement of facilities.
 2. Provide additional material and labor in timely fashion to properly rectify failure to follow requirements.
- C. Concealment: Conceal work above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment impossible or impractical, notify Owner's Representative before starting that part of work and install only after his review. In areas with no ceilings, install only after Owner's Representative's review.
- D. Cutting and Patching Comply with Section 01 70 00 - Execution and Closeout Requirements.
- E. Waterproofing: Seal foundation penetrations by communications conduits and sleeves to eliminate intrusion of moisture and gases into building.
1. Spare Conduits: Plugged with expandable plugs.
 2. Service Entrance Conduits through Building: Sealed or resealed upon cable placement.
 3. Conduits with Cables in Them: Permanently sealed by firmly packing void around cable with oakum and capping with hydraulic cement or waterproof duct seal.
- F. Supports: Provide required supports, beams, angles, hangers, rods, bases, braces, straps, struts, and other items to properly support contract work.
1. Coordinate means and methods for anchoring supports with Construction Manager. All anchorages to structure must be approved by project structural engineer.
 2. Supports: Approved by Owner's Representative.

3. Modify studs, add studs, add framing, or otherwise reinforce studs in metal stud walls and partitions as required to suit contract work. If necessary, in stud walls, provide special supports from floor to structure above.
 4. Precast Panels/Planks and Metal Decks: Support communication work as determined by manufacture and Owner's Representative.
 5. Mounting Plates: Provide heavy gauge steel mounting plates for mounting communication work.
 - a. Mounting Plates: Span two or more studs.
 - b. Size Gage and Strength: Sufficient for equipment size, weight, and desired rigidity.
 - G. Cable Routing: Designed and installed so cabling and associated equipment does not interfere with operation or maintenance of other equipment.
 1. Wiring: Not hung, tied to, or supported from anything other than telecommunications raceway independently supported J-hooks, or building structure.
 2. Accessible Spaces: Install cable for easy access.
 3. Cable Paths above Suspended Ceilings, Mechanical Rooms, Closets: Not blocked or covered in way to impede addition of cable in future.
 - H. Power Separation: Do not place distribution cabling alongside power lines, or share same conduit, channel or sleeve with electrical apparatus.
 - I. Painting: Comply with Section 09 91 23 - Interior Painting. Include following:
 1. Painting for cut and patch work.
 2. Painting called for on Drawings.
- 3.5 BONDING AND GROUNDING
- A. Provide ground at distribution frames and ensure proper bonding to existing facilities.
 1. Ensure ground continuity by properly bonding appropriate cabling, closures, cabinets, conduits, service boxes, and framework.
 2. Grounds: Supplied from approved building ground and bonded to main electrical ground.
 3. Grounding: In accordance with ANSI-J-STD-607-A, NEC, NESC, NFPA, and local codes and practices.
- 3.6 PROJECT PHOTOGRAPHS
- A. Photographs: Take prior to concealment of interior or exterior conduit pathways
 1. Take at locations so that entire length of pathway captured in photograph.
 2. Underground: Prior to concrete pour and again prior to backfill.
 3. Prior to concealment of other cables that will become inaccessible after concealment.
 4. Of all firestop assemblies, from both sides of penetration, clearly showing label.
 5. Of interior manhole wall elevations.
 6. Of other installation or situation as required by Owner's Representative.
- 3.7 PENETRATIONS
- A. Conduit and Sleeve Openings: Waterproofed and fireproofed in compliance with applicable codes and regulations.
 1. Seal joints on exterior of conduit penetration in accordance with Section 07 92 00 - Joint Sealants.
 2. All core holes passing through floors shall use STI/EZ Path Series 44 devices.
 - B. Firestopping: Fire-stop openings and penetrations through fire and smoke rated wall and floor assemblies in accordance with Section 07 84 13 - Penetration Firestopping.
 1. Inside of Vertical Conduits, Fire-stop System: Dielectric, water-resistant, non-hardening, permanently pliable/re-enterable putty along with appropriate damming or backer materials.
 - a. Sealant: Capable of being removed and reinstalled.
 - b. Sealant: Adhere to penetrants and common construction materials and capable of allowing normal wire/cable movement without being displaced.
 - c. For MDF and TR Room vertical risers, use STI/EZ Path Series 44 devices. Number of STI/EZ Path devices to be determined during design stage according to cabling volume.
 2. Inside of Horizontal Conduits/Sleeves, Fire-Stop System: Mechanical system, non-hardening, permanently re-enterable assembly along with appropriate materials for assembly installation.
 3. Horizontal penetrations into MDF and TR Rooms require STI/EZ Path Series 44 devices to be determined during design stage according to cabling volume.

4. Where conduits are required to extend pathway as indicated on Drawings in such a way as mechanical systems cannot be used: Dielectric, water-resistant, moderately hardening, re-enterable material (e.g. caulks) along with appropriate damming or backer materials.
 - a. Sealant: Sets to a moderately hardened condition that will not slum over time.
 - b. Sealant: Capable of being removed and reinstalled.
 - c. Sealant: Adhere to penetrants and common construction materials and capable of allowing normal wire/cable movement without being displaced.
5. Patch openings remaining around and inside conduit, sleeves, and cable penetrations to maintain integrity of fire rated assembly.

3.8 FIELD QUALITY CONTROL

- A. Site Tests & Inspections:
 1. Provide promptly, facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as required by Contract Documents.
 2. Inspections and Tests by Owner's Representative:
 - a. Performed in manner to not unnecessarily delay work.
 - b. Contractor: Responsible to assist with these functionality and performance tests.
 - c. Demonstration Setup: Benchmark for comparison of results.
 - d. Failure of Subsystems or Systems to Perform as Specified: Considered as failure to comply with requirements of Contract Documents.

3.9 USE OF CABLE PRIOR TO ACCEPTANCE

- A. Contractor: Permit Owner to place and install cross connects, patch cords and/or equipment onto wire or cable installed under this contract, prior to Substantial Completion.
 1. Such Placement or Installation: Not evidence completion of work nor signify Owner's acceptance of Work.
- B. Owner: Responsible for any damages caused by their work forces in regards to temporary connection to new cable plant before final acceptance.
- C. Wire, cabling, and equipment provided, whether work of Contractor is partially or fully completed or not, shall be property of Owner. Owner: Certain rights and privileges in connection with their use.

3.10 CLEANING

- A. General: Comply with Section 01 70 00 - Execution and Closeout Requirements.
 1. Keep site and surrounding area free from accumulation of waste materials and rubbish on daily basis.
 2. Owner: Right to call Contractor back to perform cleanup. If Contractor fails to perform cleanup another contractor will be engaged at Contractors expense to perform cleanup.
 3. Keep communications equipment and fixtures clean for duration of project. Comply with applicable regulations regarding facilities and environmental extreme cleanliness.
 4. Provide manufacturer dust caps or cover outlet openings with residue-free tape. Cover TR termination panels to prevent dust contamination during installation. Remove of coverings, caps, and tape shall leave clean, unmarked surfaces.

3.11 CUTOVER, GO-LIVE SUPPORT, AND SUPPORT

- A. Cutover: Place cross connects at the main technology rooms and TRs.
 1. Provide minimum of two technicians, onsite, for total of 40 hours each to assist as required with system(s) activation.
 2. Activities: Include, but not be limited to:
 - a. Set/Device Placement and testing for telephone devices.
 - b. Placement of TR patch cables and cross connects.
 - c. Troubleshooting of installed cable plant.
 - d. Installation of additional cables.
 - e. Trouble ticket resolution.
- B. Go-Live Support: Provide two technicians for five days beginning with first scheduled go-live date. For period of four weeks after this day, provide necessary support to assure two-hour response time to issues arising from Work identified by Owner's Representative.

3.12 DEMONSTRATION

- A. Demonstration and Instruction of Owner's Personnel:
1. Provide 40 hours of training and orientation of Owner's personnel to cable plant.
 2. Demonstration and Instruction: Include, but not be limited to:
 - a. Physical review of installed cable plant.
 - b. Review of cable plant documentation and test results.
 - c. Instructions on industry standard termination and testing methods to enable Owner's personnel to successfully terminate and test cabling.
 - d. Additional Owner requirements defined during project.

END OF SECTION 27 05 00

SECTION 27 05 26

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
 - 1. Grounding Conductors.
 - 2. Telecommunications Grounding Busbars.
 - 3. Rack-mount busbars.
 - 4. Connectors.

1.3 RELATED REQUIREMENTS

- A. Section 01 25 00 - Substitution Procedures.
- B. Section 01 33 00 - Submittal Procedures.
- C. Section 27 05 00 - Common Work Results for Communications.
- D. Section 27 05 53 - Identification for Communications Systems.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. Reference Standards: See Section 01 42 00 - References and 27 05 00 - Common Work Results for Communications. In addition to requirements indicated or specified, comply with applicable provisions of following for design, materials, fabrication, and installation of component parts:
 - 1. ANSI J-STD-607-A - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
 - 2. TIA-607- Generic Telecommunications Bonding and Grounding.
 - 3. UL 467 - Grounding and Bonding Equipment.

1.5 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00 - Submittal Procedures and 27 05 00 - Common Work Results for Communications.
- B. Product Data and Installation Instructions: Submit for products included within this specification section.
- C. Product Samples: As required.
- D. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

PART 2 - PRODUCTS

2.1 GROUNDING CONDUCTORS

- A. Grounding conductor:
 - 1. Stranded copper wire.
 - 2. Insulated and green in color (when available).
 - 3. Sized in accordance with ANSI J-STD-607-A or as calculated from the TDMM.

2.2 CONNECTORS

- A. Exothermic weld connections, all materials and equipment.
- B. Listed compression two hole lug connectors with long barrels.
- C. Irreversible compression type connectors.
- D. Electro tin-plated copper.
- E. Cast metal.

- F. UL-listed and CSA certified.
- G. Acceptable Manufacturers:
 1. Burndy.
 2. Hubbell Power Systems.
 3. Panduit.
 4. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures

2.3 ACCESSORIES

- A. Washers:
 1. External or Internal-External lock washers (Star washers).
 2. Paint piercing, both sides of washer.
- B. Antioxidant joint compound:
 1. Oxide inhibiting joint compound for grounding bonds.
 2. Specific to bond type: copper/copper and tinned copper/tinned copper.
- C. Cable bonding - Copper and Optical Fiber Backbone Cables:
 1. Alligator-type bonding clamps, commonly referred to as "B Bond Clamps"
 2. Acceptable Manufacturers:
 - a. 3M.
 - b. Preformed Line Products.
 - c. Thomas & Betts.
 - d. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.

PART 3 - EXECUTION

3.1 INTERIOR COMMUNICATIONS PATHWAYS

- A. Cable Tray Sections: Bonded together with grounding strap or continuous grounding conductor.
- B. Provide grounding wires from telecommunications grounding busbars (TGB) to both ends of cable support system.
- C. Provide grounding conductors from cable support system to structural steel (when present) at 50 ft intervals along the cable support system. Bonds to structural steel shall be with exothermic welds.
- D. Bond metallic cable support system to TGB.
- E. Horizontal Pathways: Bonded and grounded per NEC Article 250.

3.2 TELECOMMUNICATIONS GROUNDING BUSBARS

- A. Provide TGB in technology rooms, computer rooms, data centers, entrance facilities, and all other technology rooms. Mount TGB in such a way as to minimize telecommunications bonding backbone (TBB) sweeps within the TR and to prevent accidental contact with the busbar. Provide multiple busbars in larger TRs as required or as shown on Drawings. Mount busbars at 6 inches above ladder rack.
- B. Multiple TR Installations: Provide a continuous TBB from TMGB to farthest TR using pigtails to connect TBB to TGBs. Provide multiple TBBs when indicated on drawings. Provide grounding equalizers when indicated on Drawings.
- C. Bond metallic equipment racks, conduits, metallic ductwork, cable runways and ladder rack to TGB. Bond all metallic elements entering the TR with the exception of explosive or flammable gas/fluid piping. Size conductors in accordance with ANSI J-STD-607-A.
- D. Bond any electrical service panels within room to TGB.
- E. Provide TMGB within main electrical room or in TR within close proximity to main electrical room.
- F. Provide warning labels on or next to busbars per ANSI J-STD-607-A.

3.3 GROUNDING CONDUCTORS

- A. TBB: Appropriately bond to TMGB and electrical building ground.
- B. Provide pigtail connection from TBB to TGB with TR using conductor sized to match the TBB.
- C. Provide an exothermic weld or irreversible compression fitting for all pigtail to TBB bonds.
- D. Provide exothermic welds for all structural steel bonds.
- E. Provide exothermic welds for all TBB to TBB Bonds.
- F. Provide bonding conductor for telecommunications (BCT) from electrical ground busbar to TMGB, sized to match TBB. Length of BCT to be added to TBB length when calculating TBB size per ANSI J-STD-607-A.

END OF SECTION 27 05 26

SECTION 27 05 28.29

HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
 - 1. Open-Top Cable Support (J-Support).
 - 2. Supporting Device.

1.3 RELATED REQUIREMENTS

- A. Section 07 84 43 - Joint Firestopping.
- B. Section 27 05 00 - Common Work Results for Communications.
- C. Section 27 05 26 - Grounding and Bonding for Communications Systems.
- D. Section 27 05 53 - Identification for Communications Systems.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. Reference Standards: See Section 01 42 00 - References and Section 27 05 00 - Common Work Results for Communications.

1.5 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00 - Submittal Procedures and Section 27 05 00 - Common Work Results for Communications.
- B. Product Data and Installation Instructions: Submit for products included within this specification section.
- C. Product Samples: As required.
- D. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

PART 2 - PRODUCTS

2.1 OPEN-TOP CABLE SUPPORT (J-SUPPORT)

- A. Prefabricated, zinc coated, carbon steel designed specifically for telecommunication cable installations.
- B. Open top, 90 degree rolled edges and 1-5/8 to 4 inch minimum diameter loop as per load and growth requirements.
- C. UL listed and spaced at 4 to 5 foot intervals.
- D. Provide beam clamps, rod fasteners, flange clips and brackets as job conditions require.
- E. Acceptable Manufacturers:
 - 1. Cooper B-Line.
 - 2. Erico.
 - 3. Panduit.
 - 4. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.

2.2 CABLE TIE

- A. Plenum rated when used in plenum environment hook and loop only.
- B. Hook and loop type cable tie that easily reopens for moves, adds and changes.
- C. Acceptable Manufacturers:
 - 1. Hubbell.
 - 2. Leviton.
 - 3. Ortronics.

4. Panduit.
5. Pass & Seymour.
6. Siemon.
7. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.

2.3 SUPPORTING DEVICE

- A. Miscellaneous Support: Provide in accordance with Section 27 05 00.
- B. 14 gage U-Channel systems with 9/16 inch diameter holes at minimum of 1-7/8 inch OC in top surface.
 1. Provide fittings and accessories that match and mate channel.
- C. Anchors: Carbon steel, wedge or sleeve type expansion anchors, steel springhead toggle bolts and heat-treated steel power driven threaded stud fastening equipment as required by construction types.

PART 3 - EXECUTION

3.1 ALL CABLE PATHWAYS

- A. Maintain following clearances from possible sources of electromagnetic interference (EMI) exceeding 5 kVA:
 1. Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway: 6 inch.
 2. Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway: 12 inch.
 3. Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways: 24 inch.
 4. Electrical motors and transformers: 47 inch.

3.2 OPEN-TOP CABLE SUPPORT (J-SUPPORT)

- A. Provide cable supports at 4 to 5 foot intervals wherever cable tray or conduit not present.
- B. Ceiling Ties and Rods: Not allowed to hang cable or cable supports.
- C. Load supports as recommended by manufacturer.
 1. Provide supports side by side on common bracket where cable quantities require.
- D. Do not install cables loose above lock-in type, gypsum board, or plaster ceilings.
- E. Do not support cable from ceiling system tie wires or grid in fire rated systems.
- F. Install at a minimum of 3 inches above ceiling tiles, support channels, vertical supports and other components on the suspended ceiling, and at 6 inches where sufficient space is available.
- G. Cables shall not come in contact with the ceiling or ceiling components.
- H. Use independent telecommunication-dedicated support rods, wires, and fasteners, no attachment to other systems acceptable.
- I. Cable ties and other methods of binding cabling shall not be installed in such a fashion to as to bend, crimp or deform the cabling in any way so as to alter the electrical or transmission characteristics of the cabling.
- J. Refer to Section 27 05 28.36 - Cable Trays for Communications Systems for horizontal pathway penetrations of fire-rated walls.

3.3 CABLE TIE

- A. Only plenum rated Velcro ties shall be installed, as required. Plastic ties shall not be allowed.
- B. Install at 5 foot intervals and at corners, as required.
- C. Installed to put snug grip on bundle of cables and not cinched down tightly.
- D. Not be used in place of J-Hooks.
- E. Install only as needed with cable tray systems to contain cables within cable tray. Cables shall not be "combed" or bundled within cable tray.

3.4 SUPPORTING DEVICE

- A. Provide steel angles, channels and other materials necessary for proper support of wall-mounted cabinets, racks, panels, etc.
- B. Cabinets, large pull boxes, and cable support boxes: Secure to ceiling and floor slab and not from conduits.
- C. Small equipment boxes may be supported on walls.

- D. Racks for support of conduit and heavy equipment: Secure to building construction by substantial structural supports.

END OF SECTION 27 05 28.29

SECTION 27 05 28.33

CONDUITS AND BOXES FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
 - 1. Materials required for installation of interior pathways.
 - 2. Minimum requirements for installation of interior communication pathways.
- B. Minimum composition requirements and installation methods for following:
 - 1. Conduit and Sleeve.
 - 2. Communications Backbox.
 - 3. Masonry Box.

1.3 RELATED REQUIREMENTS

- A. Section 07 84 43 - Joint Firestopping.
- B. Section 27 05 00 - Common Work Results for Communications.
- C. Section 27 05 26 - Grounding and Bonding for Communications Systems.
- D. Section 27 05 28.36 - Cable Trays for Communications Systems.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. Reference Standards: See 01 42 00 - References and Section 27 05 00 - Common Work Results for Communications.
- C. ANSI C80.1 - American National Standard for Electrical Rigid Steel.
- D. ANSI C80.3 - American National Standard for Electrical Metallic Tubing.

1.5 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00 - Submittal Procedures and Section 27 05 00 - Common Work Results for Communications.
- B. Product Data and Installation Instructions: Submit for products included within this specification section.
- C. Product Samples: As required.
- D. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

PART 2 - PRODUCTS

2.1 CONDUIT AND SLEEVE

- A. Rigid Steel Conduit: ANSI C80.1
- B. EMT and Fittings: ANSI C80.3
 - 1. Fittings: Compression type.
- C. Mechanical Sleeve:
 - 1. UL listed and approved.

2.2 COMMUNICATIONS BACKBOX

- A. Double gang, minimal size: 4-11/16 inches high by 4-11/16 inches wide by 2-1/8 inches deep.
- B. Metallic, welded.
- C. Minimal knock-outs: two 1.25 inches or two 1 inch on each side, depending on drawing requirements.
- D. UL-Listed.
- E. Acceptable manufacturers:

1. Thomas & Betts: 72171-1 1/4, or 1 inch version depending on drawing requirements.
2. Hubbell Raco.
3. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.

2.3 MASONRY BOX

- A. Multiple gang, minimal depth: 3-1/2 inches.
- B. Single piece construction with no interior protrusions, for purposes of accepting medical communications devices.
- C. Metallic, welded.
- D. Minimal knock-outs: two 0.75 inch on each side per gang size.
- E. UL-Listed.
- F. Acceptable manufacturers:
 1. Hubbell Raco: 695, 696, 697, 698.
 2. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.

PART 3 - EXECUTION

3.1 CONDUIT AND SLEEVE

- A. Reamed and bushed prior to cable installation.
- B. Secured with clamps or channel stock to prevent movement at wall penetration points.
- C. Conduits shall be installed for vertical penetrations between floors.
- D. Conduits/sleeves shall not be used to penetrate fire-rated walls. Refer to Section 27 05 28.36 - Cable Trays for Communications Systems for horizontal pathway penetrations of fire-rated walls.

3.2 GROUNDING AND BONDING

- A. Bond to ground openings in accordance with Section 27 05 26 - Grounding and Bonding for Communications Systems and Section 27 05 00 - Common Work Results for Communications.

3.3 FIRESTOPPING

- A. Firestop openings and penetrations through fire and smoke rated wall and floor assemblies in accordance with 07 84 43 - Joint Firestopping and Section 27 05 00 - Common Work Results for Communications.

END OF SECTION 27 05 28.33

SECTION 27 05 53

IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
 - 1. Identification Products.

1.3 RELATED REQUIREMENTS

- A. Comply with following:
 - 1. Section 27 05 00 - Common Work Results for Communications.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. Reference Standards: See Section 01 42 00 - References and 27 05 00 - Common Work Results for Communications.
- C. UL 969 - Marking and Labeling Systems.

1.5 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00 - Submittal Procedures and 27 05 00 - Common Work Results for Communications.
 - 1. Product Data: Include data on features, ratings, and performance for each component specified.
 - 2. Shop Drawings: Include dimensioned plan and elevation views of components. Show access and workspace requirements.
 - a. System labeling schedules, including electronic copy of labeling schedules, as specified in Part 3, in software and format selected by Owner.
 - 3. Samples: Provide samples of all label products (e.g. printed labels indicating size, font, color, etc.) to be used to the owner for approval before use.
- B. Informational Submittals: Submit following packaged separately from other submittals:
 - 1. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
 - 2. Qualification Data: For firms and persons specified in Quality Assurance Article. Provide evidence of applicable registration or certification.
- C. Closeout Submittals:
 - 1. Operation and Maintenance Data: for products.
- D. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

PART 2 PRODUCTS

2.1 IDENTIFICATION PRODUCTS

- A. Labels: Preprinted or laser printed type.
 - 1. Legibility, Defacement, Exposure and Adhesion: UL 969.
 - 2. Where insert type labels used provide clear plastic cover over label.
- B. Cable Marking: Vinyl substrate with white printing area and clear tail that self laminates printed area when wrapped around cable. If cable jacket white, provide cable label with printing area colored other than white, preferably orange or yellow – so that labels easily distinguishable.
- C. Confirm color of labels, font, and size with owner prior to labeling. Confirm placement of label on faceplates without windows with owner prior to labeling.

- D. Acceptable Label Manufacturers:
 - 1. Brother P-Touch.
 - 2. Deal.
 - 3. Panduit.
 - 4. WH Brady.
 - 5. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures

PART 3 EXECUTION

3.1 IDENTIFICATION

- A. All jacks or Work Area Outlets (WAO) will be labeled with the floor, TR room number for which it is terminated in, a period, followed by the patch panel position number it is terminated on (ex. 3.565.24 – floor. TR#. patch panel location). The first patch panel located about midway down on the relay rack (21U) will be cable locations 1-24. The second patch panel will be cable locations 25-48 and so on.
- B. Cables will be labeled in the TR with room number cable it is pulled to, and cable number (based on the number of cables pulled to that room or faceplate (ex: 512.2 - Rm# Cable #)
- C. Distribution Racks and Frames: Label each unit and field within that unit.
- D. Copper feeder cable shall be labeled on each end with the exact destination of its distant end (floor. TR room#).
- E. Fiber optic cable will be labeled on each end with the exact destination of its distant end including rack or cabinet number, the fiber shelf number it is terminated in, and the position of the connectors inside the shelf. Fiber optic strand numbers must be clearly labeled, easily understandable and in the exact same order/position number in both cabinets on each end. If this is not achievable with existing cabinets then new cabinets must be installed.
- F. Coax cables are normally pulled to the LV (low voltage) rooms. In the patient or waiting room areas, the cable will have the exact LV room number it is terminated in. In the LV room, the cable will have the exact patient or waiting room number it is terminated in.

END OF SECTION 27 05 53

SECTION 27 07 00

COMMUNICATIONS TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Testing methods for copper cable, optical fiber cable, coaxial cable and grounding and bonding.
- B. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
 - 1. OTDR and power meter - Fiber Optic Cable Tester.
 - 2. Category 6A 100 Ohm UTP Tester.
 - 3. 75 Ohm Coax Tester.
 - 4. Grounding and Bonding Tester
 - 5. Spectrum Analyzer with Power Meter.
 - 6. Signal Generator.
 - 7. Wireless Network Optimization Platform

1.3 RELATED REQUIREMENTS

- A. Section 27 05 00 - Common Work Results for Communications

1.4 REFERENCE STANDARDS

- A. Reference Standards: See Section 01 42 00 - References and Section 27 05 00 - Common Work Results for Communications

1.5 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00 - Submittal Procedures and Section 27 05 00 - Common Work Results for Communications.
- B. Product Data: Submit following:
 - 1. Test equipment.
- C. Test Reports: Submit electronic copies.
 - 1. Electronic Reports: Submit reports electronically..

PART 2 - PRODUCTS

2.1 FIBER OPTIC CABLE TESTER

- A. Light Source – Multimode:
 - 1. Provide 850 nm (plus or minus 30 nm) and 1300 nm (plus or minus 20 nm) wavelength LED light sources.
 - 2. Spectral Width of Sources: 30 – 60 nm for 850 nm wavelength and 100 – 140 nm for 1300 nm wavelength.
- B. Light Source: Single-Mode:
 - 1. Provide 1310nm and 1550nm (plus or minus 20 nm) wavelength laser light sources.
- C. Power Meter
 - 1. Provide 850 nm, 1300 nm, 1310nm and 1550nm plus or minus 20 nm wavelength test capability.
- D. Optical Time Domain Reflectometer (OTDR): Front CRT display.
- E. Acceptable Manufacturers:
 - 1. Corning.
 - 2. Fluke.
 - 3. Ideal.
 - 4. JDSU
 - 5. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.

2.2 CATEGORY 6A 100 OHM UTP TESTER

- A. Permanent link testing is the only method accepted.
- B. Physical Interface: Modular RJ-45 connector.
- C. Injector for complete wire mapping and TDR for determining cable length.
- D. Measure NEXT and Attenuation.
- E. Additional Measurement Capabilities: Include impedance, loop resistance, capacitance, impulse noise and peak to peak noise.
- F. Acceptable Manufacturers:
 - 1. Fluke.
 - 2. Ideal.
 - 3. JDSU
 - 4. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.

2.3 75 OHM COAX TESTER

- A. Test continuity for 75 ohm, Series 6, Series 11, Hard-line type coaxial cable.
- B. Identify open conductors, open shield/braid and shorted connections with pass/fail indicator.
- C. Acceptable Manufacturers:
 - 1. ITC
 - 2. Paladin Tools.
 - 3. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.

2.4 GROUNDING AND BONDING TESTER

- A. Clamp-On:
 - 1. Amprobe.
 - 2. Fluke.
 - 3. Extech Instruments.
- B. 2/3 Point:
 - 1. Fluke.
 - 2. LEM.
 - 3. Megger.

2.5 SPECTRUM ANALYZER WITH POWER METER

- A. Frequency range: 100 KHz to 6 GHz.
- B. Software and PC connectivity for transferring test results.
- C. Measurements:
 - 1. Frequency.
 - 2. Amplitude.
 - 3. RF power meter.
 - 4. Distortion.
 - 5. Noise.
- D. Acceptable Manufacturers:
 - 1. Agilent.
 - 2. Anritsu.
 - 3. Rohde & Schwarz.
 - 4. Tektronix.
 - 5. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.

2.6 SIGNAL GENERATOR

- A. Frequency range: 250 KHz to 3 GHz.
- B. Continuous wave.
- C. Modulation: AM, FM, PM.
- D. Output power: plus13 dBm minimum.
- E. Acceptable Manufacturers:
 - 1. Agilent.
 - 2. Anritsu.
 - 3. Rohde & Schwarz.
 - 4. AnaPico.

5. dBm.
6. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.

PART 3 - EXECUTION

3.1 FIBER OPTIC CABLE TESTER

- A. Fiber Testing: Perform on fibers in completed end to end system. Splices not allowed unless clearly defined.
 1. Testing: Bi-directional end to end power meter test, EIA/TIA 455-78-B.
 2. Test backbone multimode fiber at both 850 and 1300 nm, TIA-526-14-A. Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.
 3. Test backbone single mode fiber at both 1310 and 1550 nm, TIA-526-7. Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant.
 4. Provide system loss measurements at 850 and 1300 nm for multimode fibers and 1310 and 1550 nm for single mode fibers.
- B. Preinstallation Cable Testing: Test fiber optic cable prior to installation of cable.
 1. Contractor: Responsible for replacement of cable if found defective at later date.
- C. Loss Budget - Fiber Links:
 1. Maximum loss of:
 - a. $(\text{Allowable cable loss per km})(\text{km of fiber in link}) + (0.75 \text{ dB})(\text{number of mated pairs of connectors}) = \text{maximum allowable loss.}$
 - b. Bring links not meeting requirements of standard into compliance, at no charge to Owner.

3.2 COPPER BACKBONE (HIGH PAIR COUNT) TESTING

- A. Test Process:
 1. Owner reserves right to be present during testing.
 2. Test 100 Percent of Installed Backbone Cabling: Tests shall pass acceptance criteria defined below.
- B. Test cable with test set to match NVP for cable as stated by cable manufacturer.
- C. Test Parameters: Include Wire Map, bonding.
- D. Wire Map:
 1. Wire Map Test: Verify pair to pin termination at each end and check for connectivity errors. Wire map shall indicate following for each of eight conductors:
 - a. Continuity to remote end.
 - b. Shorts between any two or more conductors.
 - c. Crossed pairs.
 - d. Reversed Pairs.
 - e. Split Pairs.
 - f. Other miss-wiring.
- E. Bonding:
 1. Cable armor must be bonded to telecommunication grounding system within TR/MTR.
 2. Test bond per section 3.6 below.

3.3 CATEGORY 6A 100 OHM UTP TESTER

- A. If post-manufacture performance data supplied by manufacturer of cables or connecting hardware, keep copies of such data for inclusion in documentation and make available to Owner upon request.
- B. Testing Parameters Called for in this Section: Apply for up to 295 ft of horizontal cable, 8P8C outlet and one consolidation point or transition point.
- C. Test Process:
 1. Owner reserves right to be present during testing.
 2. Testing of Permanent Link: Retest cabling not tested in accordance with these procedures at no additional cost to Owner.
 3. Test 100 Percent of Installed Cabling: Tests shall pass acceptance criteria defined below.
- D. Test cable with test set to match NVP for cable as stated by cable manufacturer.
- E. Test Parameters: Include Wire Map, Length, Attenuation, NEXT, ACR, PS-NEXT, PS-ACR, Return Loss, ELFEXT and PS-ELFEXT.
- F. Wire Map:

1. Wire Map Test: Verify pair to pin termination at each end and check for connectivity errors. Wire map shall indicate following for each of eight conductors:
 - a. Continuity to remote end.
 - b. Shorts between any two or more conductors.
 - c. Crossed pairs.
 - d. Reversed Pairs.
 - e. Split Pairs.
 - f. Other miss-wiring.
 - G. Cable Length:
 1. Maximum Length of Test Link Excluding Test Equipment Cords: 295 ft
 2. Test permanent link attenuation and NEXT of cables. Permanent Link: Sum of attenuation of connecting hardware and 295 ft of cable.
 - H. Data Reporting and Accuracy:
 1. General: Determine pass or fail result for each parameter by allowable limits for each parameter. If test result of parameter closer to test limit than accuracy of tester, mark with asterisk. Test results marked with asterisk ("star pass") count as fail. Upload data at measured points to PC and printed on laser printer.
 2. Wire Map: Mark wire map tests pass if wiring determined correct.
 3. Length: Provide test results in meters and marked pass or fail based on length versus allowable length.
 4. Attenuation: Report attenuation value and frequency at point of failure or highest frequency passed. Measured attenuation values lower than 3dB used for pass / fail determination.
 - a. Measure attenuation from 1 MHz to 500 MHz (Category 6A) in 1 MHz increments.
 5. NEXT: Report NEXT value and pass or fail.
 6. Documentation: Test Reports: Include following information for each cabling element tested.
 - a. Wiremap results that indicate cabling has no shorts, opens, miswires, split, reversed, or crossed pairs, and end to end connectivity achieved.
 - b. Attenuation, NEXT, PSNEXT, Return Loss, ELFEXT, and PSELFEXT data that indicate worst case result, frequency at which it occurs, limit at that point, and margin.
 - 1) Tests: Perform in swept frequency manner from 1 MHz to highest relevant frequency, using intervals consistent with TIA and ISO requirements.
 - 2) Provide information for pairs or pair combinations and in both directions when required by appropriate standards.
 - 3) Mark individual test that fails relevant performance specification as fail.
 - c. Length (in meters), propagation delay, and delay skew relative to relevant limit. Mark individual test that fails relevant performance specification as fail.
 - d. Cable manufacturer, cable model number/type, and NVP.
 - e. Tester manufacturer, model, serial number, hardware version, and software version.
 - f. Circuit ID number and project name.
 - g. Autotest specification used.
 - h. Overall pass/fail indication.
 - i. Date of test.
 - j. Submit test reports within seven business days of completion of testing.
- 3.4 50 OHM COAX TESTER
- A. Calibrate equipment in accordance with manufacturer specifications.
 - B. Test for the following:
 1. VSWR.
 2. Attenuation.
 3. DTF (if VSWR or attenuation is higher than allowed).
 4. Cable length.
 - C. Data reporting and accuracy:
 1. General: Determine pass or fail result for each parameter by allowable limits for each parameter. Allowable limits for each parameter will be determined by cable manufacturer's data sheet. If test result of parameter is closer to test limit than accuracy of tester, mark with asterisk. Upload data to PC.

2. Documentation: Test Reports: Include following information for each cabling element tested.
 - a. VSWR and attenuation pass results that indicate parameters are under the allowable limit. Mark individual test that fails relevant performance specification as fail.
 - b. Length (in meters).
 - c. Cable manufacturer, cable model number/type.
 - d. Tester manufacturer, model, serial number, hardware version, and software version.
 - e. Circuit ID number and project name.
 - f. Overall pass/fail indication.
 - g. Date of test.
 3. Submit test reports within seven business days of completion of testing.
- 3.5 75 OHM COAX TESTER
- A. Calibrate Network Analyzer in accordance with manufacturer specifications.
 - B. Test for Continuity.
 - C. Test for Attenuation.
 - D. Test for TDR Impedance
 - E. Test for VSWR
 - F. Provide pass or fail test results.
- 3.6 GROUNDING AND BONDING TESTER
- A. All bonds installed by the contractor shall be tested for impedance with an earth ground resistance test in its two-point setup, such as a LEM Handy GEO tester.
 - B. The Contractor shall test the impedance of all bonds of the grounding system, including cable armor bonding to ground. The impedance of a two-point bonding test across any bond shall not exceed 0.1 ohm. The Contractor shall remediate any bond(s) over this limit or which contribute to a total impedance exceeding 0.1 ohm from any point in the network.
 - C. Test all grounding conductors, once installed, for current. Measure AC and bi-directional DC current. Report any AC current over 1 Amp. Report any DC current, in either direction, over 500 milliamps.
- 3.7 SPECTRUM ANALYZER WITH POWER METER/SIGNAL GENERATOR/WIRELESS NETWORK OPTIMIZATION PLATFORM
- A. Pre-construction testing: At a minimum Contractor shall perform the following tasks.
 1. Service Coverage Verification using Wireless survey equipment to ensure coverage area is optimized prior to UHF Indoor antenna and Omni-Directional Multi-Band Antenna installation.
 2. Use live survey equipment to gather accurate information about how the RF signal will propagate in a given area.
 3. The placement of a base station radio at a given location and the use of a laptop Wireless card or actual remote subscriber to provide real-time information about the signal strength and coverage area,
 - B. Post-Construction Testing: At a minimum Contractor shall perform the following tasks.
 1. Testing shall be performed to simulate wireless RF signals that will be propagated once the system is installed.
 2. Testing shall consist of placing wireless receivers in various sample locations that will be expected to serve intended coverage areas.
 3. Wireless systems in all areas must provide at least 90% coverage with overlap.
- 3.8 TEST RESULTS
- A. Fiber Optic Cables:
 1. Test fiber optic cables and submit fiber test result data in electronic format, to include showing graphically, entire length of fiber.
 2. Reports: Show circuit ID, cursor marks, total attenuation, date of installation and test used.
 3. Submit one copy of software capable of viewing electronic test result files.
 - B. Cables: Submit test results in electronic format.
 1. Horizontal Station Cables: Test individual copper cables.
 2. High Pair Count Copper Cables: Test high count copper cables.
 3. Acceptable Formats: Manufacturers format (include one copy of software capable of viewing test result files) and in PDF format.

C. Grounding and Bonding

1. Place a QA label (with date and inspector) in proximity to each bond tested.

3.9 ACCEPTANCE

A. Once work has been completed, 100 percent pass rating test documentation has been received, and Owner's Representative satisfied that work in accordance with Contract Documents, Owner's Representative shall notify Contractor in writing of formal acceptance of system.

B. Acceptance Requirements:

1. Contractor: Warrant in writing that 100 percent of installation meets requirements specified under Standards Compliance and Test Requirements above.
2. Owner reserves right to conduct, using Contractor equipment and labor, random re-test of up to five percent of cable plant to confirm documented results.
 - a. Random Re-testing, if Performed: At expense of Owner, using standard labor rates.
 - b. Failing Cabling: Re-tested and restored to passing condition. In event more than two percent of cable plant fails during re-test, re-test and restore entire cable plant to passing condition at no additional cost to Owner.

END OF SECTION 27 07 00

SECTION 27 11 19

COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
 - 1. Commscope 24 port angled modular patch panels.
 - 2. Voice Grade Backbone Patch Panel.

1.3 RELATED REQUIREMENTS

- A. Section 27 05 00 - Common Work Results for Communications
- B. Section 27 05 26 - Grounding and Bonding for Communications Systems
- C. Section 27 05 53 - Identification for Communications Systems
- D. Section 27 13 23.13 - Communications Optical Fiber Splicing and Terminations

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. Reference Standards: See Section 01 42 00 - References and Section 27 05 00 - Common Work Results for Communications

1.5 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00 - Submittal Procedures and Section 27 05 00 - Common Work Results for Communications.
- B. Product Data and Installation Instructions: Submit for products included within this specification section.
- C. Product Samples: As required.
- D. If providing pre-standards manufacturer system solution, submit installer/contractor certification documentation and channel certification information and requirements from manufacturer.
- E. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

PART 2 - PRODUCTS

2.1 CATEGORY 6A HORIZONTAL PATCH PANEL

- A. Meet or exceed latest Category 6A standards.
 - 1. Termination Block: Commscope M2400A-1U-GS/760118349 GigaSPEED X10D U/UTP Angled Single-Row Modular Panel, 24 port fitted with GigaSPEED X10D MGS600-262; white in color.
- B. Accessories:
 - 1. 19 inch Rack Mount Bracket
 - 2. Back Panels for rack-mounting
- C. UL listed.
- D. Acceptable Manufacturers:
 - 1. CommScope Systimax
 - 2. No Substitutions.

2.2 VOICE GRADE BACKBONE PATCH PANEL

- A. Termination Block: Commscope 760180000/PPP-5E-DM-1U-24 Patch Panel, category 5e, RJ45, 19 in, 24 port, black.
- B. Accessories:
 - 1. 19 inch Rack Mount Bracket

- 2. Back Panels for rack-mounting
- C. UL listed.
- D. Acceptable Manufacturers:
 - 1. CommScope Systimax
 - 2. No Substitutions.

PART 3 - EXECUTION

3.1 CATEGORY 6A HORIZONTAL PATCH PANEL

- A. Install per manufacturer's requirements.
- B. Each rack will contain a maximum of 16 24-port patch panels for a total of 384 cables.
- C. Patch panel installs will start from mid-rack (17U) with each additional patch panel added beneath the first.
- D. Cable numbering will start from the top left to the right (numbered 1 to 24 respectively) and from top to bottom of rack.
- E. Installation of copper riser will be based on TR design and discussed with architect during rack elevation layout
- F. Provide labels for each cable in accordance with Section 27 05 53 – Identification for Communications Systems

END OF SECTION 27 11 19

SECTION 27 11 23

COMMUNICATIONS CABLE MANAGEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
 - 1. Rack/Cabinet/Zone Box Management: Vertical and Horizontal.
 - 2. Horizontal Lacing Bar.

1.3 RELATED REQUIREMENTS

- A. Section 27 05 00 - Common Work Results for Communications
- B. Section 27 05 28.29 - Hangers and Supports for Communications Systems
- C. Section 27 05 28.36 - Cable Trays for Communications Systems
- D. Section 27 05 53 - Identification for Communications Systems

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00 - Submittal Procedures and Section 27 05 00 - Common Work Results for Communications.
- B. Product Data and Installation Instructions: Submit for products included within this specification section.
- C. Product Samples: As required.
- D. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

PART 2 - PRODUCTS

2.1 RACK/CABINET/ZONE BOX MANAGEMENT: VERTICAL AND HORIZONTAL

- A. Horizontal Cable Manager: Locate as indicated on Drawings.
 - 1. CPI Horizontal wire manager.
 - 2. Single sided (35441-701 or 35441-702).
 - 3. Rack-mountable to 19 inch rails.
 - 4. Height: 1U and 2U as indicated on Drawings
- B. Vertical Cable Manager: Locate as indicated on Drawings.
 - 1. CPI double sided 8 and 10 inch wire managers. Part number CPI 10 inch 35573-703 and CPI 8 inch 35572-703.
 - 2. Width: 10 in or 8 in as indicated on Drawings.
 - 3. Double Sided, with one door on front.
 - 4. Black.
 - 5. Same height as rack/cabinet.
- C. Acceptable Manufacturers:
 - 1. CPI
 - 2. No Substitutions.

PART 3 - EXECUTION

3.1 RACK/CABINET/ZONE BOX MANAGEMENT: VERTICAL AND HORIZONTAL

- A. Cables into Racks/Cabinets: Provide neat and organized distribution of cables into rack/cabinet. 10 inch vertical managers will be used between racks and 8 inch vertical managers on the ends.

- B. Cable Transitions from Vertical to Horizontal Path: Ensure stress relief with cable ties and support. Support weight of cable at 90-degree bend point with this cable stress management and not by termination point at jack.

END OF SECTION 27 11 23

SECTION 27 13 13.13

COMMUNICATIONS COPPER CABLE SPLICING AND TERMINATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Requirements for terminating copper backbone cabling.
- B. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
 - 1. Splice Closures.
 - 2. Multi-Pair Splice Modules.
 - 3. Single-Pair Splice Connectors.

1.3 RELATED REQUIREMENTS

- A. Section 01 25 00 - Substitution Procedures
- B. Section 01 33 00 - Submittal Procedures
- C. Section 01 42 00 - References
- D. Section 27 05 00 - Common Work Results for Communications
- E. Section 27 05 26 - Grounding and Bonding for Communications Systems
- F. Section 27 11 13 - Communications Entrance Protection
- G. Section 27 11 19 - Communications Termination Blocks and Patch Panels

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. Reference Standards: See Section 01 42 00 - References and Section 27 05 00 - Common Work Results for Communications.

1.5 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00 - Submittal Procedures and Section 27 05 00 - Common Work Results for Communications.
- B. Product Data: Submit product data for each type of cable to be installed including but not limited to physical dimensions, configurations, construction and performance specifications
- C. Product Samples: As required.
- D. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

PART 2 - PRODUCTS

2.1 SPLICE CLOSURES

- A. Complete pressure tight re-enterable closure system for enclosing spliced connections of communications cables in a wide variety of applications, including manholes.
 - 1. Fire Retardant Closures.
 - 2. Pressurized Closures.
 - 3. Stainless Steel shell.
 - 4. Pre-drilled end caps.
- B. Acceptable Manufacturers:
 - 1. 3M.
 - 2. Preformed Line Products.
 - 3. Tyco.
 - 4. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.

2.2 MULTI-PAIR SPLICE MODULES

- A. 710-style multiple pair splicing modules and appropriate hardware, as determined by the enclosure manufacturer.
 - B. IDC splice connector and hardware, as determined by the enclosure manufacturer.
 - C. Acceptable Manufacturers:
 - 1. 3M.
 - 2. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.
- 2.3 SINGLE-PAIR SPLICE CONNECTORS
- A. Gel-filled connector.
 - B. IDC splice connector.
 - C. Accommodates 22 AWG to 24 AWG conductors.
 - D. Acceptable Manufacturers:
 - 1. 3M.
 - 2. Thomas & Betts.
 - 3. Ideal Industries.
 - 4. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.

PART 3 - EXECUTION

3.1 MIDSPAN SPLICES

- A. Midspan splices are not allowed unless otherwise directed by UTSW Infrastructure Services.

3.2 OSP SPLICING

- A. See Section 27 11 13 - Communications Entrance Protection for OSP copper cable termination information.
- B. See Section 27 11 19 - Communications Termination Blocks and Patch Panels for ISP copper cable termination information.
- C. Proper installation of a splice/termination shall require remediation of any past improper installation procedures that would impact the proper installation of the device (e.g. proper grounding).
- D. Install in accordance with manufacturer's instructions.
- E. High pair count copper cable splicing shall be performed with multi-pair modular connectors unless otherwise approved by Owner's Representative.
- F. The splice and stripped cable shall be protected by a rated splice closure.
- G. Closures shall be sized to accommodate the maximum number of splice modules for the feeder backbone cable.
- H. When installing a branch splice, Contractors shall not use the last available opening in the endplates for a spliced backbone cable if any unspliced pairs would remain unused within the enclosure.
- I. If only one opening in the endplates is available and if unspliced pairs would remain with the enclosure, Contractor shall provide a single short cable spliced to the available pairs. This cable shall terminate in a new enclosure from which the needed pairs for the final installation may be spliced. If all pairs cannot be spliced onto a single cable, Contractors shall contact the Owner's Representative before proceeding. A new enclosure, or custom endplates may be required.
- J. Outside plant cable must be spliced within 50' of entering any building or it must be installed inside rigid metallic conduit. Splice enclosures must be easily accessible and have their locations documented.

3.3 ISP SPLICING

- A. Intra-building copper cables shall not be spliced, but shall be continuous between communications rooms.

3.4 TESTING

- A. Test all cables in accordance with Section 27 07 00 - Communications Testing.
- B. Pressure test all OSP splice enclosures per manufacturer's instructions.
- C. Test all sheath and grounding conductors for continuity through the splice.

3.5 IDENTIFICATION

- A. Label all cables in accordance with Section 27 05 53 - Identification for Communications Systems.

3.6 BONDING AND GROUNDING

- A. All splices shall maintain grounding continuity between all non-transmitting, conductive elements within the cables within the enclosure. Bond and ground in accordance with Section 27 05 26 - Grounding and Bonding for Communications Systems

END OF SECTION 27 13 13.13

SECTION 27 13 13.13

COMMUNICATIONS COPPER CABLE SPLICING AND TERMINATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Requirements for terminating copper backbone cabling.
- B. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
 - 1. Splice Closures.
 - 2. Multi-Pair Splice Modules.
 - 3. Single-Pair Splice Connectors.

1.3 RELATED REQUIREMENTS

- A. Section 01 25 00 - Substitution Procedures
- B. Section 01 33 00 - Submittal Procedures
- C. Section 01 42 00 - References
- D. Section 27 05 00 - Common Work Results for Communications
- E. Section 27 05 26 - Grounding and Bonding for Communications Systems
- F. Section 27 11 13 - Communications Entrance Protection
- G. Section 27 11 19 - Communications Termination Blocks and Patch Panels

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. Reference Standards: See Section 01 42 00 - References and Section 27 05 00 - Common Work Results for Communications.

1.5 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00 - Submittal Procedures and Section 27 05 00 - Common Work Results for Communications.
- B. Product Data: Submit product data for each type of cable to be installed including but not limited to physical dimensions, configurations, construction and performance specifications
- C. Product Samples: As required.
- D. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

PART 2 - PRODUCTS

2.1 SPLICE CLOSURES

- A. Complete pressure tight re-enterable closure system for enclosing spliced connections of communications cables in a wide variety of applications, including manholes.
 - 1. Fire Retardant Closures.
 - 2. Pressurized Closures.
 - 3. Stainless Steel shell.
 - 4. Pre-drilled end caps.
- B. Acceptable Manufacturers:
 - 1. 3M.
 - 2. Preformed Line Products.
 - 3. Tyco.
 - 4. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.

2.2 MULTI-PAIR SPLICE MODULES

- A. 710-style multiple pair splicing modules and appropriate hardware, as determined by the enclosure manufacturer.
 - B. IDC splice connector and hardware, as determined by the enclosure manufacturer.
 - C. Acceptable Manufacturers:
 - 1. 3M.
 - 2. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.
- 2.3 SINGLE-PAIR SPLICE CONNECTORS
- A. Gel-filled connector.
 - B. IDC splice connector.
 - C. Accommodates 22 AWG to 24 AWG conductors.
 - D. Acceptable Manufacturers:
 - 1. 3M.
 - 2. Thomas & Betts.
 - 3. Ideal Industries.
 - 4. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.

PART 3 - EXECUTION

3.1 MIDSPAN SPLICES

- A. Midspan splices are not allowed unless otherwise directed by UTSW Infrastructure Services.

3.2 OSP SPLICING

- A. See Section 27 11 13 - Communications Entrance Protection for OSP copper cable termination information.
- B. See Section 27 11 19 - Communications Termination Blocks and Patch Panels for ISP copper cable termination information.
- C. Proper installation of a splice/termination shall require remediation of any past improper installation procedures that would impact the proper installation of the device (e.g. proper grounding).
- D. Install in accordance with manufacturer's instructions.
- E. High pair count copper cable splicing shall be performed with multi-pair modular connectors unless otherwise approved by Owner's Representative.
- F. The splice and stripped cable shall be protected by a rated splice closure.
- G. Closures shall be sized to accommodate the maximum number of splice modules for the feeder backbone cable.
- H. When installing a branch splice, Contractors shall not use the last available opening in the endplates for a spliced backbone cable if any unspliced pairs would remain unused within the enclosure.
- I. If only one opening in the endplates is available and if unspliced pairs would remain with the enclosure, Contractor shall provide a single short cable spliced to the available pairs. This cable shall terminate in a new enclosure from which the needed pairs for the final installation may be spliced. If all pairs cannot be spliced onto a single cable, Contractors shall contact the Owner's Representative before proceeding. A new enclosure, or custom endplates may be required.
- J. Outside plant cable must be spliced within 50' of entering any building or it must be installed inside rigid metallic conduit. Splice enclosures must be easily accessible and have their locations documented.

3.3 ISP SPLICING

- A. Intrabuilding copper cables shall not be spliced, but shall be continuous between communications rooms.

3.4 TESTING

- A. Test all cables in accordance with Section 27 07 00 - Communications Testing.
- B. Pressure test all OSP splice enclosures per manufacturer's instructions.
- C. Test all sheath and grounding conductors for continuity through the splice.

3.5 IDENTIFICATION

- A. Label all cables in accordance with Section 27 05 53 - Identification for Communications Systems.

3.6 BONDING AND GROUNDING

- A. All splices shall maintain grounding continuity between all non-transmitting, conductive elements within the cables within the enclosure. Bond and ground in accordance with Section 27 05 26 - Grounding and Bonding for Communications Systems

END OF SECTION 27 13 13.13

SECTION 27 15 13

COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Minimum requirements for horizontal copper twisted pair cabling.
- B. Horizontal Cabling:
 - 1. Communication:
 - a. Communication horizontal cabling for project shall use conventional hierarchical star topology that home runs cables, from the communications room (FDs) to the WAO locations.
 - 2. Use point-to-point cable runs as indicated on drawings.
- C. Minimum composition requirements and/or installation methods for following materials and work are included in this Section:
 - 1. Category 6A/6 UTP Cable.
 - 2. #23 AWG Shielded Twisted Pair Cable.
 - 3. Data/Power Cable.

1.3 RELATED REQUIREMENTS

- A. Section 01 25 00 - Substitution Procedures
- B. Section 01 33 00 - Submittal Procedures
- C. Section 01 42 00 - References
- D. Section 07 84 13 - Penetration Firestopping
- E. Section 27 05 00 - Common Work Results for Communications
- F. Section 27 41 00 - Common Work Results for Audiovisual Systems and Equipment
- G. Section 27 05 26 - Grounding and Bonding for Communications Systems
- H. Section 27 05 53 - Identification for Communications Systems
- I. Section 27 07 00 - Communications Testing
- J. Section 27 11 19 - Communications Termination Blocks and Patch Panels

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. Reference Standards: See Section 01 42 00 - References and Section 27 05 00 - Common Work Results for Communications.

1.5 SUBMITTALS

- A. General:
 - 1. Submit in accordance with Section 01 33 00 - Submittal Procedures and Section 27 05 00 - Common Work Results for Communications.
 - a. Selection of cable category shall be in accordance with Section 27 05 00 - Common Work Results for Communications.
- B. Product Data: Submit product data for each type of cable to be installed including but not limited to physical dimensions, configurations, construction and performance specifications
- C. Product Samples: As required.
- D. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

1.6 ATTIC STOCK

- 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. Cable: 1000 feet of each type used for project. Furnish on reels.

PART 2 - PRODUCTS

2.1 CABLES, GENERAL

- A. All cables shall be plenum rated.

2.2 CATEGORY 6A/6 UTP CABLE

A. Physical Characteristics:

1. Category 6A/6 copper cable.
2. Pairs: 4.
3. Conductor Size: 23 AWG.
4. Color Coding of Pairs:
 - a. Pair 1: W-BL; BL.
 - b. Pair 2: W-O; O.
 - c. Pair 3: W-G; G.
 - d. Pair 4: W-BR; BR.
5. Comply with ANSI/ICEA S-102-732-2009 for mechanical performance requirements, testing and testing methods.
6. Ultimate Breaking Strength, ASTM D4565: 90 lbf minimum.
7. Cold Bend Radius, ASTM D4565: 4 times cable diameter minimum at -20°C plus or minus 1°C without jacked or insulation cracking.
8. Jacket type: FEP.
 - a. Color: Yellow for Category 6A and Blue for Category 6 cables.
9. Labeled and third party verified category 6A/6 cables.

B. Transmission Characteristics:

1. DC Resistance of any Conductor, ASTM D4566: Shall not exceed 9.38 Ohms per 328 ftat 20 degrees C.
2. DC Resistance Unbalance Between any Two Conductors of any Pair, ASTM D4566: Not exceed 4 percent at 20oC.
3. Mutual Capacitance at 1 kHz, ASTM D4566: Shall not exceed 5.6 nF per 328 ftat 20°C.
4. Capacitance Unbalance, Pair-To-Ground, at 1 kHz, ASTM D4566: Shall not exceed 330 pF per 328 ftat 20° C.

C. Acceptable Manufacturers:

1. CommScope Systimax 2091SD; yellow in color and plenum rated.
2. CommScope Systimax 2071; blue in color and plenum rated.
3. No Substitutions.

2.3 #23 AWG SHIELDED TWISTED PAIR CABLE

A. Physical Characteristics:

1. #23 AWG conductors.
2. Twisted pair, stranded, color-coded conductors.
3. 100 percent overall shield with stranded copper or tinned-copper drain wire.
4. Insulation Thickness:
 - a. 0.022 to 0.016 inches

B. Transmission Characteristics:

1. Capacitance: 24 pF/ft between conductors, 79 pF/ft between one conductor and the other connected to the shield.

C. Acceptable Manufacturers:

1. Commscope

PART 3 - EXECUTION

3.1 CATEGORY CABLE

A. Cable Distributions

1. Copper Horizontal Cabling shall terminate in Voice/Data TRs, unless otherwise noted.
2. Each Copper Horizontal Cable for every faceplate shall terminate in TRs.
3. Copper Horizontal cables for IP-based cameras shall terminate in TRs.

- B. Comply with the manufacturer's installation instructions, BICSI Information Transport Systems Installation Manual and best industry practices.
 - C. Conceal in walls or soffits and install in metal conduits:
 - 1. Exposed Cabling: Installed in surface raceway.
 - 2. Cabling Below Raised Floors: Installed in cable tray and J-Hooks out to Work Area Outlet.
 - D. Schedule work in manner to complete above ceiling work/below raised floor work prior to tile/panel installation. In event installer is required to remove tiles/panels, coordinate with the contractor and do not break or disturb grid.
 - 1. Cable Above Accessible Ceilings: Supported 4 to 5 ft on center from cable support attached to building structure.
 - 2. Cable Below Raised Floor: Supported every 2 ft on center from the cable support attached to floor pedestals.
 - E. Cables shall not lay on the ceiling or the ceiling support structure. Anchor cables to not interfere with other services or space access.
 - F. Replace horizontal copper cables that do not pass Category 6A/6 requirements.
 - 1. Maximum Length: Not exceed 295 ft.
 - G. No physical defects such as cuts, tears or bulges in outer jacket. Replace cables with defects.
 - H. Install cable in neat and workman-like manner. Neatly bundle and tie cable in closets. Leave sufficient cable for 90 degree sweeps at vertical drops.
 - I. Velcro ties and other cable management clamps shall be no more than hand tightened and shall fitt snugly, but not compress, crimp, or otherwise change the physical characteristics of the cable jacket or distort the placement of twisted-pair components. Replace any cable exhibiting stresses due to over tightening of cable management devices.
 - J. Brushed aluminum raceways used in labs must have a divider between electrical and communication cabling.
 - K. Raceway adapters must be provided by GC for Commscope jacks/faceplates.
 - L. Each Run of Horizontal Copper Cable between Terminating Patch Panel and WAO: Continuous without any joints or splices.
 - M. Do not untwist horizontal copper cable pairs more than 0.5 inch when terminating.
 - N. Make use of raceways built into furniture for open office furnished work areas.
 - O. Do not install cable in common cable hangers with speaker cable.
 - P. Maintain following clearances from possible sources of electromagnetic interference (EMI) exceeding 5 kVA:
 - 1. Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway: 6 inch.
 - 2. Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway: 12 inch.
 - 3. Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways: 24 inch.
 - 4. Electrical motors and transformers: 47 inch.
 - Q. Do not install Category 6A/6 cable using more than 25 lbs pull force in accordance with TIA/EIA and BICSI TDMM practices. Utilize appropriate cable lubricant in sufficient quantity to reduce pulling friction to acceptable levels on long pulls inside conduit. Use tensile rated cords (i.e. fishing line) for difficult or questionable pulls - to judge to go/no-go condition of conduit and pulling setup.
 - R. Replace cables with jackets that are chaffed or burned, exposing internal conductor insulation or have bare copper (shiners).
 - S. If deviations from the drawings are required, they shall be approved by Owner's Representative prior to placement of affected cables.
- 3.2 NON-CATEGORY TWISTED PAIR CABLE
- A. Cable distributions
 - 1. Centralized Copper Horizontal Cabling for audiovisual systems shall terminate in Low Voltage TRs, unless otherwise noted.
 - B. Maintain separation between each of the following signal types throughout the system to avoid possible interference:
 - 1. Microphone signals.

2. Line Level Audio signals.
 3. Loudspeaker signals.
 4. Video and RF signals.
 5. Control signals.
- C. There shall be no splices in the system without the prior approval by the Owner's Representative. Splices shall never occur inside conduit, but shall only occur in accessible junction boxes or equipment racks. Cable splices shall not be wrapped with adhesive tape.
 - D. Install plenum rated cables where required by code.
 - E. Adhere to the manufacturers' guidelines for cable bend radii and maximum pulling tensions.
 - F. Maintain separation between varying cable types to avoid hum, crosstalk, and interference.
 - G. Maintain separation between cables and devices with a potential electromagnetic field to avoid interference.
 - H. Provide rubber or nylon grommets to protect cables passing through racks, panels, furniture, conduits, and junction boxes.
 - I. Arrange cables in a neat and orderly manner in junction boxes, cable trays, conduits, and accessible ceilings.
- 3.3 TESTING
- A. Test all cables in accordance with Section 27 07 00 - Communications Testing.
- 3.4 IDENTIFICATION
- A. Label all cables in accordance with Section 27 05 53 - Identification for Communications Systems.
- 3.5 FIRESTOPPING
- A. Firestop openings and penetrations through fire and smoke rated wall and floor assemblies in accordance with Section 07 84 13 - Penetration Firestopping and Section 27 05 00 - Common Work Results for Communications.
- 3.6 BONDING AND GROUNDING
- A. Bond and ground shielded cables in accordance with Section 27 05 26 - Grounding and Bonding for Communications Systems.

END OF SECTION 27 15 13

SECTION 27 15 43

COMMUNICATIONS FACEPLATES AND CONNECTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
 - 1. Category 6A Insert Commscope X10D MGS600 6A Jacks.
 - 2. Category 6 Insert Commscope XL MGS400 6 Jacks.
 - 3. Wall Phone Jack Assembly.
 - 4. Surface Mount Box (Biscuit Box).

1.3 RELATED REQUIREMENTS

- A. Section 01 25 00 - Substitution Procedures
- B. Section 01 33 00 - Submittal Procedures
- C. Section 01 42 00 - References
- D. Section 27 05 00 - Common Work Results for Communications
- E. Section 27 05 26 - Grounding and Bonding for Communications Systems
- F. Section 27 05 53 - Identification for Communications Systems

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. Reference Standards: See Section 01 42 00 - References and Section 27 05 00 - Common Work Results for Communications.

1.5 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00 - Submittal Procedures and Section 27 05 00 - Common Work Results for Communications.
- B. Product Data and Installation Instructions: Submit for products included within this specification section.
- C. Colors and Finishes: Submitted and approved by Architect prior to order.
- D. Product Samples: As required.
- E. If providing pre-standards manufacturer system solution, submit installer/contractor certification documentation and channel certification information and requirements from manufacturer.
- F. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

1.6 ATTIC STOCK

- A. Outlet assemblies: Provide one of each type for every twenty-five (25) installed, but not less than one.

PART 2 - PRODUCTS

2.1 CATEGORY 6/6A INSERT

- A. Functional from 14 to 140 degrees F.
- B. Tested: TIA/EIA-568-C.2.
- C. Connector Body: High-impact, fire-retardant plastic rated UL 94V-0.
- D. Unscreened per IEC 60603-7-41 8-position/8-conductor connector.
- E. Modular Connector: Individual snap-in-style.
 - 1. Comply with National Electrical Code; compliant with FCC Part 68; UL listed; and independently UL Certified.

- 2. In addition to Category 6/6A Compliance, Connector: Ability to support high megabit and shared sheath applications.
 - 3. Connector Wiring Label: Provide installation color codes for both T568A and T568B wiring schemes.
- F. Modular Connector: Consult with Owner on termination scheme.
- G. Acceptable Manufacturers:
- 1. Cat6A: CommScope Systimax 360 GigaSPEED X10D MGS600-262.
 - 2. Cat6: CommScope Systimax 360 GigaSPEED XL MGS400-262.
 - 3. No Substitutions.
- 2.2 WALL/MODULAR FURNITURE FACEPLATE
- A. Wall-mounted Faceplates: High impact, thermoplastic or stainless, flush-mounted design.
- 1. Capable of accepting mixed multimedia.
 - 2. Rear-loading inserts.
 - 3. Single gang – Systimax L Type Flush Mounted 4-Port Faceplate, M14L-262.
 - 4. Double gang – Systimax L Type Flush Mounted Double Gang Faceplate
 - 5. Readily accept Systimax outlets without modification to device.
- 2.3 WALL PHONE JACK ASSEMBLY
- A. Mount to single gang outlet box.
- B. Mounting lugs designed to mate with corresponding telephone base plate or adapter.
- C. 8-pin jack configuration.
- D. UL listed.
- E. Acceptable Manufacturers:
- 1. CommScope Systimax
 - 2. No Substitutions.
- 2.4 SURFACE MOUNT BOX (BISCUIT BOX)
- A. Surface mount with snap-on cover.
- B. Accepts snap-in type SCS inserts.
- C. Side breakouts for cable or raceway entry.
- D. Rear cable access.
- E. Fastens to mounting surface utilizing screws or modular furniture mounting bracket.
- F. Cable tie anchor points for cable management and strain relief.
- G. Includes port identification labels.
- H. Acceptable Manufacturers:
- 1. CommScope Systimax
 - 2. No Substitutions.

PART 3 - EXECUTION

- 3.1 8P8C INSERT
- A. UTP Cables: Terminated with high density modular jacks that snap into faceplate mounted on wall outlet box, modular furniture raceway or in floor box bracket.
- B. Fill extra openings with blank inserts.
- C. Coordinate with Owner's Representative for proper termination standard (T568A or T568B).
- 3.2 FACEPLATE/SURFACE MOUNT BOX (BISCUIT BOX)
- A. Secure outlet boxes to building with mechanical fasteners. Adhesive fasteners not allowed.
- B. Coordinate modular furniture faceplates with furniture provider.
- C. Fill extra openings with blank inserts.
- 3.3 TESTING
- A. Test all connectors and inserts in accordance with Section 27 07 00 - Communications Testing.
- 3.4 IDENTIFICATION
- A. Label all faceplates in accordance with Section 27 05 53 - Identification for Communications Systems.

END OF SECTION 27 15 43

SECTION 27 16 19

COMMUNICATIONS PATCH CORDS AND STATION CORDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Qualitative requirements for Patch Cords, Station Cords and Cross Connect Wire.
- B. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
 - 1. Category 6A UTP and/or 6A UTP Patch Cord/Station Cord.
 - 2. RG-6 Coaxial Patch Cord/Station Cord.
 - 3. Fiber Optic Patch Cord/Station Cord.
 - 4. RG142 Coaxial Jumper.
- C. Modular Cords: A modular cord is a length of cable with connectors on both ends used to join telecommunications circuits/links. A Patch Cord is a modular cord located at the cross-connect. A Station Cord is a modular cord located at the work area outlet.

1.3 RELATED REQUIREMENTS

- A. Section 01 25 00 - Substitution Procedures
- B. Section 01 33 00 - Submittal Procedures
- C. Section 01 42 00 - References
- D. Section 27 05 00 - Common Work Results for Communications
- E. Section 27 15 13 - Communications Copper Horizontal Cabling
- F. Section 27 15 33 - Communications Coaxial Horizontal Cabling
- G. Section 27 15 43 - Communications Faceplates and Connectors

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. Reference Standards: See Section 01 42 00 - References and 27 05 00 - Common Work Results for Communications

1.5 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00 - Submittal Procedures and Section 27 05 00 - Common Work Results for Communications.
- B. Product Data: Submit product data for each type of Patch Cord, Station Cord and Cross Connect Wire to be installed including but not limited to physical dimensions, configurations, construction and performance specifications
- C. Product Samples: As required.

1.6 ATTIC STOCK

- 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. Patch Cords: 10 percent spare of each type used on the project, but not less than one.
 - 2. Station Cords: 10 percent spare of each type used on the project, but not less than one.

PART 2 - PRODUCTS

2.1 CATEGORY 6A UTP PATCH CORD/STATION CORD

- A. Physical Characteristics:
 - 1. Conductors: 6 Stranded. 6A Solid.
 - 2. Lengths: Coordinate with Owner prior to ordering.
 - 3. Color: Coordinate with Owner prior to ordering.

- B. Transmission Characteristics:
 - 1. Performance Requirements: Meet Category 6A performance criteria.
 - 2. Manufacturer: Approved partner with horizontal cable, jacks & patch panels.
 - C. Provide three patch cords for every Category 6A cable installed.
 - 1. One 7' CommScope CO199K2-02F007 for technology rooms at 100 percent of quantity needed.
 - 2. One 7' CommScope CPCSSX2-02F007 for WAO at 70 percent of quantity needed.
 - 3. One 10' CommScope CPCSSX2-02F010 for WAO 30 percent of quantity needed.
 - D. Acceptable Manufacturers:
 - 1. CommScope Systimax.
 - 2. No Substitutions.
- 2.2 SERIES 6 COAXIAL PATCH CORD/STATION CORD
- A. Physical Characteristics:
 - 1. Lengths: Manufactured in field to Owner's required lengths.
 - 2. Connector Type: Terminated with F-type [BNC-type] connector at both ends.
 - B. Transmission Characteristics:
 - 1. Performance Requirements: Meet same characteristics as horizontal RG-6 cable.
 - 2. Manufacturer: Approved partner with horizontal cable, jacks & patch panels.
 - C. Provide two patch cables for every coaxial pass-through adapter.
 - D. Acceptable Manufacturers:
 - 1. Belden.
 - 2. Commscope.
 - 3. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.
- 2.3 FIBER OPTIC PATCH CORD/STATION CORD
- A. Physical Characteristics:
 - 1. Cable: Shall contain the same number of fibers as the connector used (e.g., duplex connectors using duplex patch cord cable) and be of an indoor construction.
 - 2. Connectors: Duplex LC, in accordance with Section 27 15 43 - Communications Faceplates and Connectors.
 - 3. Lengths: Coordinate with Owner prior to ordering.
 - 4. Color: Laser Optimized multimode– Aqua; Single-mode – Yellow.
 - B. Transmission Characteristics:
 - 1. Performance Requirements: Meet transmission characteristics of optical horizontal cable.
 - 2. Manufacturer: Approved partner with horizontal cable and connectors.
 - C. Provide two patch cords for every port.
 - D. Acceptable Manufacturers:
 - 1. CommScope Systimax.
 - 2. No Substitutions.
- 2.4 PATCH CORDS
- A. Physical Characteristics:
 - 1. Conductors: Stranded.
 - 2. Lengths: Coordinate with Owner prior to ordering.
 - 3. Color: Coordinate with Owner prior to ordering.
 - B. For horizontal patch panel to data RJ45 to data RJ45:
 - 1. RJ45 to RJ45 patch cord.
 - 2. Cord length 7'.
 - 3. Provide patch cord for every cable.
 - 4. Light blue in color.
 - C. For Station Cable to WAO
 - 1. Systimax RJ45 to RJ45.
 - 2. One 7' patch cord at 70 percent required.
 - 3. One 10' patch cord at 30 percent required.
 - 4. Provide two patch cords in accordance with required percentages.
 - 5. Light blue in color.

- D. Acceptable Manufacturers:
 - 1. CommScope Systimax.
 - 2. No Substitutions.
- 2.5 RG142 COAXIAL JUMPER
 - A. N-type male to N-type male:
 - 1. Pre-manufactured using crimp connectors and heatshrink.
 - 2. NEC CMP rated.
 - 3. Braided coaxial.
 - B. N-type male to SMA-type right angle male:
 - 1. Pre-manufactured using crimp connectors and heatshrink.
 - 2. NEC CMP rated.
 - 3. Braided coaxial.

PART 3 - EXECUTION

3.1 PATCH CORD INSTALLATION

- A. Exact lengths and colors of patch cords specified in Product Description above.
- B. Deliver patch cords to site or location designated by Owner's Representative.
- C. Example of patch cord quantities for 1,000 cables installed equate to 3,000 patch cords delivered:
 - 1. 1,000 - 7' CommScope CO199K2-02F007 for technology rooms.
 - 2. 1,400 - 7' CommScope CPCSSX2-02F007 for WAO.
 - 3. 600 - 10' CommScope CPCSSX2-02F010 for WAO.

3.2 RG142 COAXIAL JUMPER

- A. Use coaxial jumpers from active equipment ports, passive devices ports, and antenna ports to coaxial cable. Never connect a coaxial cable directly into an active equipment port, passive device port, or antenna port unless indicated by contract documents.

END OF SECTION 27 16 19

SECTION 27 53 13

CLOCK SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
 - 1. Primary Transmitter.
 - 2. Satellite Transmitter.
 - a. Analog.
 - b. Digital.

1.3 RELATED REQUIREMENTS

- A. Section 27 05 00 - Common Work Results for Communications
- B. Section 27 05 26 - Grounding and Bonding for Communications Systems
- C. Section 27 05 53 - Identification for Communications Systems
- D. Section 27 11 00 - Communications Room Fit-Out
- E. Section 27 11 13 - Communications Entrance Protection
- F. Section 27 13 33 - Communications Coaxial Backbone Cabling

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. Reference Standards: See Section 01 42 00 - References and Section 27 05 00 - Common Work Results for Communications

1.5 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00 - Submittal Procedures and Section 27 05 00 - Common Work Results for Communications.
- B. Product Data and Installation Instructions: Submit for products included within this specification section.
- C. Colors and Finishes: Submitted and approved by Architect prior to order.
- D. Product Samples: As required.
- E. If providing pre-standards manufacturer system solution, submit installer/contractor certification documentation and channel certification information and requirements from manufacturer.
- F. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

PART 2 - PRODUCTS

2.1 PRIMARY TRANSMITTER

- A. General: The clock system shall include a transmitter, a roof or window mounted GPS receiver, indicating clocks, and all accessories for complete operation.
- B. GPS Receiver: GPS roof mounted with 100 foot cable.
- C. The GPS Receiver shall be a complete GPS receiver including antenna in a waterproof case, designed for roof or outdoor mounting.
- D. Provide mounting bracket for attachment to antenna mast structure.
- E. The GPS Receiver cable must be plenum rated where required by local code.
- F. Transmitter: Primex Wireless Model 14000-E with external antenna, GPS receiver, a surge suppressor/battery backup, and a mounting shelf.
 - 1. Unit shall obtain current atomic time from satellite.
 - 2. The clock system shall transmit time continuously to all clocks in the system.

- G. Transmission:
 - 1. Frequency Range: 72.100 to 72.400 MHz.
 - 2. Transmission Power: One [30] watt 45 dBm maximum.
 - 3. Radio technology: Narrowband FM.
 - 4. Number of channels: 16.
 - 5. Channel bandwidth: 20 kHz maximum.
 - 6. Transition mode: one-way communication.
 - 7. Data rate: 2 KBps.
 - 8. Operating range: 32 degree F to 158 degrees F.
- H. Transmitter:
 - 1. Transmitter output power: +26 to +30 dBm.
 - 2. Frequency deviation: plus or minus 4 kHz.
 - 3. Transmitter power requirements: 120 VAC 60 Hz.
 - 4. Internal power requirements: 5 VDC.
 - 5. Carrier frequency stability: plus or minus 20 ppm.
 - 6. Transmitter shall have 16 selectable channels to assure interference-free reception.
 - 7. Transmitter shall have the following switches:
 - a. Time zone adjustment switches for all time zones in the world. Includes: Eastern, Central, Mountain, Pacific, Alaska, and Hawaii.
 - b. Daylight Saving Time bypass switch.
 - c. 12-hour or 24-hour display.
 - 8. Antenna shall be 46 inches high, commercial type, mounted on top center of transmitter housing. Antenna gain shall be < 2.2 dB. Antenna polarization shall be vertical.
- I. Transmitter housing shall incorporate a display which shall include the following:
 - 1. Time readout.
 - 2. AM and PM indicator if 12-hour time display is set.
 - 3. Day and date readout.
 - 4. Indicator for daylight savings or standard time.
 - 5. LED which shall flash red in event of reception problem.
- J. GPS reception indicator:
 - 1. Transmitter shall contain an internal clock such that failure of reception from the GPS will not disable the operation of the clocks.
- K. Power supply (included):
 - 1. Input: 120 volt AC 50/60 Hz, 0.4 amps.
 - 2. Output: 9 volt DC, 1.5 amps.
- L. Surge Protector/Battery Backup (included):
 - 1. Input: 120 volt AC 60 Hz plus or minus 1 Hz.
 - 2. Output: 120 volt AC, 500VA, 300 watts.
 - 3. Surge Energy Rating: 365 joules.
- M. Acceptable Manufacturers:
 - 1) Primex Wireless.
 - 2) Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.

2.2 SATELLITE TRANSMITTER

- A. Additional out door GPS antenna will be required with Wireless Receiver Switches:
- B. Switches shall receive time packets from the Primary Transmitter and relay the synchronized time to the Satellite Transmitter connected to it. The unit shall include the following:
 - 1. Antenna mounted on top of the switch housing, 11-1/2 inches long.
- C. Power Supply:
 - 1. Input 120 VAC 50/60 Hz, 0.4 amps.
 - 2. Output: 9 volt DC, 1.5 amps.
 - 3. RS 232 data cable, 5 feet long.
 - 4. Daylight Savings Time bypass switch.
- D. Satellite Transmitters Primex Wireless Model 14401: Satellite Transmitters shall receive the signal from the Wireless Receiver Switches and transmit the signal to the devices in its vicinity, which are out of the range from the Master Transmitter.

- E. The unit shall include the following:
 - 1. Antenna mounted on top of the housing, 46 inches long.
 - 2. Wireless Receiver Switch.
 - 3. Power Supply Input: 120 VAC, 50/60 Hz, 0.4 amps.
 - 4. Output: 9 volt DC, 1.5 amps.
 - 5. 6 foot cord.
 - 6. Surge Suppressor/Battery Backup.
 - 7. Mounting Shelf.
 - 8. Transmission Power: 1 watt maximum.
 - 9. 72 MHz frequency.
- F. Acceptable Manufacturers:
 - 1. Primex Wireless.
 - 2. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.

2.3 ELAPSE TIMERS

- A. General: six digit, multi-function clock/timer.
- B. Display:
 - 1. 6-digit time display (hh:mm:ss).
 - 2. Red digitals.
 - 3. 2.25 inch min. high numerals for hours and minutes, numerals for seconds may be smaller.
- C. Count up/count down timer.
- D. Display all zeros when not actively running as a timer.
- E. Code Blue incrementing timer.
- F. Controller.
 - 1. Minimum of a two-button controller to start/stop and reset.
 - 2. Wall-mount, flush.
- G. 120 VAC power, hard-wired.
- H. Communications wiring, as required by the manufacturer, between the timer and controller, including interconnections to nurse call code blue system.
- I. Compatible with centralize clock system for time synchronization.
- J. Surface Color – Coordinate with architect prior to purchasing.
 - 1. Brushed stainless steel.
 - 2. Black.
 - 3. Off-white.
- K. Mounting Hardware.
 - 1. Flush-mount option.
- L. Acceptable Manufacturers:
 - 1. Primex.
 - 2. American Time & Signal Company.
 - 3. Bender Medical Products.
 - 4. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that construction is complete in spaces to receive equipment and that rooms are clean and dry.
- B. Verify that 120 volt electrical outlet is located within 6 feet of location of transmitter and the outlet is operational and properly grounded.

3.2 PRIMARY/SECONDARY TRANSMITTER AND CLOCKS

- A. Installation:
 - 1. Provide all equipment necessary for a complete and operable system.
 - 2. GPS Unit: Install on roof in location indicated, in clear view of the sky.
 - a. Install unit in location free from standing water, and above accumulations of leaves or debris.
 - b. Seal cable connection to GPS with cable connection sealant.
 - c. Any added cable lengths must be protected from outside elements.

3. Transmitter:
 - a. Locate transmitter where indicated, a minimum of 2 to 3 feet above the floor, away from large metal objects such as filing cabinets, lockers or metal framed walls.
 - b. Transmitter(s) will be placed at locations indicated.
 - c. Attach receiver to transmitter using cable.
 - d. Connect antenna to transmitter, using care not to strip threads.
 - e. Connect power supply to the transmitter.
 - f. Set the channel number on the display to correspond to the FCC license.
 - g. Plug power supply into electrical outlet.
 - h. Analog clocks perform the following operations with each clock:
 - i. Set clock to correct time in accordance with manufacturer's instructions.
 - j. Observe analog clock until valid signals are received and analog clock adjusts itself to correct time.
 - k. Install the analog clock on the wall in the indicated location, plumb, level and tight against the wall. If using 12-1/2 inch clock, attach using clock-lock hanging method and suitable fasteners as approved by clock manufacturer.
 - l. Analog clocks (AC): Perform the following operations with each clock.
 - m. Observe clock until valid time signals are received and analog clock adjusts itself to correct time.
 - n. Install the analog clock on the wall in the indicated location, plumb, level, and tight against the wall.
 - o. Attach using clock-lock hanging method and suitable fasteners as approved by clock manufacturer.
 - p. Wire Guards: Secure to wall, using approved theft-resistant fasteners.
 - B. Adjusting: Prior to final acceptance, inspect each clock, adjust as required, and replace parts which are found defective.
 - C. Cleaning:
 1. Prior to final acceptance, clean exposed surfaces of clocks, using cleaning methods recommended by clock manufacturer.
 2. Remove temporary labels from clock faces. Do not remove labels from backs of clocks.
 - D. Demonstration: Provide training to Owner's representative on setting and adjusting clocks, replacing batteries and routine maintenance.
 - E. Protection: Protect finished installation until final acceptance of the project.
 - F. Testing: All devices must be tested at their operational location under normal operational conditions to assure reception of signal.
- 3.3 TIMERS
- A. Coordinate placement and elevation of timers and controls with architectural elevations prior to installation.

END OF SECTION 27 53 13

SECTION 27 53 13.13
WIRELESS CLOCK SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Furnish and install a complete new Wireless Clock System using the Primex OneVue™ Sync System with Bluetooth Low Energy Technology.
- B. Furnish and install all system devices, accessories, and materials in accordance with these specifications and drawings to provide a complete and operating Wireless Clock System.
- C. All bids shall be based on the equipment as specified herein. The model designations are that of Primex. The specifying authority must approve any alternate Wireless Clock System.
- D. System shall include the following system devices:
 - 1. Bridge with Ethernet/Power over Ethernet (PoE) technology and Bluetooth® low energy wireless technology.
 - 2. Repeater with Bluetooth® low energy wireless technology.
 - 3. Analog Clocks with Bluetooth® low energy wireless technology.
 - 4. Digital Clocks with Bluetooth® low energy wireless technology.
 - 5. Digital Code Blue Timers with Bluetooth® low energy wireless technology.
 - 6. Digital Elapsed Timers with Bluetooth® low energy wireless technology.
 - 7. Personal Series LCD Clock with Bluetooth® low energy wireless technology.

1.3 RELATED REQUIREMENTS

- A. Division 26 Electrical Sections.
- B. Section 26 00 00 - Basic Electrical Requirements.
- C. Section 27 05 00 - Common Work Results for Communications.
- D. Division 27 Cabling Sections for requirements for Horizontal Cabling.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. System devices specified shall meet or exceed the requirements of the following.
 - 1. Federal Communications Division (FCC); Part 15 - Code of Federal Regulations.
 - 2. National Fire Protection Association (NFPA); NFPA 70E, Standard for Electrical safety in the Workplace.
 - 3. Institute of Electrical and Electronics Engineers (IEEE); IEEE 802.3af, Standard for Information Technology - Telecommunications and Information Exchange Between Systems.
 - 4. Bluetooth® wireless technology standard 4.1

1.5 DEFINITIONS

- A. TSA: Technical Support Agreement.
- B. AWS: Amazon Web Services.
- C. TLS: Transport Layer Security.
- D. HTTPS: Hypertext Transfer Protocol Secure.
- E. Bluetooth® low energy: a wireless technology protocol used for communication between embedded devices and smart devices.
- F. SNTP: Simple Network Time Protocol.
- G. PoE: Power over Ethernet.
- H. IP: Internet Protocol.

1.6 SYSTEM DESCRIPTION

- A. System shall provide synchronized time by way of system devices and a cloud-based system software hosted by the Manufacturer that allows the system Owner to manage and monitor system devices.
- B. System can be scaled from a single building to a network of buildings, or an enterprise spread across many time zones, providing traceability accuracy, data and performance.
- C. System shall consist of system Bridge devices equipped with Ethernet/Power over Ethernet (PoE) and Bluetooth® low energy wireless technology.
- D. System Bridge devices shall be required to have a direct connection to the Owner's existing Ethernet/Power over Ethernet (PoE) network.
- E. System shall consist of system clocks enabled with Bluetooth low energy wireless technology.
- F. System shall provide an option to include system repeater devices, enabled with Bluetooth low energy wireless technology, to address coverage gaps.
- G. System Bluetooth clock or repeater devices shall not have a direct connection to the OWNER'S Ethernet/Power over Ethernet (PoE) network or Wi-Fi network.
- H. System Bluetooth devices shall form a system mesh by way of the proprietary Bluetooth Network Protocol designed and developed by the Manufacturer, that allows system Bluetooth devices to form a system mesh to allow a communication path to send device data to the system Bridge devices.
- I. System Bridge devices shall receive data from the system Bluetooth clocks and repeater devices over the system proprietary mesh network, and Bridge devices shall send the received data to the system cloud-based software through their direct connection to the Owner's existing Ethernet/Power over Ethernet (PoE) network.
- J. System Bridge devices shall download settings from the system software and send settings to the system Bluetooth devices over the system proprietary mesh.
- K. System Bridge devices shall receive UTC time from a Network Time Protocol (NTP) time source; allowing up to three NTP time sources for fail-over purposes.
- L. System shall not require the installation of any onsite system hardware or software, with the exception of the specified system devices and mobile configurator app.

1.7 SYSTEM SOFTWARE SPECIFICATIONS

- A. System Bridge devices shall download settings from the system software over the Owner's existing IP network.
- B. System shall provide a mobile app that allows the Owner to add system Bridge devices to the system software or edit the devices' assigned network and other primary settings for those devices added to the system software.
- C. System software shall log the NTP accuracy of the system Bridge devices.
- D. System software shall monitor and display the operating status of system devices.
- E. System software shall provide an automated reporting method to notify system users of device operating statuses that may warrant corrective action.
- F. System software shall allow Owner to manage authorized system users, including user access to data and system settings that is based on the role assigned to each system user. Access can be limited to viewing and managing the system, including reports, device settings, system users, and account settings.
- G. System software shall maintain and store data for up to a minimum of ten (10) years.

1.8 SYSTEM MESH NETWORK SPECIFICATIONS

- A. System mesh shall be able to adjust and synchronize system Bluetooth clocks and repeater devices to specified Time Zone Offset and DST rules; time zone settings are managed within the system software and sent to the system Bluetooth clocks and repeater devices over the system mesh.
- B. System mesh protocol shall form a tree-type topology; where data transfer is up or down in a tree structure topology; a path with the highest Bluetooth Wireless Signal level quality is chosen at any time.
- C. System mesh shall have the capability to distinguish the system Bluetooth devices with Bluetooth wireless technology by the system devices' unique Device ID and/or Network ID; allowing only system Bluetooth devices to authenticate to the system mesh.
- D. At a system set daily time interval, the system Bluetooth clocks and repeaters shall advertise their Bluetooth signal to form a system mesh.
- E. System mesh shall be self-forming, self-healing, and self-organizing.

1. Self-healing: in the event of a system Bluetooth clock or repeater hardware failure or loss of Bluetooth wireless signal, a connection previously handled by it is rerouted to another device within the system mesh.
2. Self-forming: a system mesh is automatically formed once daily at a system set time to allow system Bluetooth clocks and repeaters to advertise their status to form the system mesh.
3. Self-organizing: the system mesh automatically connects system Bluetooth clocks or repeaters that are within Bluetooth wireless range to form a data transmission path within the system mesh.

1.9 SYSTEM BRIDGE DEVICE SPECIFICATIONS

- A. Bridge shall be equipped with Bluetooth enabled gateway; which allows the device to send and receive communication to and from system Bluetooth clocks and repeater devices.
- B. Bridge devices shall connect to the Owner's existing Ethernet/PoE network to send its device data and the system Bluetooth device data to the system software, download its settings and all system Bluetooth device settings from the system software.
- C. Bridge shall send settings to system Bluetooth clocks and repeater devices within the system mesh.
- D. Each system Bluetooth device is identified by a unique Device ID allowing each device to receive its unique Device ID settings. Device ID settings shall be managed in the system software. Bluetooth Analog Clock Device ID settings include its Time Zone Offset setting and DST rules. Bluetooth Digital Clock/Timer Device ID settings include its Time Zone Offset setting and DST rules and display settings.
- E. Bridge shall listen and receive system Bluetooth clock and repeater device data advertised in the system mesh. During its 8- hour deployment mode, a Bridge shall send new Bluetooth Device IDs to the system software within 30 minutes of receiving them. If not in 8-hour deployment mode, new Bluetooth device data is sent the system software within 24 hours to 7 days.
- F. Bridge shall obtain Coordinated Universal Time (UTC) derived from a Network Time Protocol (NTP) Server (either internal or external); up to three designated NTP Servers may be specified to ensure continuity of time synchronization. The Bridge shall send obtained UTC time received from its assigned NTP Server (time source) to the system Bluetooth clocks and repeaters, and clocks shall synchronize the received UTC time to their Time Zone Offset setting and DST rules.
- G. Bridge devices shall be primarily powered by Power over Ethernet. Battery-power shall be used only as a backup power source for a relatively short period of time.
- H. Bridge devices can be pre-configured by the Manufacturer with Owner provided settings before shipment to the OWNER facility or configured locally at the device by the Owner on-site.
- I. Bridge device shall have an LCD screen that displays connection status and indicate when in an error or alarm state.
- J. Bridge device shall have LED indicators, located on the front of the device, that provide a visual indicator of its current status and operating state.
- K. Bridge device shall have the ability to store configuration data for up to 1000 Bluetooth clocks/repeaters in its local device memory; to avoid loss of data if a network connectivity issue prevents data to be sent to the system software.
- L. Bridge device Unresponsive Timeout setting shall be set by the system for three consecutive days. Unresponsive Timeout is defined as the amount of time a device can go without a connection to the system software; when this time is exceeded, the system sets the device to a warning state.

1.10 SPECIFICATIONS: SYSTEM CLOCKS ENABLED WITH BLUETOOTH® LOW ENERGY WIRELESS TECHNOLOGY (SYSTEM BLUETOOTH CLOCKS)

- A. Clocks shall not require manual or direct configuration by an end-user to establish a connection to a system mesh, nor does an end-user need to know about the intricacies of Bluetooth networking. The entire system's Bluetooth mesh infrastructure is transparent to the end-user.
- B. Clocks shall be equipped with a Bluetooth low energy wireless technology radio component; that allows system Bluetooth clocks to establish wireless Bluetooth connections to form a system mesh. Each clock shall be a node within the system mesh.
- C. Clocks shall form a wireless connection and communication path by way of the proprietary system mesh protocol designed and developed by the Manufacturer.
- D. Clocks shall wake-up once a day, at a system-defined time, to form and build a system mesh; allowing each system clock to send and/or forward its status data to a Bridge and receive setting updates sent by a Bridge. Each clock connects to another Bluetooth clock or repeater based on the strongest Bluetooth

- signal. The Bridge stores and sends clock status data to the system software once a day. When a Bridge is in an 8-hour deployment mode, clock data is sent every 30 minutes to the system software.
- E. Upon first-power up at its installation location, a clock shall go through a self-discovery initiation process; the clock shall continuously search for a system mesh to receive its time and daily connection schedule.
 - F. Clocks shall not be required to be in line-of-sight or directly connected to a system Bridge device and shall act as independent nodes within the system mesh.
 - G. If a clock's Bluetooth wireless signal connection is interrupted or down, the other clocks or repeaters within the Bluetooth wireless range shall be able to transmit data over the system mesh to a Bridge device through other Bluetooth devices within the system. Clock data moves through the system mesh communication path until the data reaches a system Bridge device.
 - H. Clocks shall be available, at predefined time intervals set by the system, to connect to new Bluetooth clocks that are attempting to connect to the system mesh; allowing new clocks to receive and synchronize their time from an existing system Bluetooth device.
 - I. Clock device firmware shall perform diagnostics on battery status, time accuracy, and connection strength. The Bridge devices shall transmit the clock diagnostic data to the system software.
- 1.11 CLOCKS SHALL OPERATE WITH A FREE-RUNNING ACCURACY OF .45 SECONDS PER DAY, AND WILL CONTINUE TO OPERATE IN THE ABSENCE OF RECEIVING THE BROADCASTED UTC TIME FROM THE BRIDGE.
- A. Clocks shall be fully portable, capable of being relocated at any time.
 - B. Analog clocks shall report gross mechanical failures by way of automatically performing a daily midnight hand verification check; which if this check shall fail for three consecutive days, the clock shall report a hand position failure status, resulting in a clock warning state within the system software.
- 1.12 SPECIFICATIONS: SYSTEM REPEATERS ENABLED WITH BLUETOOTH® LOW ENERGY WIRELESS TECHNOLOGY (SYSTEM BLUETOOTH REPEATER DEVICES)
- A. Repeaters shall not require manual or direct configuration by an end-user to establish a connection to a system mesh, nor does an end-user need to know about the intricacies of Bluetooth networking. The entire mesh infrastructure is transparent to the end-user.
 - B. Repeaters shall form a wireless connection and communication path by way of the proprietary system mesh protocol designed and developed by the Manufacturer.
 - C. Repeaters shall be equipped with a Bluetooth low energy wireless technology radio component; that allows the device to establish wireless Bluetooth connections to form a system mesh. Each repeater shall be a node within the system mesh.
 - D. Repeaters shall wake-up once a day, at a system-defined time, to form and build a system mesh; allowing each system Bluetooth device to send and/or forward its status data to the Bridge and receive setting updates sent by the Bridge. Each repeater connects to another system Bluetooth device based on the strongest Bluetooth signal.
 - E. Upon first-power up at its installation location, a new system Bluetooth repeater shall go through a self-discovery initiation process; the repeater shall continuously search for a system Bluetooth device to receive its time and daily connection schedule.
 - F. Repeaters shall not be required to be in line-of-sight or directly connected to a system Bridge device and shall act as independent nodes within the system mesh.
- 1.13 IF A REPEATER'S BLUETOOTH WIRELESS SIGNAL CONNECTION IS INTERRUPTED OR DOWN, THE OTHER SYSTEM BLUETOOTH DEVICES WITHIN THE BLUETOOTH WIRELESS RANGE SHALL BE ABLE TO TRANSMIT DATA TO THE SYSTEM BRIDGE DEVICE THROUGH OTHER BLUETOOTH DEVICES WITHIN THE SYSTEM MESH. BLUETOOTH DEVICE DATA MOVES THROUGH THE SYSTEM MESH COMMUNICATION PATH UNTIL THE DATA REACHES A SYSTEM BRIDGE DEVICE.
- A. Repeaters shall be available, at predefined time intervals set by the system, to connect to new Bluetooth system devices that are attempting to connect to the system mesh; allowing new system Bluetooth devices to receive and synchronize their time from an existing system Bluetooth device.
 - B. Repeater device firmware shall perform diagnostics on battery status, time accuracy, and connection strength. The Bridge devices shall transmit repeater diagnostic data to the system software.

- C. Repeaters shall be fully portable, capable of being relocated at any time.
- 1.14 ENCRYPTION AND AUTHENTICATION SPECIFICATIONS
- A. User software access sessions between the web browser and the system software shall be encrypted by the HTTPS protocol.
 - B. The network communication of system devices enabled with Ethernet/PoE technology shall be secure and encrypted using the Transport Layer Security (TLS) encryption protocol and Secure Hypertext Transfer Protocol (HTTPS) authentication.
- 1.15 SYSTEM ADMINISTRATION SPECIFICATIONS
- A. Software interface shall allow the OWNER'S system admin user(s) to manage the system components, including system device settings, reports, system-wide user password complexity settings and user session timeout setting to align with OWNER information security policies and procedures, manage system users and grant user access to system data and features, activate and deactivate system users, and view user log in history.
 - B. System software shall allow each system user to manage their own system profile, including their password and contact settings.
 - C. System software shall allow system device settings to be user-defined to meet OWNER requirements.
- 1.16 SYSTEM SOFTWARE SHALL ALLOW DEVICES, THAT SEND DATA TO AND DOWNLOAD DATA FROM THE SYSTEM SOFTWARE OVER AN IP NETWORK, TO BE ASSIGNED TO A DHCP OR NON-DHCP PRIMARY AND AN ALTERNATE NETWORK FOR FAILOVER PURPOSES. NETWORK SETTINGS ARE MANAGED WITHIN THE SYSTEM SOFTWARE, ALLOWING REMOTE MANAGEMENT TO MIGRATE DEVICES FROM ONE NETWORK TO ANOTHER.
- A. System software shall allow user-defined reporting; system shall store and present system historical data in the form of system reports. User-defined data shall include the system devices included in a report, frequency a report is system generated, and specific range of data included in a report. System reports shall be displayed in the system software electronically within the interface allow a system user to download reports. System shall allow report data to be restricted based on the role(s) assigned to a system user profile.
- 1.17 SYSTEM DEVICES WITH ETHERNET/POE NETWORK COMMUNICATION SPECIFICATIONS
- A. Network Communication Protocols: Hypertext Transfer Protocol Secure (HTTPS) | IP Addressing: Dynamic Host Configuration Protocol (DHCP), static IP addressing | Data Packet Size: typically less than 5 kilobytes (kB)
 - B. Network setting data is stored locally in devices shall be encrypted and access to locally stored setting data can be controlled by a system admin user.
 - C. Manufacturer shall provide standalone configuration software to locally configure a device to meet OWNER security policies if IP network setting data cannot be stored in third-party software or to troubleshoot device network connectivity issues.
- 1.18 REGULATORY REQUIREMENTS
- A. Equipment and components furnished shall be of the Manufacturer latest model.
 - B. System devices shall be installed in compliance with local and state authorities having jurisdiction.
 - C. Electrical Components, Devices, and Accessories: Listed and labeled per NFPA 70 by qualified testing agency.
 - D. Regulatory Requirements: System design and installation shall comply with the following: National Electric Code (NEC).
 - 1. Underwriters Laboratory (UL) standards.
 - 2. Local codes and regulations.
- 1.19 SUBMITTALS
- A. Product Data: Submit complete catalog data for each system device and components, describing physical characteristics and method of installation.
 - B. Shop Drawings: Showing the following.
 - 1. Diagram of the proposed system showing the communication pathway and schedule of individual system device installation locations.

- 2. Indicate integration with the Owner's network. Include a line diagram of network relationships.
 - 3. Show system device power requirements.
 - C. Samples: Submit one specified system device model(s) for approval. Approved sample(s) shall be tagged and shall be installed at a location directed.
 - D. Manufacturer Instructions: Submit complete installation, set-up, and maintenance instructions electronically.
 - E. Information submittal: Manufacturer Sample Warranty.
 - F. Information submittal: Manufacturer Technical Support Agreement (TSA).
 - G. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.
- 1.20 SUBSTITUTIONS
- A. Proposed substitutions, to be considered, shall be manufactured of equivalent materials that meet or exceed specified requirements of this Section.
 - B. Proposed substitutions shall be identified not less than 10 days prior to the bid date.
- 1.21 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Manufacturer of wireless and IP Ethernet/PoE connected system with a minimum of ten years record of satisfactory manufacturing and support of systems comparable to the basis of specified system design.
- 1.22 DELIVERY STORAGE AND HANDLING
- A. Deliver all components to the site in the Manufacturer original packaging.
 - B. Packaging shall contain Manufacturer name and address, product identification number, and other related information.
 - C. Store equipment in finished building and in unopened packaging until ready for installation.
- 1.23 PROJECT SITE CONDITIONS
- A. System design is integrated with the Owner's existing Ethernet/PoE network; limited to system devices equipped with IP network technology.
 - B. Conductors and Cables: Comply with requirements of Division 27 Sections "Common Work Results for Communications" and "Communications Horizontal Cabling."
 - C. Signal and Control Circuits: Manufacturer recommended stranded, single conductors, or twisted-pair cables.
 - D. Data Circuits: Category 5 minimum, twisted-pair cable.
- 1.24 SOFTWARE MAINTENANCE
- A. Manufacturer shall offer an annual Technical Support Agreement (TSA); agreement shall be inclusive to system software access, phone/email technical support, software maintenance and revisions, and firmware revisions.
 - B. All system updates, enhancements and maintenance are performed per agreed upon TSA.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design:
 - 1. Primex, Inc. 965 Wells St, Lake Geneva, WI 53147 | Phone: (800) 537-0464 | info@primexinc.com | www.primexinc.com.
 - 2. Approved equivalent.

2.2 SYSTEM SOFTWARE

- A. Basis of Design System Software: Primex OneVue™ Sync.
 - 1. Cloud-based software that resides on Amazon Web Services (AWS) and is accessed via the internet.
 - 2. System software stores and monitors system transmitter device operating conditions.
 - 3. All system devices and system settings are managed from the system software or mobile configurator app.

2.3 SYSTEM DEVICES & ACCESSORIES

- A. Clocks (single-sided) shall be wall-mounted.

- B. Additional colors, finishes, and dial faces are available from Manufacturer.
- C. Clock faces can be customized by Manufacturer to display the organization name or logo as specified.
- D. Clock frames and lenses are of durable thermoplastic.
- E. Clocks shall have a tamper-proof/theft resistant clock-lock mounting slots.
- F. A dual-mount kit is available from the Manufacturer that combines two single clocks to create a dual-sided clock.
- G. Electric (AC) models include a cord with a plug. The power plug may be removed and the cord cut to length for hardwired (pigtail) installation. Pigtail installation requires a 120V~ power line in a junction box installed by a licensed electrician.
- H. If power is interrupted, the clock will stop until power resumes. Upon resumption of power, the clock will self-correct to the current time.
- I. Battery-operated analog clocks shall have a 5-year nominal battery life.
 - 1. Installer will furnish clock batteries in accordance with Manufacturer instructions.

2.4 SUPPLY MODELS - ANALOG CLOCKS

- A. Education series:
 - 1. Size: 12.5 inches.
 - 2. Color: Black.
 - 3. Power: Battery.
- B. Traditional series:
 - 1. Size: 12.5 inches.
 - 2. Color: White.
 - 3. Power: AC.
- C. Traditional series:
 - 1. Size: 9 inches.
 - 2. Color: Black.
 - 3. Power: Battery.
- D. Slim metal series:
 - 1. Size: 12.5 inches.
 - 2. Power: AC.
- E. Slim metal series:
 - 1. Size: 9 inches.
 - 2. Power: Battery.
- F. Wood series:
 - 1. Size: 16 inches.
 - 2. Finish: Honey.
 - 3. Power: AC.
- G. Wood series:
 - 1. Size: 11.5 inches.
 - 2. Finish: Honey.
 - 3. Power: Battery.
- H. Gallery series:
 - 1. Size: 24 inches.
 - 2. Finish: Distressed Brown.
 - 3. Power:
- I. Personal Series LCD Clocks shall meet below specifications:
 - 1. Clock shall have time (12/24 hour modes), date, and day-of-week display options.
 - 2. Clock shall have a backlight illumination option.
 - 3. Clock shall have an easel stand for desk or tabletop use or can be wall-mounted by way of a patented anti-theft clock lock.
 - 4. Installer shall furnish clock batteries in accordance with Manufacturer instructions; requires 4 C-cell alkaline batteries.
- J. Supply Models - Personal Series LCD Clock
 - 1. Technology: Bluetooth® low energy wireless technology.
 - 2. Power: Battery.

- K. Digital Clocks shall meet the following specifications:
1. Clock LED display must include a 12- or 24-hour time display, a PM indicator light, and an alternating time and date display option.
 2. Dual-mount kit is available from the Manufacturer that combines two single clocks to allow for a dual-sided clock.
 3. Power over Ethernet (PoE) models shall have an IEEE 802.3af compliant power supply built into the clock assembly.
 4. AC (120 VAC/50-60 cycle) models, with Bluetooth wireless technology, shall include a 10' (3m) power cord with a plug. The power plug may be removed and cord cut to length for hardwired (pigtail) installation. Pigtail installation requires a 120V~ power line in a junction box installed by a licensed electrician.
- L. Flush mount models, with Bluetooth wireless technology, shall have a 30 inch (44.72 cm) AC-power cord with pigtail.
- M. Clock shall have a power outage memory backup and maintain the correct time up in its memory for a minimum of 1 hour without power.
- N. Clock shall be viewable from 150 feet (45.7 m).
- O. Clock shall have highly visible 7-segment LED digits.
- P. Clock shall have display dimmer options, including 100, 75, 50, and 25 percent.
- Q. Clock enclosure shall be ABS plastic and junction box shall be UL listed (UL 50E 1st Ed; listing number E469550).
- R. SUPPLY MODELS - Digital Clocks:
1. Surface Mount 2.5 inch Digits.
 2. Number of Digits: 4 digit.
 3. Digit Color: Red.
 4. Bracket: 4 degree Slope Bracket, 10 foot (3m) cord with plug.
- S. Surface Mount 4 inch Digits:
1. Number of Digits: 4 digit.
 2. Digit Color: Red.
 3. Bracket: 4 foot Slope Bracket, 10 foot (3m) cord with plug
- T. Flush Mount 2.5 inch Digits:
1. Number of Digits: 6 Digit.
 2. Digit Color: Red.
- U. Elapsed Digital Timers shall meet the following specifications:
1. Timer shall also function as a clock or function as a count-down/count-up interval timer when programmed with a three-button wall mount control switch.
 2. Timer shall accurately count up or count down up to a maximum of 99 hours, 59 minutes, and 59 seconds.
 3. Timer shall include a three-button wall-mountable control switch. This control will be mounted in a single gang electrical box. Control buttons must be washable with water and common disinfectants.
 4. Switch control shall connect to the timer with a supplied reversed wire (cross-pinned) telephone cable with an RJ-11 connector. It can be extended up to 100 feet (30.48 m).
 5. Timer switch control can be configured to simultaneously activate two connected timers.
 6. Timer shall be viewable from up to 150 feet (45.7 m).
 7. Timer shall have highly visible 7-segment LED digits.
 8. Timer shall have display dimmer options, including 100, 75, 50, and 25 percent.
 9. Timer display shall include a 12 or 24-hour time display, a PM indicator light, and an alternating time and date display option.
 10. Timer shall have an audible tone option on the count-up and count-time function with a frequency of 3KHz plus or minus 0.5KHz.
- V. AC (120 VAC/50-60 cycle) models, shall include a 10 feet (3m) power cord with a plug. The power plug may be removed and cord cut to length for hardwired (pigtail) installation. Pigtail installation requires a 120V~ power line in a junction box installed by a licensed electrician.
- W. Flush mount models, with Bluetooth wireless technology, shall have a 30 inch (44.72 cm) AC-power cord with pigtail.

- X. Timer shall have a power outage memory backup and maintain correct time up to a minimum of 1 hour without power.
- Y. Clock enclosure shall be ABS plastic and junction box shall be UL listed (UL 50E 1st Ed; listing number E469550).
- Z. Supply ModelsS - Elapsed Timers
 - 1. Surface Mount 2.5 inch Digits.
 - 2. Number of Digits: 4 digit.
- AA. LED Color: Red
 - 1. Bracket: 4 degree Slope Bracket.
- BB. Surface Mount 4 inch Digits:
 - 1. Number of Digits:4 digit.
 - 2. Digit Color: Red.
 - 3. Bracket: 4 feet Slope Bracket.
- CC. Flush Mount 2.5 inches Digits
 - 1. Number of Digits: 6 Digit.
 - 2. Digit Color: Red.
- DD. Code Blue Digital Timers shall meet the following specifications.
 - 1. Timer shall function as a standard digital clock and integrate with the OWNER'S existing (supported) code blue control system.
 - 2. Timer shall support code blue systems that apply a voltage to start a code blue event or code blue systems that use a dry contact and do not inject a voltage.
 - 3. Timer shall include a three-button wall-mountable control switch. This control will be mounted in a single gang electrical box.
 - 4. Timer switch control and buttons must be a cleanable surface with use common disinfectants.
 - 5. Timer switch control shall connect to timer with a supplied reversed wire (cross-pinned) telephone cable with an RJ-11 connector. It can be extended up to 100 feet (30.48m).
 - 6. Timer switch control can be configured to simultaneously activate two connected timers.
 - 7. Timer display must include a 12 or 24-hour time display, a PM indicator light, and an alternating time and date display option.
 - 8. Code Blue Timer must include an optional audible tone to alert changes in interval cycles in the count-up and count-down function.
 - 9. Digital Clock shall have display dimmer options, including 100, 75, 50, and 25 percent.
 - 10. Power over Ethernet (PoE) models shall have an IEEE 802.3af compliant power supply built into the clock assembly.
 - 11. AC (120 VAC/50-60 cycle) models, with Bluetooth wireless technology, shall include a 10' (3m) power cord with a plug The power plug may be removed and cord cut to length for hardwired (pigtail) installation. Pigtail installation requires a 120V~ power line in a junction box installed by a licensed electrician.
 - 12. Flush mount models, with Bluetooth wireless technology, shall have a 30 inch (44.72 cm) AC-power cord with pigtail.
 - 13. Code Blue Timer shall have a power outage memory backup and maintain the correct time up to a minimum of 1 hour without power.
 - 14. Clock enclosure shall be ABS plastic and junction box shall be UL listed (UL 50E 1st Ed; listing number E469550).

2.5 SUPPLY MODELS - CODE BLUE TIMERS

- A. Surface Mount 2.5 inch Digits
 - 1. Number of Digits: 6 Digit.
 - 2. Digit Color: Red.
 - 3. Bracket: 4 degree Slope Bracket.
- B. Surface Mount 4 inch Digits:
 - 1. Number of Digits: 6 Digit.
 - 2. Digit Color: Red.
 - 3. Bracket: 4 degree Slope Bracket.
- C. Flush Mount 2.5 inches Digits:
 - 1. Number of Digits: 6 Digit.

2. Digit Color: Red.
- D. Bridge shall meet the following specifications:
 1. Display: Liquid crystal display (LCD).
 2. Mounting: Keyhole slot with lockdown screw holes in back panel for wall mount; or surface mount with supplied dual-lock adhesive mounting strips.
 3. Configuration: configured from system software or locally at the device with supplied device configuration software.
 4. Backup Battery-power: 3.0v Primex Lithium/Iron Disulfide Battery Pack or two stand-alone 1.5v Lithium AA batteries. The use of alkaline batteries is not recommended.
 5. Local memory storage capacity: configuration data for up to 1400 Bluetooth clocks.
 6. Environment: Operating Temperature: 32 to 122° F (0 to 50° C), indoor use only | Storage Temperature: -4 to 140 ° F (-20 to 60° C).
 7. AC-power: 5V DC USB Mini B (5 pin) connector interface, 5 feet (1.5 meter) cable, Input: 100-240 VAC, 50/60 Hz, 0.4A, Output: 5V DC, 1.0A max.
- E. Certifications: FCC, CE, and IC compliant.
- F. Supply Models - Bridge.
- G. Technology: Ethernet (PoE) Technology.
- H. Power: Power over Ethernet (PoE).
- I. Repeater shall meet the following specifications.
 1. Enclosure: ABS plastic | Dimension: 4.7 inch H x 3.7 inch W x 1.3 inch D (11.93cm x 9.39cm x 3.30cm) | Weight: 0.3 lb. (136 gram) with 2 AA batteries
 2. Mounting: Keyhole slot with lockdown screw holes in back panel for wall mount or surface mount with supplied dual-lock adhesive mounting strips.
 3. Battery-power: 2 DD batteries; typical five (5) year battery life.
 4. Environment: Operating Temperature: 32 to 122° F (0 to 50° C), indoor use only | Storage Temperature: -4 to 140 ° F (-20 to 60° C).
 5. Certifications: FCC, CE, and IC compliant.
- J. Supply Models - Repeater
 1. Technology: Bluetooth low energy wireless technology.
 2. Optional AC power accessory: 5V DC USB Mini B (5 pin) connector interface, 5 feet (1.5 meter) cable, Input: 100-240 VAC, 50/60 Hz, 0.4A, Output: 5V DC, 1.0A max.

2.6 ACCESSORIES

- A. System shall include the accessories below.
 1. Analog Clock - Dual Clock Kit.
 2. Black - Fits 12.5 inches Traditional Series or Educational Series Analog Clock White - Fits 12.5 inches Traditional Series or Educational Series Analog Clock.
 3. Slim Metal Series Clock - Dual Clock Kit; Fits 12.5 inches (31.75cm) Slim Model Clock, Fits 16 inches (40.6cm) Slim Model Clock.
 4. Analog Clock Wire Clock Guard:
 - a. 16 inches Clocks (40.64cm): 18 inches square x 3 inches D (45.72cm square x 7.6cm D).
 5. Digital Clock - Dual Clock Bracket Kit.
 - a. Ceiling mount: 2-inch, 4-Digit.
 - b. Wall mount: 2-inch, 4-Digit.
 6. Digital Clock Polycarbonate Clock Guards.
 - a. 2.5 inch (6.35cm) Guard: 16.0 inches L x 7.0 inches H x 5.5 inches D (40.64cm L x 17.78cm H x 13.97 cm D)
 - b. 4 inch (10.16cm) Guard: 25.0 inches L x 9.8 inches H x 4.4 inches D (63.5cm L x 24.9cm H x 11.2 cm D)
 7. Flush Mount Digital Clock Polycarbonate Cover.
 8. Crash Cart Kit.
 9. Complete kit for mounting a Digital Clock Timer to a mobile crash cart.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions with the Installer present for compliance with requirements and other conditions affecting the performance of the system and system devices.
 - B. Do not proceed until unsatisfactory conditions have been corrected.
 - C. Verify that construction is complete in spaces to receive equipment and that rooms are clean and dry.
- 3.2 INSTALLATION
- A. General: Install system devices in accordance with applicable codes.
 - B. Install system devices in accordance with Manufacturer written instructions.
 - C. Provide all system equipment necessary for a complete and operable system.
 - D. Comply with requirements of Division 27 Sections "Common Work Results for Communications" and "Communications Horizontal Cabling."
 - E. Cables: Install cables in raceways and cable trays except within consoles, cabinets, and desks [and except in accessible ceiling spaces and framed partitions where exposed wiring is allowed by Owner]. Install plenum cable where required. Conceal cable installation where possible.
- 3.3 FIELD INSPECTION
- A. Inspection: Make observations to verify that system devices and components are properly labeled.
 - B. Prior to final acceptance, inspect each system device and component, adjust as required, and replace parts that are found defective.
 - C. At the completion of system device installation and prior to final acceptance, turn on the equipment; ensure that all equipment is operating properly and that the system software and all system devices and components are functioning.
- 3.4 SERVICES
- A. Manufacturer system software user guides and system device installation guides shall be provided electronically within system software.
 - B. Commissioning General: Provide system commissioning in accordance with Manufacturer written recommendations. Perform operational testing to verify compliance with requirements. Adjust as required.
 - C. Services shall include a specified level of commissioning services.
 - D. Remote commissioning service: system deployment training, including system set up, device configuration, and system functionality by way of a web conference.
 - E. Onsite commissioning service: system training, system set up, validation of device configuration and system functionality, verification of device network connections, and device installation training.
 - F. Onsite installation and commissioning service: system training, configuration, validation of device configuration, training on system functionality, verification of device network connections, and device installation.
- 3.5 CLEANING
- A. Prior to final acceptance, clean exposed surfaces of devices, using cleaning methods recommended by Manufacturer.
 - B. Perform cleanup as work progresses and leave work area clean at the end of each day.
 - C. Upon completion, remove surplus materials, rubbish, tools, and equipment.
 - D. Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning.
- 3.6 DEMONSTRATION
- A. Initial Demonstration: provide a demonstration to identified Owner facility staff that is responsible to maintain the system.
 - B. Demonstrate maintenance procedures for system devices.
 - C. Demonstrate the system features, including monitoring and management of system devices.
- 3.7 PROTECTION
- A. Protect finished installation until the final project acceptance.
 - B. Repair damage to adjacent materials caused by the system installation.
- 3.8 TESTING
- A. All system devices must be tested at their operational installation location under normal operational conditions.

END OF SECTION 27 53 13.13

SECTION 27 53 18

WLAN

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. WLAN Cabling: That portion of telecommunication cabling system that extends from an access point (AP) to TR/ER.
 - 1. In addition to satisfying current telecommunications requirements, WLAN cabling system shall facilitate ongoing maintenance and relocation requirements, as well as readily accommodating future equipment and service changes.
 - 2. WLAN cabling for project uses conventional hierarchical star topology that home runs UTP, from TR/ER to AP locations throughout facility.
- B. Section Includes:
 - 1. Minimum requirements for following:
 - a. Wireless Enclosure.

1.3 RELATED REQUIREMENTS

- A. Section 01 33 00 - Submittal Procedures.
- B. Section 01 42 00 - References.
- C. Section 27 05 00 - Common Work Results for Communications.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. Reference Standards: See Section 01 42 00 - References and Section 27 05 00 - Common Work Results for Communications

1.5 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00 - Submittal Procedures and Section 27 05 00 - Common Work Results for Communications.
- B. Product Data and Installation Instructions: Submit following:
 - 1. Wireless Enclosure.
- C. If providing pre-standards manufacturer system solution, submit installer/contractor certification documentation and channel certification information and requirements from manufacturer.
- D. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

1.6 QUALITY ASSURANCE

- A. Comply with Category 6 installation practices when installing UTP data/voice cabling.

PART 2 - PRODUCTS

2.1 WIRELESS ENCLOSURES

- A. Wireless Enclosures, Ceiling-Mounted:
 - 1. Ceiling-mounted wireless enclosures shall be manufactured from sheet aluminum.
 - 2. Each enclosure will be rectangular in shape sized to fit within a single 2 x 2 feet drop ceiling tile, as specified below.
 - 3. When installed into the ceiling, the body of the enclosure will be located above the drop ceiling supported from the ceiling tile support grid with included support brackets. One side of the enclosure will be flush with the drop ceiling. An access door on the flush surface will open into the work area below the drop ceiling providing access to equipment within the enclosure.

4. The access door will be fully hinged and will lock in the closed position. The access door will have an interchangeable (removable) faceplate. Faceplates will be punched with a slot and/or hole pattern to allow the antennas of wireless access point to extend below the enclosure. The wireless access point will be secured to the door with an adjustable bracket included with the enclosure, straps or hardware. The manufacturer will sell several styles of compatible faceplates as separate accessories.
5. The enclosure will have a single cable access port located on the side of the enclosure and opposite the hinge side of the access door. The ports will include approved fire-rated foam sealing kits. Cable tie points for securing cables will be located within the enclosure and on the access door. The manufacturer will sell compatible cable management straps as a separate accessory.
6. The enclosure will have an optional integrated junction box sized to accept two duplex receptacles. The junction box will be pre-punched with a 7/8 inch knockout for trade size 1/2 inch conduit.
7. Finish shall be epoxy-polyester hybrid powder coat (paint) in the color(s) specified by owner. Cable ports and mounting brackets will be mill finish.
8. The enclosure will be UL Listed for use within a plenum space. UL Listing will be stated in the manufacturer's product literature.
9. Acceptable Manufacturers:
 - a. Oberon, Inc.
 - b. Accepted Substitute in accordance with Section Division 27.

PART 3 - EXECUTION

3.1 WIRELESS ENCLOSURE

- A. Terminate Category 6 UTP cable in 1-port surface-mount box located inside of wireless enclosure.

3.2 LABELING

- A. Biscuit jack for wireless will be labeled the same as the Work Area Outlets (WAO), (see 27 05 53) with one exception the TR room number will be preceded by a W. The ceiling grid where the wireless cable is installed needs to be P-touch labeled with the same information, so cable location can be identified when ceiling is closed.

END OF SECTION 27 53 18

SECTION 27 84 13

COMMUNICATIONS PENETRATION FIRESTOPPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to:
 - 1. Firestopping of Through Penetrations in Fire Rated Assemblies.
 - 2. Smoke and Acoustical Sealing in Non-Rated Assemblies.
- B. This section addresses those unique elements that affect the Penetration Firestopping of Information Technology cabling systems which may not be addressed in other Sections.

1.3 RELATED REQUIREMENTS

- A. Section 01 33 00 - Submittal Procedures.
- B. Section 07 84 13 - Penetration Firestopping for coordination of elements that are not specific to Information Technology cabling systems.
- C. Section 27 05 28.36 - Cable Trays for Communications Systems.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.
- C. UL 1479 - Standard for Fire Tests of Penetration Firestops.
- D. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- E. UL (FRD) – Fire Resistance Directory.
- F. NFPA 101 - Life Safety Code.
- G. NFPA 70 - National Electrical Code.
- H. ANSI/TIA-1179 - Healthcare Facility Telecommunications Infrastructure Standard.
- I. ANSI/TIA-569-D - Commercial Building Standard for Pathway's and Spaces.

1.5 PERFORMANCE REQUIREMENTS

- A. Fire rated cable pathway devices shall be used in fire-rated construction for ALL low-voltage, video, data and voice cabling, optical fiber raceways and certain high-voltage cabling where frequent cable moves, adds and changes may occur. Pathways required for high voltage cabling will be detailed on the prints. Such devices shall:
 - 1. Meet the hourly fire-rating of fire rated wall and or floor penetrated.
 - 2. Have UL Systems permitting cable loads from; "Zero to 100 percent Visual Fill." This requirement eliminates need for fill-ratio calculations to be made by cable technicians to ensure cable load is within maximum allowed by UL System.
 - 3. Not have inner fabric liner that tightens around and compresses cables tightly together encouraging potential cable damage or interference.
 - 4. Removal and or replacement of any material such as, but not limited to, firestop caulk, putty, pillows, bags, foam muffins, foam, foam plugs, foam blocks, or foam closures of any sort.
- B. Where non-mechanical pathways must be utilized, such as sealing (caulking) around single or grouped conduits, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction. Provide letter from manufacturer certifying compliance with this section.

1.6 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 - Submittal Procedures.
- B. Product Data: Provide manufacturer's standard catalog data for specified products demonstrating compliance with referenced standards and listing numbers of systems in which each product is to be used.
- C. Schedule of UL System Drawings for Fire Rated Construction: Submit schedule of all expected opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance ratings.
- D. UL System Drawings for Fire Rated Construction: Furnish copies of all UL Systems identified in other areas of this specification. Include any engineering recommendations.
- E. Certificates: Product Certificate of Compliance from the by manufacturer certifying material compliance with applicable code and specified performance characteristics.
- F. Installation Instructions: Submit manufacturer's printed installation instructions.
- G. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

1.7 QUALITY ASSURANCE

- A. Products/Systems: Provide firestopping systems that comply with the following requirements:
 - 1. Firestopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for firestop system acceptable to authorities having jurisdiction.
 - 2. Firestopping products bear the classification marking of qualified testing and inspection agency.
- B. Installer Qualifications: Experience in performing work of this section who is qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products in accordance with specified requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
 - 1. Manufacturer's original, unopened, undamaged containers, identification labels intact identifying product and manufacturer, date of manufacture; lot number; shelf life, if applicable; qualified testing and inspection agency's classification marking; and mixing instruction for multi-component products.
 - 2. Handle and store products according to manufacturer's recommendations published in technical materials. Leave products wrapped or otherwise protected and under clean and dry storage conditions until required for installation.
- B. Storage and Protection
 - 1. Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

1.9 PROJECT CONDITIONS

- A. Do not install products when ambient or substrate temperatures are outside limitations recommended by manufacturer.
- B. Do not install products when substrates are wet due to rain, frost, condensation, or other causes.
- C. Maintain minimum temperature before, during, and for a minimum 3 days after installation of materials.
- D. Do not use materials that contain flammable solvents.
- E. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- F. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- G. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer:
 - 1. Specified Technologies, Inc.
- B. Substitutions: None permitted.

- C. Single Source: Obtain firestop systems for each type of penetration and construction condition indicated only from a single manufacturer.

2.2 MATERIALS

A. General:

- 1. Products specified are based around products manufactured by Specified Technologies, Inc. for penetration firestopping for Information Technology systems. Coordinate penetration firestopping systems for other applications in accordance with Section 07 84 13 - Penetration Firestopping.
- 2. Use only products that have been tested for specific fire resistance rated construction conditions or acoustical and smoke related requirements conforming to construction assembly type, penetrating item type, annular space requirements, and rating involved for each separate instance.

B. Firestop Sealants: STI SpecSeal® Brand single component latex formulations that upon cure do not re-emulsify during exposure to moisture, the following products are acceptable:

- 1. Specified Technologies Inc. (STI) SpecSeal® Series SSS Sealant.
- 2. Specified Technologies Inc. (STI) SpecSeal® Series LCI Sealant.

C. Firestop Putty: STI SpecSeal® Brand intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers or silicone compounds, the following products are acceptable:

- 1. Specified Technologies Inc. (STI) SpecSeal® Series SSP Putty.

D. Firestop Pillows: STI SpecSeal® Brand re-enterable, non-curing, mineral fiber core encapsulated on six sides with intumescent coating contained in a flame retardant poly bag, the following products are acceptable:

- 1. Specified Technologies Inc. (STI) SpecSeal® Series SSB Pillows.

E. Fire-Rated Cable Grommet: STI SpecSeal® Brand Firestop Grommet is a molded, two-piece grommet with an integral fire and smoke sealing foam membrane for sealing individual cable penetrations through framed wall assemblies. Grommet snaps together around cable and locks tightly into the wall.

- 1. Specified Technologies Inc. (STI) SpecSeal® Brand Ready® Firestop Grommets; RFG1.

F. Fire-Rated Cable Pathways: STI EZ-PATH® Fire-Rated Pathway device modules comprised of steel pathway with self-adjusting intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable.

- 1. Specified Technologies Inc. (STI) EZ-PATH® Fire Rated Pathway.

G. Smoke and Acoustical Pathways: STI EZ-PATH® Smoke & Acoustical Pathway device module comprised of a nonmetallic pathway with integral self-adjusting smoke and sound sealing system for cable penetrations through non-fire-resistance rated wall or floor assemblies, the following products are acceptable:

- 1. Specified Technologies Inc. (STI) EZ-PATH® Smoke & Acoustical Pathway; Model No. NEZ33.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Before beginning installation, verify that substrate conditions previously installed under other sections are acceptable for installation of firestopping in accordance with manufacturer's installation instructions and technical information.
- B. Surfaces shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellents, and any other substances that may inhibit optimum adhesion.
- C. Provide masking and temporary covering to protect adjacent surfaces.
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.
- B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of products.

3.3 FIELD QUALITY CONTROL

- A. Keep areas of work accessible until inspection by authorities having jurisdiction.
- B. Where deficiencies are found, repair firestopping products so they comply with requirements.

3.4 ADJUSTING AND CLEANING

- A. Remove equipment, materials, and debris, leaving area in undamaged, clean condition.

B. Clean all surfaces adjacent to sealed openings to be free of excess firestopping materials and soiling as work progresses.

3.5 EQUIPMENT SCHEDULES

PENETRANT TYPE	CONCRETE FLOOR	CONCRETE WALL	GYPSUM BOARD WALL
BLANK OPENING	C-AJ-0100 C-AJ0101 C-AJ-0113 C-AJ-0116	C-AJ-0100 C-AJ0101 C-AJ-0113 CAJ-0116	W-L-0020 W-L-0034
METAL CONDUITS	C-AJ-1080 C-AJ1240 C-AJ-1353	C-AJ-1080 W-J-1098 W-J-1100	W-L-1049 W-L-1222 W-L-1168
PLASTIC CONDUITS/RACEWAYS	C-AJ-2140 C-AJ2292 F-A-2186 F-A-2210 F-A-2225	C-AJ-2038 C-AJ2108 C-AJ-2578 CAJ-2586 W-J-2018 W-J-2076	W-L-2059 W-L-2074 W-L-2093 W-L-2241
CABLES	C-AJ-3214 C-AJ3231 F-A-3015 F-A-3021 F-A-3054	C-AJ-3214 C-AJ3231 W-J-3098 W-J-3099 W-J-3124 W-J-3150 W-J-3180	W-L-3219 W-L-3248 W-L-3287 W-L-3356 W-L-3377 W-L-3378 W-L-3379 W-L-3390
CABLE TRAYS	C-AJ-3317 C-AJ8181 C-AJ-4029 F-A-3015 F-A-3037	C-AJ-8181 W-J-4021 W-J-4022 W-J-4033 W-J-3098 W-J-3145 W-J-3158	W-L-3218 W-L-3271 W-L-3286 W-L-3306 W-L-4008 W-L-4029 W-L-404 3W-L-8073

END OF SECTION 27 84 13



DIVISION 28

ELECTRONIC SAFETY AND SECURITY



SECTION 28 05 00

GENERAL SECURITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Electronic Security Systems: Provide complete access control, video surveillance, and intrusion detection systems with accessories.
 - 1. The systems shall be integrated for detecting; delaying and deterring unauthorized personnel from entering protected facilities, while providing control access to authorized personnel. The systems shall process and display the data and video signals from the various sensors and detecting devices as indicated on the drawings and specifications.
- B. It is the intent of these specifications to provide a complete and workable security system ready for the owners use. Any item not specifically shown on the drawings or called for in the specifications, but normally required to conform to the intent, are to be considered as part of the contract.
- C. Applications Standards: Include, but not be limited to, IEEE 802.3-2002, 10Base5, 10BASE-T, IEEE 802.5, 4 Mbps, 16Mbps, and TP-PMD.
 - 1. Access Control, Intrusion detection and Video Surveillance:
 - a. 3/4 inch fire rated plywood mounted at location shown in telecom room.
 - b. Power supply at telecom rooms and security operation center to power the individual systems with 25 percent headroom.

1.3 RELATED REQUIREMENTS

- A. Section 01 33 00 - Submittal Procedures.
- B. Section 01 79 00 - Demonstration and Training.
- C. Section 01 77 00 - Closeout Procedures and Submittals.
- D. Section 07 84 13 - Penetration Firestopping.
- E. Section 07 92 00 - Joint Sealants.
- F. Section 08 31 13 - Access Doors and Frames.
- G. Section 09 91 23 - Interior Painting.
- H. Section 28 13 00 - Access Control System.
- I. Section 28 05 13 - Conductors and Cables for Electronic Safety and Security.

1.4 REFERENCE STANDARDS

- A. Reference Standards: In addition to requirements shown or specified, comply with applicable provisions of following for design, materials, fabrication, and installation of component parts:
 - 1. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - 2. ADA Standards – Americans with Disabilities Act.
 - 3. ANSI C80.1 - Specification for Rigid Steel Conduit, Zinc Coated.
 - 4. ANSI C80.3 - Electrical Metallic Tubing; Zinc Coated.
 - 5. ANSI C80.6 - Intermediate Metal Conduit; Zinc Coated.
 - 6. ANSI/TIA/EIA 526-7 - Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant.
 - 7. ANSI/TIA/EIA-526-14A - Optical Power Loss Measurements of Installed Multi-mode Fiber Cable Plant.
 - 8. ANSI/TIA/EIA-568-B.3 - Optical Fiber Cabling Components Standard.
 - 9. ANSI/TIA/EIA-568-B.3-1 – Optical Fiber Cabling Components Standard; Addendum 1 – Additional Transmission Performance Specifications for 50/125 Micron Optical Fiber Cables.
 - 10. ANSI/TIA/EIA-598-A - Optical Fiber Cable Color Coding.

11. ANSI-J-STD-607-A - Commercial Building Grounding (Earthing) and Bonding Requirements For Telecommunications.
12. ASTM B633 - Specification for Electro-deposited Coatings of Zinc on Iron and Steel.
13. ASTM C33/C33M - Standard Specification for Concrete Aggregates.
14. City and State or District Ordinances, as applicable to location.
15. DCID 6/9 – Physical Security Requirements for SCI.
16. DCID 6/4 – SCI Personnel Security Standards.
17. DCID 6/3 – Protecting SCI in Information System.
18. DOD 5200.8 – R Physical Security Program.
19. Factory Mutual and/or Owner's Representative's Insurance Carrier.
20. FCC Part-15 – Radiated Emission Limits.
21. FCC Part-68 – Connection of Terminal Equipment to the Telephone Network.
22. IEEE C2, National Electrical Safety Code®, latest edition including all subsequent addendums.
23. ISO/IEC 11801 Ed.2: 2002, Information Technology – Generic Cabling for Customer Premises
24. Military Handbook – 1013/1A Design for Physical Security of Facilities.
25. NEMA 250 – Enclosures for Electrical Equipment.
26. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
27. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
28. NEMA TC 6&8 - PVC Plastic Utilities Duct for Underground Installations.
29. NEMA TC 9 - Fittings for PVC Plastic Utilities Duct for Underground.
30. NEMA VE 2 - Cable Tray Installation Guidelines.
31. NFPA 70, National Electrical Code®, latest edition including all subsequent addendums.
32. NFPA 72, National Fire Alarm Code®, latest edition including all subsequent addendums.
33. NFPA 101, Life Safety Code®, latest edition including all subsequent addendums.
34. NFPA 730 - Guide for Premises Security®, latest edition including all subsequent addendums.
35. NFPA 731 -, Standard for the Installation of Electronic Premises Security Systems®, latest edition including all subsequent addendums.
36. NRCA®, latest edition including all subsequent addendums.
37. UL 6 - UL Standard for Safety for Electrical Rigid Metal Conduit – Steel.
38. UL 50 – UL Standard for Cabinets and Boxes.
39. UL 294 – UL Standard for Access Control Unit.
40. Underwriters Laboratories Standard 630 – UL Standard for Power Supplies for use with Burglar-Alarm Systems.
41. UL 634 – UL Standard for Connectors and Switches for use with Burglar-Alarm Systems.
42. UL 639 – UL Standard for Intrusion Detection Units.
43. Underwriters Laboratories Standard 796 – UL Standard for Printed Circuit Boards.
44. UL 797 – UL Standard for Electrical Metallic Tubing- Steel.
45. UL 1037 – UL Standard for Antitheft Alarms and Devices.
46. UL 1242 - Type IMC threaded and unthreaded conduit, nipples, bends, and couplings in 1 to 4 inch trade size.
47. Unified Facilities Criteria (UFC) and Anti-Terrorism/Force Protection (ATFP) Requirements.

1.5 DEFINITIONS

- A. Definitions: See Section 01 42 00 - References for additional definitions.
 1. As Indicated: As shown on the drawings and in accordance with the specifications.
 2. As required: As required to provide a complete and satisfactory work in full conformance with the drawings and specifications.
 3. Code Requirements: Minimum requirements.
 4. Design Equipment: Refer to BASIS OF DESIGN or Preliminary Design Guidelines.
 5. Design Make: Refer to BASIS OF DESIGN or Preliminary design Guidelines.
 6. Final Acceptance: Owner's Representative's acceptance of project from Contractor.
 7. Furnished by Others: Receive delivery at job site or where called for and install.
 8. Labeled: Classification by standards agency.
 9. Owner's Representative: Prime Professional: Architect or Engineer having contract directly with Owner for professional services.
 10. Provide: Furnish, install, connect, test and make ready for use.

11. Relocate: Disassemble, disconnect, and transport equipment to new locations, then clean, test, and install ready to use.
12. Remove Existing: Remove existing item and return item to client.
13. Replace: Remove and provide new item.
14. Rough in: Pipe, duct, conduit, equipment layout and installation.

B. Acronyms:

1. ACP: Access Control Panel.
2. ADA: Americans with Disabilities Act.
3. ANSI: American National Standards Institute.
4. ASTM: American Society for Testing Materials.
5. ATM: Asynchronous Transfer Mode.
6. AWG: American Wire Gauge.
7. BD: Building Distributor (replacing Intermediate Cross-Connect [IC]).
8. BDF: Building Distribution Facility.
9. BICSI®: Building Industry Consulting Services International.
10. BNC: Bayonet Nut Connector.
11. CATV: Community Antenna Television (cable television).
12. CCD: Charge Coupled Device.
13. CCTV: Closed Circuit Television.
14. dB: Decibel.
15. DSP: Digital Signal Processing.
16. DVR: Digital Video Recorder.
17. DVRMS: Digital Video Recorder and Management System.
18. EIA: Electronics Industry Alliance.
19. EMC: Electromagnetic Compatibility.
20. EMI: Electromagnetic Interference.
21. EMT: Electrical Metallic Tubing.
22. ER: Equipment Room.
23. FCC: Federal Communications Commission.
24. FDDI: Fiber Distribution Data Interface.
25. FM: Factory Mutual Insurance Company.
26. FMC: Flexible Metal Conduit.
27. FOTP: Fiber Optic Test Procedure.
28. Freq.: Frequency.
29. Gnd.: Ground
30. H.264: MPEG4 Video Compression Standard.
31. HH: Handhole.
32. HVAC: Heating, Ventilation, and Air Conditioning.
33. Hz: Hertz.
34. ICEA: Insulated Cable Engineers Association.
35. IDC: Insulation Displacement Connectors.
36. IEEE: Institute of Electrical and Electronic Engineers.
37. ISD: Information Systems Division.
38. ISO: International Organization for Standardization.
39. LAN: Local Area Network.
40. LCD: Liquid Crystal Display.
41. LED: Light-Emitting Diode.
42. Mbps: Megabits per second.
43. MH: Maintenance Hole.
44. MHz: Megahertz.
45. MPEG: Moving Picture Experts Group.
46. NEC: National Electrical Code, NFPA 70.
47. NEMA: National Electrical Manufacturers Association.
48. NESCC: National Electrical Safety Code, C2-1997.
49. NFPA: National Fire Protection Association.
50. NTSC: National Television System Committee.

51. NVR: Network Video Recorder.
52. OSHA: Occupational Safety and Health Administration.
53. PAL: Phase Alternation Lines.
54. PIC: Plastic Insulated Conductor.
55. POTS: Plain Old Telephone Service.
56. PR: Pair.
57. PTZ: Pan Tilt Zoom.
58. PVC: Polyvinyl Chloride.
59. RCDD®: Registered Communications Distribution Designer.
60. REX: Request To Exit.
61. RFI: Radio Frequency Interference.
62. RH: Relative Humidity.
63. SCS: Structured Cabling System.
64. SM: Single Mode.
65. SMDF: Strategic Main Distribution Frame.
66. SNR: Signal-to-Noise Ratio.
67. TR : Telecommunications Room (replacing Telecommunication Closet [TC]).
68. UL: Underwriters Laboratory.
69. UTP: Unshielded Twisted Pair.
70. µm: Micron.
71. UPS: Uninterruptible Power Supply.
72. VAC: Volt Alternating Current.
73. VDC: Volt Direct Current.
74. WAN: Wide Area Network.

1.6 SUBMITTALS

- A. General: Comply with Section 01 33 00 - Submittal Procedures.
 1. Submittal Schedule and Log: Comply with Section 01 33 00 - Submittal Procedures.
 2. Proposed Products List: Comply with Section 01 33 00 - Submittal Procedures.
 3. Product Data: Comply with Section 01 33 00 - Submittal Procedures.
 4. Shop Drawings: Comply with Section 01 33 00 - Submittal Procedures.
 5. Test Reports: Comply with Section 01 33 00 - Submittal Procedures.
 6. Operation and Maintenance Data: Comply with Section 01 33 00 - Submittal Procedures including all documents provided in digital format.
 - a. Submit operation and maintenance manuals for electronic security systems and equipment. Use manuals during demonstrations and instruction of Owner's personnel.
 7. Warranty: Comply with Section 01 33 00 - Submittal Procedures.
 8. Submittals and Shop Drawings review shall include the UTSW Police Access Control Division.
 9. Training: Provide description of planned content to be provided in digital video recordings. Comply with requirements of Section 01 79 00 - Demonstration and Training.
- B. Project Record Documents:
 1. Comply with the requirements of Section 01 77 00 - Closeout Procedures and Submittals.
 2. Maintain timely and accurate records of actual device locations.
 3. Carefully documents major deviations in work as actually installed.
 4. Include notations reflecting as-built conditions of any additions to or variation from original Drawings.
 5. Include actual locations of any installed conduits and raceways that are installed to provide the required functionality of the system.
 6. Accurately show the physical placement of the following:
 - a. Location and identification of distribution cabinets and of equipment located inside cabinets and equipment rooms.
 - b. Junction and pull box locations.
 - c. Schematic drawings of installed devices.
 - d. Routing of cable and termination information.
 - e. End-of-line resistor locations.
 - f. Interfaces to external equipment and systems including those local or at remote location.
 - g. Connections to power, network and telephone circuits where required.

7. Include complete listing of pair assignment records for copper wiring, optical fiber cabling and coaxial cabling.
 - a. Copper Cable Records: Include status of each copper pair.
 - b. Optical Fiber Cable Records: Include strand allocation, test results, and identification of media and protocol used.
 8. Project record drawings shall show wire and cable runs, zone numbers, tamper circuit configuration, panel/circuit breaker numbers from which equipment is powered and splice points.
 9. Project Record Drawings; Submit in digital format, utilizing AutoCAD (Latest version).
- C. System Documentation:
1. Comply with the requirements of Section 01 77 00 - Closeout Procedures and Submittals.
 2. Provide a complete collection of all installation, programming, operation, maintenance manuals and work sheets relating to the equipment provided as part of the work, compiled in digital format and submitted to UTSW PM.
 3. Maintain a file of system of system documentation at the project site throughout the course of the work. Such file shall be updated with new information as equipment is received and installed. System documentation shall be available for inspection by (Client) Project Manager as required.
 4. Upon completion of work, and prior to final acceptance, contractor shall prepare and submit to UTSW PM the As-Built system documentation in digital format.
- D. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.
- 1.7 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Firms regularly and currently engaged in production of equipment and accessories provided.
1. Equipment: In satisfactory and efficient operation on at least five installations for not less than three years.
 2. Suppliers: Factory or manufacturer trained and authorized personnel for installation and service of equipment provided.
- B. Installer Qualifications:
1. Certified by electronic security equipment manufacturer, adhere to engineering, installation and testing procedures and utilize authorized manufacturer components and distribution channels in provisioning this Project.
 2. Experienced in electronic security work and able to demonstrate direct experience on recent systems of similar type, size and complexity.
 3. Labor: Competent, skilled and certified by systems manufacturer.
 4. Own and maintain tools and equipment necessary for successful installation and testing of electronic security systems and have personnel adequately trained in use of such tools and equipment.
 5. Employ full-time Project Manager that are thoroughly trained and certified by the manufacturer in the installation and service of the security systems. Project Manager:
 - a. Installer's representative, speak and respond for Installer.
 - b. Make at least one day per week visit to construction site to determine progress of construction and be available to resolve contract issues.
 6. Project Manager: Contractor: Employ competent Project Manager (PM), satisfactory to Owner's Representative, on Work during progress of Work. Project Manager: Represent Contractor and communications given to PM shall be as binding as if given to Contractor. Contractor [Installer]: Not remove approved PM from Work without approval of Owner's Representative, unless that PM leaves employ of Contractor.
- C. Regulatory Requirements: Comply with Section 01 41 00 - Regulatory Requirements. Comply with following:
1. Americans with Disabilities Act. (ADA), Texas Accessibility Standards (TAS).
 2. NFPA 70 - National Electrical Code (NEC).
 3. NFPA 101 - National Life Safety Code.
 4. Federal Communications Commission (FCC).
 5. FCC 47 CER 68.
 6. Applicable rules and regulations of Federal and State and Local Governmental Agencies.

- D. Pre-Construction Meeting: Attend meeting when requested by Contractor. Come prepared with questions and prepared to answer questions about electronic security work.
 - E. Progress Meetings: Attend meetings when requested by Contractor. Come prepared with questions and prepared to answer questions about electronic security work.
 - F. Intent of Documents:
 - 1. Drawings: Diagrammatic. See Section 01 73 00 - Execution.
 - a. Due to small scale of Drawings, it is not possible to indicate offsets, fittings, changes in elevation, etc. Prior to rough-in, verify exact locations for installation with field measurements and with equipment being connected.
 - b. If field conditions or equipment require significant change to original documents, contact Owner's Representative before proceeding.
 - c. Exact locations of equipment and fixtures subject to approval of Owner's Representative.
 - d. Coordination Drawings: Prepare in accordance with Section 01 31 00 - Project Management and Coordination.
 - 2. Omissions from Drawings or Specifications, or incorrect description of details of Work which are necessary to carry out intent of Drawings and Specifications, or which are customarily performed, shall not relieve Contractor from performing such omitted or incorrect described detail of Work. Perform such Work as if verified field measurements, field construction criteria, materials, catalog numbers and similar data, or will do so, and that he has checked and coordinated each shop drawing and sample with requirements of Work and of Contract Documents.
 - G. Review of Contract Documents: Comply with Section 01 31 00 - Project Management and Coordination.
 - 1. Verify dimensions locating work and its relation to existing work, existing conditions and their relation to work and man made obstructions and conditions, etc. affecting completion and proper execution of work as indicated in Contract Documents.
 - H. Coordination: Coordinate work of this section with requirements of fire alarm contractor, elevator contractor, requirements of Owner's telephone equipment supplier, workstation, and local area network (LAN) equipment suppliers, furniture suppliers and other sub-contractors as required.
 - 1. Meet with representatives of above organizations and Owner's Representative to exchange information and agree on details of equipment arrangements and installation interfaces.
 - 2. Record agreements reached in meetings and distribute record to other participants.
 - 3. Adjust arrangements and locations of control panels, patch panels, and power supplies in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of electronic security equipment.
 - I. Methods of construction not specifically described or indicated in Contract Documents subject to control and approval of Owner's Representative.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. General: Comply with Section 01 60 00 - Product Requirements.
 - 1. Cable Storage: Do not roll or store cable reels without appropriate underlay.
 - 2. Pre-installation Inspection: Visually inspect all electronic security equipment, and shipping cartons to detect possible damage incurred during shipping and transport. Replace visibly damaged goods at no additional cost to Owner.
- 1.9 CONTRACTOR QUALIFICATIONS
- A. Contractor shall be certified at the Authorized Dealer Level for systems been proposed providing certification and other documentation that demonstrate there standing from the manufacturer of the system proposed.
 - B. Dealer shall have at least two (2) Lenel Professional Certified Programmers in Access Control and Digital Video that reside withing 50 miles of the site.
 - C. Dealer shall have at least (2) Microsoft Certified Professionals on staff.
 - D. Contractor shall have minimum of (5) years of experience in the installation of security systems of the type, size and complexity to be provided on this project.
 - E. Lenel hardware installers shall be OnGuard Core certified.
- 1.10 SITE VISIT

- A. Prior to bid submission, the contractor shall visit the site and examine the drawings of other trades to determine the existing design conditions that may affect the work. The contractor shall be held responsible for any assumptions in regards thereto.
- B. The contractor shall verify all dimensions and distances in the field and document the cable lengths and materials to be furnished and installed. The provision and installation of non specified miscellaneous hardware, i.e. nuts, bolts, tie wraps, etc., and shall be the contractor's responsibility.

1.11 PROJECT CONDITIONS

- A. Use of Premises: Comply with Section 01 10 00 - Summary.
 - 1. Make every effort to minimize disruption and expedite work through coordination and cooperation.
 - 2. For areas under renovation, coordinate installation activities with Owner's Representative and updated drawings detailing proposed modifications to Architectural, Mechanical or Electrical facilities.
 - 3. Adjust work schedule within reason, as per direction of Owner's Representative, and coordinate with work of other trades in order to make portions of project available to Owner as soon as possible.
 - 4. Contractor: Responsible for expenses due to untimely or improperly coordinated work.

1.12 SEQUENCING AND SCHEDULING

- A. General: Sequence and schedule work in accordance with Section 01 10 00 - Summary.
- B. Progress Schedule: Prepare and submit in accordance with Section 01 33 00 - Submittal Procedures.

1.13 WARRANTY

- A. Special Warranty:
 - 1. Cable Integrity and Associated Terminations: Warrant being free from defects, transpositions, opens-shorts, kinks, damaged jacket insulation, etc.
 - 2. Guarantee shall cover all costs associated with troubleshooting, repair and replacement of defective work, including cost of labor, transportation, lodging, materials and equipment.
 - 3. One Year Correction Period: For period of one year from Substantial Completion, replace defective equipment within 24 hours of first notification.
 - a. Complete repairs to equipment within 72 hours. If repairs cannot be completed during this time period or if ordering of parts is required, forward progress of repairs to Owner's Representative every 48 hours.

1.14 SYSTEM STARTUP

- A. Power shall only be applied to the system after re-checking for proper grounding of the system and measuring all loops for lack of shorts, grounds and open circuits.

1.15 COMMISSIONING

- A. After all work is completed; contractor shall conduct a final inspection and pre-test all equipment and system features. Contractor shall correct any deficiencies discovered as a result of the inspection and pre-test.
- B. Contractor shall submit a request for an acceptance test in writing to the (Client) Project Manager, no less than fourteen days prior to the requested test date. The request for acceptance test shall be accompanied by certification from contractor that all work is complete, pre-tested and all corrections have been made.
- C. During acceptance test, contractor shall demonstrate all equipment and system features to (Client). Contractor shall remove covers, open wiring connections, operate equipment and perform other reasonable work as requested by (Client).
- D. Any portions of work found to be deficient or not in compliance with the project drawing and specifications will be rejected. Contractor shall promptly correct all deficiencies. Upon correction of deficiencies, contractor shall submit a request in writing to (Client) Project Manager for another acceptance test.
- E. If, at the conclusion of the acceptance test, all work is found to be acceptable and in compliance with the project drawings and specifications. The (Client) Project manager will issue a letter of acceptance to the contractor.
- F. The University Police Access Control Division must be involved with all, testing, commissioning, and sign off on proper operation and alarm activation, display, resets, and acknowledgements for all security equipment.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. General: Comply with Section 01 60 00 - Product Requirements.
- B. Materials and Equipment: New and unused, clean, free of defects, and free of damage and corrosion.
 - 1. Used equipment or damaged material not allowed.
 - 2. Standard products of manufacturer unless otherwise specified.
 - 3. Materials: Bear UL label where applicable.
 - 4. Application and Installation: In accordance with labeling and listing.
 - 5. Materials: Flame spread rating of 25 or less and smokes developed rating of 50 or less, NFPA 255.
 - 6. Electrical Equipment and Systems: UL Standards, NEC, and CSA. This listing requirement applies to entire assembly. Perform modifications to equipment to suit intent of specifications in accordance with these requirements.
- C. Basis of Design: Contract documents prepared on basis of one manufacturer as "design equipment," even though other acceptable manufacturers listed.
 - 1. If Contractor proposes to use one of listed manufactures or products other than "design equipment," submit detailed drawings, indicating proposed installation of equipment.
 - 2. Additional Engineering Services: If Consultant provides additional engineering services as result of substitute materials or equipment by Contractor, or changes by Contractor in dimension, weight, power requirements, etc., of equipment provided, then Contractor shall pay Owner for cost of such additional services.
 - 3. If revised arrangement submittal is rejected, revise and resubmit specified "design equipment" item that conforms to Contract Documents.
 - 4. If acceptable manufacturers not listed, provide design make or submit equivalent manufacturer and/or make.
 - 5. Product Options, Acceptable Manufacturers, and Accepted Substitutions: Comply with Section 01 60 00 - Product Requirements.
- D. Installed Equipment and Materials: Compatible with other items being provided and with existing items so that complete and fully operational system results.

2.2 CABLES

- A. Provide all wire and cable required to install systems as indicated. Wire and cable shall be sized to provide minimum voltage drop and minimum resistance to the devices supplied.
- B. All cables shall be specifically designed for their intended use (plenum, direct burial, aerial, etc).
- C. Cable in Plenums: Rated, listed and marked for use in plenum application, regardless if ceiling is ducted return air plenum or not.
 - 1. Plenum Cable: CMP rated per NEC and comply with other applicable codes.
- D. Cable Type: As indicated on drawings.
- E. Cable Size: As indicated on Drawings.
- F. Control and signal cables shall be multi-conductor cable with stranded conductors. The cable shall supply the power and voltage needed to operate the intended device at the distance required.
- G. Each cable shall terminate on the device by direct connection. Adapters, jumpers, clips or splices are not allowed.
- H. Cables between enclosures and junction boxes shall be in conduit, wire way, raceway, duct, cable trays; or when specifically authorized, run externally to these devices and secured to solid building structures as described herein.
- I. Cables may run outside of conduit, cable trays, wire ways, duct, etc., when specifically authorized. The cable provided in these locations shall be certified for use in air plenum areas, hidden, protected and fastened at no more than 18 inches intervals to solid building structure.

2.3 FACTORY-ASSEMBLED PRODUCTS

- A. Provide maximum standardization of components to reduce spare part requirements.
- B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.
 - 1. Components of assembled unit need not be products of same manufacturer.
 - 2. Alike Constituent parts: Product of single manufacturer.
 - 3. Components: Compatible with each other and with total assembly for intended service.

- C. Components of Equipment: Bear manufacturer's name or trademark, model number and serial number on name plate securely affixed in conspicuous place, or cast integral with, stamped or otherwise permanently marked upon components of equipment.
- D. Equipment that Serves Same Function: Same make and model. Exception allowed if performance requirements couldn't be met.

2.4 TOOLS AND EQUIPMENT

- A. Miscellaneous Equipment: Provide screws, anchors, clamps, tie wraps, distribution rings, wire molding, miscellaneous grounding and support hardware, etc., necessary to facilitate installation of electronic security system.
- B. Special Equipment and Tools: Provide special installation equipment or tools necessary to properly complete system. This may include, but is not limited to, tools for terminating cables, testing equipment for copper/fiber cables, communication devices, jack stands for cable reels, or cable wenchers.
- C. Lifting Attachments: Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position.
- D. Lifting Attachments: Withstand handling conditions that might be encountered without bending or distortion of shape, such as rapid lowering and braking of load.

2.5 MISCELLANEOUS

- A. Miscellaneous Support: Metal Bars, Plates, Tubing: ASTM Standards:
 - 1. Steel Plates, Shapes, Bars, and Grating: ASTM A36/A36M.
 - 2. Cold-Formed Steel Tubing: ASTM A500/A500M.
 - 3. Hot-Rolled Steel Tubing: ASTM A501/A501M.
 - 4. Steel Pipe: ASTM A53/A53M, Schedule 40, welded.
 - 5. Electrical Metallic tubing (EMT).
 - 6. Flexible Metal Conduit.
 - 7. Provide rain-tight fittings and connectors as required for installation of liquid tight flexible conduit.
 - 8. Provide fittings and connectors as required for installation of EMT or flexible conduit.
 - 9. Protected with zinc coating or treatment of equivalent corrosion resistance using approved alternative treatment, finish or inherent material characteristic.
 - 10. Products for Outdoor Applications: Hot dipped galvanized.
- B. Junction and Pull Boxes:
 - 1. Interior Boxes: Sizes to be determined in accordance with code requirements for conductor fill. No box shall be smaller than a single gang 1-1/2 inch deep. Provide box covers as required.
 - 2. Exterior Boxes: All exterior boxes shall be NEMA 4 or NEMA 3R, watertight and dust tight.
 - 3. All interior and exterior boxes shall have their covers fastened using security screws.
- C. Breakout Boxes: Provide breakout boxes installed above each access controlled door.
 - 1. For non-auto operator access controlled doors, install one 8 x 8 inch breakout box with lid and three TS8 terminal strips.
 - 2. For auto operator access controlled doors, install one 12 x 12 inch breakout box with lid and five TS8 terminal strips.
- D. Access Doors: Provide in accordance with Section 08 31 13 - Access Doors and Frames.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General: Examine conditions and proceed with work in accordance with Section 01 41 00 - Regulatory Requirements.
- B. Examination of Premises:
 - 1. Visit Site to become familiar with local conditions under which work is to be performed and correlate observations with requirements of Contract Documents.
 - 2. No allowance made for claims for concealed conditions which Contractor, in exercise of reasonable diligence in its observations of site and local conditions should have learned of.
- C. Before ordering any materials or doing Work, verify measurements and be responsible for correctness of same.
 - 1. No extra charge or compensation allowed for duplicate work or material required because of unverified difference between actual dimension and measurement indicated on Drawings.

2. Submit discrepancies found in writing to Owner's Representative for consideration before proceeding with Work.
- D. Facility Review: Conduct walk through with Owner's Representative of work areas, describing specific work methods and proposed schedules, before commencing work, enabling Owner's Representative to identify areas of concern, desired installation timetables and review important procedural and safety precautions.
 - E. Prior to start of installation, meet at project site with Contractor and other trades performing related work to coordinate efforts. Review areas of potential interference and resolve conflicts before proceeding with work. Plan crucial scheduled completions of equipment room, central monitoring center, server and workstation locations and network drop.
 - F. Examine areas and conditions under which system is to be installed. Do not proceed with work until satisfactory conditions have been achieved.
 1. Beginning of installation means installer accepts existing conditions.
- 3.2 PREPARATION
- A. Protection: Protect Owner's facilities, equipment, and materials from dust, dirt, and damage during construction.
 1. Remove protection at completion of work.
 2. Bench test all equipment prior to delivery to the job site.
 3. Verify the availability of power where required. If a new source of power is required, a licensed electrician shall be used to install it.
- 3.3 ROUGH-IN
- A. Before construction work commences, visit site and identify exact routing for power, video, data and control cables. Identify required core locations.
 - B. Equipment Locations: Coordinate with other trades, other renovation projects, and existing conditions to eliminate interference with required clearances for equipment maintenance and inspections.
 1. Provide easy, safe, and code mandated clearances at equipment racks and enclosures, and other equipment requiring maintenance and operation.
 - a. If it is determined that ample maintenance and passage space has not been provided, rearrange work and/or provide other equipment as required for maintenance space.
 2. Coordinate work with other trades and existing conditions to determine exact routing of cable tray, hangers, conduit, etc., before fabrication and installation.
 - a. Where more than one trade is involved in area, space or chase, cooperate to utilize space appropriately in relation to their individual requirements.
 3. Bring changes in size or location of material or equipment necessary to meet field conditions or in order to avoid conflicts between trades to immediate attention of Owner's Representative before such alterations are made.
 4. Verify with Owner's Representative exact location and mounting height of equipment in finished areas, such as equipment racks, work stations, servers, monitors and electronic security devices.
 5. Additional Engineering Services: If Consultant provides additional engineering services for following, then Contractor shall pay Owner for cost of such additional services:
 - a. To examine and evaluate changes proposed by Contractor for convenience of Contractor.
 - b. As result of Contractor's errors, omissions or failure to conform to requirements of Contract Documents.
 - C. Access Doors: Provide in accordance with Section 08 31 13 - Access Doors and Frames when necessary to provide proper access to electronic security system components.
- 3.4 INSTALLATION
- A. General: Comply with Section 01 31 00 - Project Management and Coordination and Section 01 60 00 - Product Requirements.
 1. Install materials and equipment in accordance with manufacturer's recommendations. Refer conflicts between manufacturer's recommendations and Contract Documents to Owner's Representative for resolution.
 2. Coordinate ordering and installation of equipment with long lead times or having major impact on work by other trades so as not to delay job or impact schedule.

3. Where mounting heights not detailed or dimensioned, install systems, materials and equipment to provide maximum headroom possible.
 4. Equipment: Not hidden or covered up prior to observation by Owner's Representative.
 5. Contractor: Responsible for damage to any surfaces or work disrupted as result of his work. Repair surfaces, including painting. Replace damaged ceiling tiles.
- B. Installation: In accordance with EIA/TIA 568-B.1, 568-B.2 and 568-B.3 standards and manufacturer's design and installation guidelines.
1. Ensure maximum-pulling tensions of specified distribution cables not exceeded and cable bends maintain proper radius during placement of facilities.
 2. Provide additional material and labor in timely fashion to properly rectify failure to follow requirements.
- C. Concealment: Conceal work above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment impossible or impractical, notify Owner's Representative before starting that part of work and install only after his review. In areas with no ceilings, install only after Owner's Representative's review.
- D. Waterproofing: Seal foundation penetrations by electronic security conduits and sleeves to eliminate intrusion of moisture and gases into building.
1. Spare Conduits: Plugged with expandable plugs.
 2. Service Entrance Conduits through Building: Sealed or resealed upon cable placement.
 3. Conduits with Cables in Them: Permanently sealed by firmly packing void around cable with oakum and capping with hydraulic cement or waterproof duct seal.
- E. Supports: Provide required supports, beams, angles, hangers, rods, bases, braces, straps, struts, and other items to properly support contract work.
1. Supports: Approved by Owner's Representative.
 2. Modify studs, add studs, add framing, or otherwise reinforce studs in metal stud walls and partitions as required to suit contract work. If necessary, in stud walls, provide special supports from floor to structure above.
 3. Precast Panels/Planks and Metal Decks: Support communication work as determined by manufacture and Owner's Representative.
 4. Mounting Plates: Provide heavy gauge steel mounting plates for mounting electronic security work.
 - a. Mounting Plates: Span two or more studs.
 - b. Size Gage and Strength: Sufficient for equipment size, weight, and desired rigidity.
- F. Cable Routing: Designed and installed so cabling and associated equipment does not interfere with operation or maintenance of other equipment.
1. Wiring: Not hung, tied to, or supported from anything other than electronic security system raceway or building structure.
 2. Accessible Spaces: Install cable for easy access.
 3. Cable Paths above Suspended Ceilings, Mechanical Rooms, and Closets: Not blocked or covered in way to impede addition of cable in future.
- G. Power Separation: Do not place electronic security system cabling alongside power lines, or share same conduit, channel or sleeve with electrical apparatus.
- H. Painting: Comply with Section 09 91 23 - Interior Painting. Include following:
1. Painting for cut and patch work.
 2. Painting called for on Drawings.
 3. Painting of junction boxes, JB covers and conduits per Owner's standards.
 4. Painting for damage to existing wall and ceiling surfaces.
- 3.5 BONDING AND GROUNDING
- A. Provide ground at security device location and ensure proper bonding to existing facilities.
1. Ensure ground continuity by properly bonding appropriate cabling, closures, cabinets, conduits, service boxes, and head-end equipment.
 2. Grounds: Supplied from approved building ground and bonded to main electrical ground.
 3. Grounding: In accordance with ANSI-J-STD-607-A, NEC, NFPA, and local codes and practices.
- 3.6 PENETRATIONS

- A. Conduit and Sleeve Openings: Waterproofed and fireproofed in compliance with applicable codes and regulations.
 - 1. Seal joints on exterior of conduit penetration in accordance with Section 07 92 00 - Joint Sealants.
- B. Firestopping: Fire-stop openings and penetrations through fire and smoke rated wall and floor assemblies in accordance with Section 07 84 13 - Penetration Firestopping.
 - 1. Inside of Conduits, Fire-stop System: Dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with appropriate damming or backer materials.
 - a. Sealant: Capable of being removed and reinstalled.
 - b. Sealant: Adhere to penetrants and common construction materials and capable of allowing normal wire/cable movement without being displaced.
 - 2. Add fire-stop pillows specs for sealing existing cable tray penetrations through firewall.
 - 3. Patch openings remaining around and inside conduit, sleeves and cable penetrations to maintain integrity of fire rated assembly.

3.7 FIELD QUALITY CONTROL

- A. Site Tests & Inspections: Comply with Section 01 41 00 - Regulatory Requirements.
 - 1. Provide promptly the facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as required by Contract Documents.
 - 2. Inspections and Tests by Owner's Representative:
 - a. Performed in manner to not unnecessarily delay work.
 - b. Contractor: Responsible to assist with these functionality and performance tests.
 - c. Demonstration Setup: Benchmark for comparison of results.
 - d. Failure of Subsystems or Systems to Perform as Specified: Considered as failure to comply with requirements of Contract Documents.
- B. Observations: On-going Observations: Performed during construction by Owner's Representative, including but not limited to following items:
 - 1. Design documentation complete? Cables properly labeled as specified from end-to-end?
 - 2. Terminated cables properly tested for specific category as well as tested for opens, shorts, polarity reversals, transposition and presence of AC and/or DC voltage?
 - 3. Cable type suitable for its pathway? Cables bundled in parallel?
 - 4. Pathway manufacturer's guidelines followed? Cable penetrations installed properly and firestopped
 - 5. Excessive cable bending?
 - 6. Potential EMI and RFI sources been considered and properly protected?
 - 7. Cable fills correct?
 - 8. Hanging supports properly spaced? Hanging cable exhibit sag?
 - 9. Telecommunications closet terminations compatible with applications equipment?
 - 10. Patch panel instructions followed?
 - a. Jacket removal point?
 - b. Termination positions?
 - c. Pair terminations tight with minimal pair distortions?
 - d. Twists maintained up to index strip?
 - 11. Modular panel instructions followed?
 - a. Cable dressing first?
 - b. Jackets remain up to connecting block?
 - c. Pair terminations tight and undistorted?
 - d. Twists maintained up to connecting block?
 - 12. Connectors properly turned right side up in jack panels without cables wrapped or twisted around mounting collars?
 - 13. Correct outlet connectors used?
 - 14. Jacket maintained right up to jack?
 - 15. Identification markings uniform, permanent and readable?

3.8 PLYWOOD BACKING

- A. Install DGP's, power supplies and other related equipment on a fire rated plywood backboard at location designated on drawings such as in IDF's.

3.9 CLEANING

- A. General: Comply with Section 01 74 19 - Construction Waste Management and Disposal.
 - 1. Keep site and surrounding area free from accumulation of waste materials and rubbish on daily basis.
 - 2. Owner: Right to call Contractor back to perform cleanup. If Contractor fails to perform cleanup another contractor will be engaged at Contractors expense to perform cleanup.
 - 3. Keep electronic security equipment and fixtures clean for duration of project. Comply with applicable regulations regarding facilities and environmental extreme cleanliness.

3.10 CUTOVER, GO-LIVE SUPPORT, AND SUPPORT

- A. Contractor is to provide UT Police Access Control with completed Pre-Function Test sheets on all security equipment before scheduling Access Control for Final Acceptance Testing.
 - 1. Obtain test sheets from UT Police Access Control prior to Cutover.
- B. Integration with existing systems.
- C. Provide seamless integration of the installed CCTV, emergency communication, panic buttons, motion detectors and card access system to ensure that access levels, camera pop-ups and other systems functionalities worked as described per the systems operating manuals.
- D. Provide infrastructure that will deliver the video and card access activities in real time basis with the ability to record and play back video at any workstation within the security network as designed.
- E. Provide integration of access control and fire alarm system to ensure free egress from protected spaces in the event of fire alarm system activation.
- F. Provide integration of PTZ cameras and emergency phones in the parking areas to activate the camera coverage and call up as shown on device matrix.
- G. Provide integration of the access control system with the existing LENEL OnGuard presently in use by the client at existing facilities.
- H. Provide integration of biometric readers with access control system at locations specified and ensure access can be granted using the following combinations.
 - 1. Proximity card only.
 - 2. Proximity card and biometric.
 - 3. Biometric template only.
- I. Cutover:
 - 1. Provide minimum of one [1] technicians onsite for total of eight [8] hours each to assist as required with system(s) activation, troubleshooting and test.
 - 2. Activities: Include, but not be limited to:
 - a. Set/Device Placement and testing for security systems devices.
 - 3. Respond with technician onsite to Owner determined emergencies within eight [8] hours of request.
 - a. Response Requirement: Applies to calls received from 8 AM – 5 PM, Monday through Friday.
 - b. Calls received after 5 PM: Treated as call received at 8 AM on following business day.
 - 4. Emergency Response Requirement: In effect for duration of system warranty.

3.11 TRAINING

- A. Furnish the services of competent instructors who will give instruction in the adjustments, operation and maintenance, including pertinent safety requirements of the equipment and system specified. The training shall be oriented toward the system installed rather than being a general training course. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. Equipment required for classroom training shall be provided by the contractor.
 - 1. The training shall be provided using digital video recordings as described in Section 01 79 00 - Demonstration and Training
 - 2. Training topics shall be saved in sections addressing the following topics:
 - a. General Security System Configuration.
 - b. Operation of Computers and Peripherals including printers and badge making systems (signature pads, ID capture camera, encoders) as well as the badge making software.
 - c. Operator control functions for both CCTV and ACS using control via the keyboard, touch screen or mouse control.
 - d. Graphics Generation from programmed floor plans for the protected spaces.
 - e. Storing and retrieving of archived video clips from storage medium.

- f. Exporting of retrieved video images for reviewing and distribution while maintaining integrity of the recorded video.
 - g. General Equipment layout.
 - h. Troubleshooting Procedures.
 - i. Preventative Maintenance Procedures to optimize systems performance.
- 3.
- a. System Programming of all relevant parameters including data base creation and management
 - b. System Administration of database, including report generation and distribution, video archiving and retrieval of video images from the video management system.
 - c. Manager Level Operator Commands such as setting access levels and time zones of users accessing the data base of the installed systems.

3.12 ACCEPTANCE

- A. Submit detailed acceptance test procedure designed to demonstrate compliance with contract requirements at least two weeks before the start of testing.
- B. During acceptance testing, provide services of a fully qualified security systems technician who is knowledgeable of the project.
- C. Using the commissioning test data, the Owner/Engineer and or his representative shall select at random, functions to be demonstrated. All of the functions demonstrated must perform as specified and documented on commissioning data sheets, if failed the system must be retested.
- D. After the acceptance tests are complete and the system is demonstrated to be functioning as specified, a thirty-day endurance test period shall begin. If the system functions as specified throughout the endurance test period requiring only routine test period the system shall be accepted. If during the endurance test period the system fails to perform as specified and cannot be corrected within eight hours, the Owner/Engineer may request that the endurance tests be repeated after the problems have been corrected.

3.13 DEMONSTRATION

- A. Demonstration and Instruction of Owner's Personnel:
 - 1. Provide eight [8] hours of training and orientation of Owner's personnel to electronic security systems described herein. This may be done in two (2) four (4) hour sessions in order to accommodate the client's staff.
 - 2. Demonstration and Instruction: Include, but not be limited to:
 - a. Physical review of installed surveillance cameras, servers, workstations, guard tour stations, emergency phones, parking control systems and card readers.
 - b. Review of systems operation documentation and test results of the various security sub-systems.
 - c. Instructions on industry standard termination and testing methods to enable Owner's personnel to successfully perform system test to verify systems status and operational conditions.
 - d. Additional Owner requirements defined during project.
 - e. Review systems integration with special emphasis on card reader additions, additional time zone and access levels that may have been added to the system database.
 - f. Review camera call up procedures and camera identifier for newly installed cameras and adjust lens to provide a clear video image of the areas under surveillance.
 - g. Review of emergency phones and their integration with the CCTV system, to ensure camera call up and display upon activation of an emergency phone station.
 - h. Review of guard tour system including building the tour database and tour retrieval from workstation.
 - i. Review of entry control at garage entrances using gate arms and crash rated parking barriers.

3.14 PROPOSAL PRICING

- A. Contractor shall provide the unit price for all devices and systems quoted in there proposal. Lump sum pricing shall not be submitted and will not be accepted.
- B. Contractor shall provide as part of there quotation a full service maintenance contract for the following increments in time of one of (1), three (3) and five (5) years. Each increment shall list the services that will be performed through the length of the increment and any discount that may be applicable if accepted.

- C. Contractor shall provide pricing for the proximity/smart technology cards in increments of one (1), one hundred (100), with any savings occurring at each increment clearly stated.
- D. Contractor shall provide pricing for computer servers, workstations, network switches and LCD monitors with the understanding that some or all of these systems may be owner furnished and contractor installed. Contractor shall provide full specifications for these systems to the owner in a timely fashion if so requested by the owner or its representative.
- E. In the event that Owner chooses to supply any of the equipment listed in section D above, Contractor shall provide owner with the required specifications required of said devices in order to meet there operational requirements.

END OF SECTION 28 05 00

SECTION 28 05 13

CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Minimum requirements for conductors and cables for electronic safety and security systems.
- B. Horizontal Cabling:
 - 1. Security:
 - a. CCTV and Access Control System: Horizontal copper twisted pair cabling for project that extends from the device (Camera, reader interface) network switch located in the communications room (TR, MTR).
 - b. Security devices horizontal cabling for project shall use conventional hierarchical star topology that home runs cables, from the communications room (TR, MTR) to the individual device locations as shown on drawings.
 - 2. Use point-to-point cable runs as indicated on drawings.
- C. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
 - 1. Category 6A UTP Cable.
 - 2. #22 AWG Shielded Twisted Pair Cable.
 - 3. #16 AWG Unshielded Twisted Pair Cable.
 - 4. #12 AWG Unshielded Twisted Pair Cable.
 - 5. Data/Power Cable.
 - 6. Shielded Data Cable.
 - 7. Composite Access Control Cable.

1.3 RELATED REQUIREMENTS

- A. Section 28 05 00 - General Security Requirements.
- B. Section 27 05 26 - Grounding and Bonding for Communications Systems.
- C. Section 27 05 00 - Common Work Results for Communications.
- D. Section 27 05 53 - Identification for Communications Systems.
- E. Section 27 07 00 - Communications Testing.
- F. Section 27 11 19 - Communications Termination Blocks and Patch Panels.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ASTM D4565 - Standard Test Methods for Physical and Environmental Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable.
- C. ASTM D4566 - Standard Test Methods for Electrical Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable.

1.5 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00 - Submittal Procedures and Section 27 05 00 - Common Work Results for Communications.
- B. Product Data: Submit product data for each type of cable to be installed including but not limited to physical dimensions, configurations, construction and performance specifications.
- C. Product Samples: As required.
- D. Extra Materials: 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. Cable: 1000 feet (305 m) of each type used for project. Furnish on reels.

- E. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

PART 2 - PRODUCTS

2.1 CATEGORY 6A UTP CABLE

A. Physical Characteristics:

1. Plenum indoor Category 6A copper cable as required by the NEC Article 800.
2. Pairs: 4.
3. Conductor Size: 22 AWG to 24 AWG.
4. Color Coding of Pairs:
 - a. Pair 1: W-BL; BL.
 - b. Pair 2: W-O; O.
 - c. Pair 3: W-G; G.
 - d. Pair 4: W-BR; BR.
5. Comply with ANSI/ICEA S-90-661-2002 for mechanical performance requirements, testing and testing methods.
6. Maximum Cable Diameter: 0.354 inch (9.0 mm).
7. Ultimate Breaking Strength, ASTM D4565: 90 lbf (400 N) minimum.
8. Cold Bend Radius, ASTM D4565: 4 times cable diameter minimum at -20°C plus or minus 1°C without jacked or insulation cracking.
9. Jacket type: FEP.
10. Labeled and third party verified category 6A cables.

B. Transmission Characteristics:

1. DC Resistance of any Conductor, ASTM D4566: Shall not exceed 9.38 Ohms per 328 ft (100 m) at 20°C.
2. DC Resistance Unbalance Between any Two Conductors of any Pair, ASTM D4566: Not exceed 4 percent at 20°C.
3. Mutual Capacitance at 1 kHz, ASTM D4566: Shall not exceed 5.6 nF per 328 ft (100 m) at 20°C.
4. Capacitance Unbalance, Pair-To-Ground, at 1 kHz, ASTM D4566: Shall not exceed 330 pF per 328 ft (100 m) at 20° C.
5. Minimum channel Return Loss at 20°C plus or minus 3°C: Meet or exceed following, worst pair:

Frequency (MHz)	Return Loss (dB/100m)
1.00	19.0
4.00	19.0
8.00	19.0
10.00	19.0
16.00	18.0
20.00	17.5
25.00	17.0
31.25	16.5
62.50	14.0
100.00	12.0
200.00	9.0
250.00	8.0
300.00	7.2
400.00	6.0
500.00	6.0

6. Maximum Insertion Loss (Attenuation): Meet or exceed following, worst pair:

Frequency (MHz)	Insertion Loss (dB/100m)
1.00	2.3
4.00	4.2
8.00	5.8
10.00	6.5
16.00	8.2
20.00	9.2
25.00	10.2
31.25	11.5

62.50	16.4
100.00	20.9
200.00	30.1
250.00	33.9
300.00	37.4
400.00	43.7
500.00	49.3

7. Minimum Near End Crosstalk (NEXT) Loss at 20°C plus or minus 3°C: Meet or exceed following:

Frequency (MHz)	NEXT (dB/100m)
1.00	65.0
4.00	63.0
8.00	58.2
10.00	56.6
16.00	53.2
20.00	51.6
25.00	50.0
31.25	48.4
62.50	43.4
100.00	39.9
200.00	34.8
250.00	33.1
300.00	31.7
400.00	28.7
500.00	26.1

8. Minimum Power Sum Near End Crosstalk (PSNEXT) Loss at 20°C plus or minus 3°C: Meet or exceed following:

Frequency (MHz)	PSNEXT (dB/100m)
1.00	62.0
4.00	60.5
8.00	55.6
10.00	54.0
16.00	50.6
20.00	49.0
25.00	47.3
31.25	45.7
62.50	40.6
100.00	37.1
200.00	31.9
250.00	30.2
300.00	28.8
400.00	25.8
500.00	23.2

9. Minimum ACRF at 20°C plus or minus 3°C: Meet or exceed following:

Frequency (MHz)	ACRF (dB/100m)
1.00	63.3
4.00	51.2
8.00	45.2
10.00	43.3
16.00	39.2
20.00	37.2
25.00	35.3
31.25	33.4
62.50	27.3
100.00	23.3
200.00	17.2
250.00	15.3
300.00	13.7
400.00	11.2

500.00	9.3
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10. Minimum PSACRF at 20°C plus or minus 3°C: Meet or exceed following:

Frequency (MHz)	PSACRF (dB/100m)
1.00	60.3
4.00	48.2
8.00	42.2
10.00	40.3
16.00	36.2
20.00	34.2
25.00	32.3
31.25	30.4
62.50	24.3
100.00	20.3
200.00	14.2
250.00	12.3
300.00	10.7
400.00	8.2
500.00	6.3

11. Minimum TCL at 20°C plus or minus 3°C: Meet or exceed following:

Frequency (MHz)	TCL (dB/100m)
1.00	40.0
4.00	40.0
8.00	36.5
10.00	35.0
16.00	31.9
20.00	30.5
25.00	29.0
31.25	27.6
62.50	23.1
100.00	20.0
200.00	15.5
250.00	14.0
300.00	12.8
400.00	11.0
500.00	9.5

12. Minimum ELTCTL at 20°C plus or minus 3°C: Meet or exceed following:

Frequency (MHz)	ELTCTL (dB/100m)
1.00	30.0
4.00	18.0
8.00	11.9
10.00	10.0
16.00	5.9
20.00	5.0
25.00	2.0
31.25	n/s
62.50	n/s
100.00	n/s
200.00	n/s
250.00	n/s
300.00	n/s
400.00	n/s
500.00	n/s

13. Maximum Propagation Delay at 20°C plus or minus 3°C: Meet or exceed following:

Frequency (MHz)	Propagation Delay (ns)
1.00	580
4.00	562
8.00	557
10.00	555

16.00	553
20.00	552
25.00	551
31.25	550
62.50	549
100.00	548
200.00	547
250.00	546
300.00	546
400.00	546
500.00	546

14. Minimum average PSANEXT loss at 20°C plus or minus 3°C: Meet or exceed following:

Frequency (MHz)	PSANEXT (dB/100m)
1.00	67.0
4.00	67.0
8.00	67.0
10.00	67.0
16.00	67.0
20.00	67.0
25.00	67.0
31.25	67.0
62.50	64.3
100.00	62.3
200.00	57.7
250.00	56.3
300.00	55.1
400.00	53.2
500.00	51.8

15. Minimum PSAACRF loss at 20°C plus or minus 3°C: Meet or exceed following:

Frequency (MHz)	PSAACRF (dB/100m)
1.00	67.0
4.00	65.0
8.00	58.9
10.00	57.0
16.00	52.9
20.00	51.0
25.00	49.0
31.25	47.1
62.50	41.1
100.00	37.0
200.00	31.0
250.00	29.0
300.00	27.5
400.00	25.0
500.00	23.0

16. Minimum average PSAACRF loss at 20°C plus or minus 3°C: Meet or exceed following:

Frequency (MHz)	PSAACRF (dB/100m)
1.00	67.0
4.00	67.0
8.00	62.9
10.00	61.0
16.00	56.9
20.00	55.0
25.00	53.0
31.25	51.1
62.50	45.1
100.00	41.0
200.00	35.0

250.00	33.0
300.00	31.5
400.00	29.0
500.00	27.0

C. Acceptable Manufacturers:

1. ADC Krone.
2. AMP Netconnect.
3. Belden.
4. Berk-Tek.
5. Commscope.
6. General Cable.
7. Mohawk.
8. Panduit.
9. Siemon.
10. Superior/Essex.
11. Systemax.
12. Windy City Wire.
13. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.

2.2 SCTP CABLE

A. General: ScTP cables shall meet the specific requirements for the category level as noted above. The following characteristics shall apply in addition to these requirements.

B. Physical Characteristics:

1. Core Shield: An electrically continuous shield shall be applied over the core, or core wrap if one is present. The core shield shall consist of a helical or longitudinal plastic and metal laminated tape, and one or more longitudinal, helical, or braided non-insulated solid tin-coated copper conductor(s) of 26 AWG equivalent or larger that are in contact with the metal side of the tape.
2. Bending Radius, ASTM D4565: 8 times cable diameter minimum at -20°C plus or minus 1°C without jacked or insulation cracking.
3. Dielectric Strength: The insulation between each conductor and the core shield shall be capable of withstanding a minimum DC potential of 2.5 kV for 2 seconds or an AC potential of 1.7 kV for 2 seconds in accordance with IEC 60189-1.
4. Surface Transfer Impedance: Shall not exceed the following values:

Frequency (MHz)	Category 3 (mΩ/m)	Category 5e (mΩ/m)	Category 6 (mΩ/m)	Category 6A (mΩ/m)
1	50	50	50	50
10	100	100	100	100
16	160	160	160	160
20	-	200	200	200
100	-	1,000	1,000	1,000

2.3 #22 AWG SHIELDED TWISTED PAIR CABLE

A. Physical Characteristics:

1. #22 AWG conductors.
2. Twisted pair, stranded, color-coded conductors.
3. 100 percent overall shield with stranded copper or tinned-copper drain wire.
4. Insulation Thickness: 0.016 inches

B. Transmission Characteristics:

1. Capacitance: 24 pF/foot between conductors and the shield.

C. Acceptable Manufacturers:

1. Belden.
2. Liberty.
3. West Penn.
4. Windy City Wire.
5. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.

2.4 #16 AWG UNSHIELDED TWISTED PAIR CABLE

- A. Physical Characteristics:
 - 1. #16 AWG conductors.
 - 2. Twisted pair, color-coded, stranded conductors.
 - 3. Insulated.
 - 4. Unshielded.
 - B. Acceptable Manufacturers:
 - 1. Belden.
 - 2. Liberty.
 - 3. West Penn.
 - 4. Windy City Wire.
 - 5. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.
- 2.5 #12 AWG UNSHIELDED TWISTED PAIR CABLE
- A. Physical Characteristics:
 - 1. #12 AWG conductors.
 - 2. Twisted pair, color-coded, stranded conductors.
 - 3. Insulated.
 - 4. Unshielded
 - B. Acceptable Manufacturers:
 - 1. Belden.
 - 2. Liberty.
 - 3. West Penn.
 - 4. Windy City Wire.
 - 5. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.
- 2.6 DATA/POWER CABLE
- A. Physical Characteristics:
 - 1. Two part construction in common jacket.
 - 2. Data conductors: #22 AWG, 1 shielded pair, stranded bare copper, minimum.
 - 3. Power conductors: #18 AWG, 2 conductors, stranded bare copper, minimum.
 - 4. Data shield: foil with tinned copper drain.
 - 5. Power shield: foil with tinned copper drain.
 - 6. Nominal outside diameter: 0.032 inches (0.8 mm).
 - B. Transmission Characteristics:
 - 1. Data nominal capacitance: 12.5 pF/foot, maximum.
 - 2. Voltage rating shall be 200V, ac or dc, minimum except that where cable is pulled in the same raceway with non-energy limited systems.
 - C. Acceptable Manufacturers:
 - 1. AMX.
 - 2. Crestron.
 - 3. Liberty.
 - 4. Windy City Wire.
 - 5. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.
- 2.7 SHIELDED DATA CABLE
- A. Physical Characteristics:
 - 1. Pairs: 2.
 - 2. Color-coded, in overall jacket.
 - 3. Center conductors: 24 AWG stranded copper, minimum.
 - 4. Insulated.
 - 5. Shielding: foil, 100 percent shield coverage.
 - B. Transmission Characteristics:
 - 1. Capacitance: 12.8 pF/foot between conductors,
 - 2. Capacitance: 12 pF/foot between one conductor and the other conductor connected to the shield.
 - C. Acceptable Manufacturers:
 - 1. Belden.
 - 2. Liberty.

3. West Penn.
4. Windy City Wire.
5. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.

2.8 COMPOSITE ACCESS CONTROL CABLE

- A. Physical Characteristics:
 1. Pairs: 8.
 2. Color-coded, no overall jacket.
 3. Lock conductors: 4C 18 AWG stranded copper, minimum.
 4. Card Reader conductors: 3TP 22AWG OAS.
 5. Door Contact conductors: 2C 22AWG shielded.
 6. Rex/Spare conductors: 4C 22AWG shielded.
 7. Insulated.
 8. Shielding: foil, 100 percent shield coverage.
- B. Transmission Characteristics:
 1. Capacitance: 12.8 pF/foot between conductors,
 2. Capacitance: 12 pF/foot between one conductor and the other conductor connected to the shield.
- C. Acceptable Manufacturers:
 1. Belden.
 2. Liberty.
 3. West Penn.
 4. Windy City Wire.
 5. Accepted Substitute in accordance with Section 01 25 00 - Substitution Procedures.

PART 3 - EXECUTION

3.1 CATEGORY CABLE

- A. Comply with the manufacturer's installation instructions, BICSI Information Transport Systems Installation Manual and best industry practices.
- B. Conceal in walls or soffits and install in metal conduits:
 1. Exposed Cabling: Installed in surface raceway.
 2. Cabling Below Raised Floors: Installed in cable tray and J-Hooks out to Work Area Outlet.
- C. Schedule work in manner to complete above ceiling work/below raised floor work prior to tile/panel installation. In event installer is required to remove tiles/panels, coordinate with the contractor and do not break or disturb grid.
 1. Cable Above Accessible Ceilings: Supported 4 to 5 feet on center from cable support attached to building structure.
 2. Cable Below Raised Floor: Supported every 2 feet on center from the cable support attached to floor pedestals.
- D. Cables shall not lay on the ceiling or the ceiling support structure. Anchor cables to not interfere with other services or space access.
- E. Replace horizontal copper cables that do not pass Category 6A, 5e, 3 requirements.
 1. Maximum Length: Not exceed 295 feet.
- F. No physical defects such as cuts, tears or bulges in outer jacket. Replace cables with defects.
- G. Install cable in neat and workman-like manner. Neatly bundle and tie cable in closets. Leave sufficient cable for 90 degree sweeps at vertical drops.
- H. Cable ties and other cable management clamps shall be no more than hand tightened and shall fit snugly, but not compress, crimp, or otherwise change the physical characteristics of the cable jacket or distort the placement of twisted-pair components. Replace any cable exhibiting stresses due to over tightening of cable management devices.
- I. Each Run of Horizontal Copper Cable between Terminating Patch Panel and WAO: Continuous without any joints or splices.
- J. Do not untwist horizontal copper cable pairs more than 0.5 inch when terminating.
- K. Make use of raceways built into furniture for open office furnished work areas.
- L. Do not install cable in common cable hangers with speaker cable.

- M. Maintain following clearances from possible sources of electromagnetic interference (EMI) exceeding 5 kVA:
 - 1. Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway: 6 inch.
 - 2. Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway: 12 inch.
 - 3. Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways: 24 inch.
 - 4. Electrical motors and transformers: 47 inch.
 - N. Do not install Category 6A, 5E, 3 cables using more than 25 lbs pull force in accordance with TIA/EIA and BICSI TDMM practices. Utilize appropriate cable lubricant in sufficient quantity to reduce pulling friction to acceptable levels on long pulls inside conduit. Use tensile rated cords (i.e. fishing line) for difficult or questionable pulls - to judge to go/no-go condition of conduit and pulling setup.
 - O. Replace cables with jackets that are chaffed or burned, exposing internal conductor insulation or have bare copper (shiners).
 - P. If deviations from the drawings are required, they shall be approved by Owner's Representative prior to placement of affected cables.
- 3.2 NON-CATEGORY TWISTED PAIR CABLE
- A. Maintain separation between each of the following signal types throughout the system to avoid possible interference:
 - 1. Microphone signals.
 - 2. Line Level Audio signals.
 - 3. Loudspeaker signals.
 - 4. Video and RF signals.
 - 5. Control signals.
 - B. There shall be no splices in the system without the prior approval by the Owner's Representative. Splices shall never occur inside conduit, but shall only occur in accessible junction boxes or equipment racks. Cable splices shall not be wrapped with adhesive tape.
 - C. Install plenum rated cables where required by code.
 - D. Adhere to the manufacturers' guidelines for cable bend radii and maximum pulling tensions.
 - E. Heat shrink tubing shall be used to dress the ends of wire and cabling including a separate tube for the drain or ground wire with the exception of HORIZONTAL COPPER and fiber optic cabling. Do not cut drain wires that are not connected, but fold them back over the cable and adhere with heat shrink.
 - F. Maintain separation between varying cable types to avoid hum, crosstalk, and interference.
 - G. Maintain separation between cables and devices with a potential electromagnetic field to avoid interference.
 - H. Provide rubber or nylon grommets to protect cables passing through racks, panels, furniture, and junction boxes.
 - I. Arrange cables in a neat and orderly manner in junction boxes, cable trays, and accessible ceilings.
- 3.3 TESTING
- A. Test all cables in accordance with Section 27 07 00 - Communications Testing.
- 3.4 IDENTIFICATION
- A. Label all cables in accordance with Section 27 05 53 - Identification for Communications Systems.
- 3.5 FIRESTOPPING
- A. Firestop openings and penetrations through fire and smoke rated wall and floor assemblies in accordance with Section 07 84 00 – Firestopping and Section 27 05 00 - Common Work Results for Communications.
- 3.6 BONDING AND GROUNDING
- A. Bond and ground shielded cables in accordance with Section 27 05 26 - Grounding and Bonding for Communications Systems.

END OF SECTION 28 05 13

SECTION 28 05 37

DISTRIBUTED ANTENNA SYSTEM (DAS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. Requirements for installation, review, and permitting for the following:
 - 1. In-building radio communication and enhancement systems for two-way portable and mobile radios.
 - 2. Distributed Antenna System (DAS).
 - 3. Public Safety Bi-Directional Amplifier System.

1.3 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NFPA 1 - Fire Code.
- C. NFPA 70 - National Electrical Code.
- D. NFPA 72 - National Fire Alarm and Signaling Code.
- E. Texas Government Code Chapter 2252.001-005 - Texas Government Code Chapter 2252.001-005.

1.4 SUBMITTALS

- A. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

1.5 SYSTEM DESCRIPTION

- A. The two-way radio system (system) shall provide designated coverage for two-way radio communication in the entire building and about the entire building at specified levels.

1.6 EQUIPMENT QUALITY

- A. The proposed equipment shall be specifically designated for use as an in-building emergency radio communication enhancement system by the manufacturer.
- B. The proposed equipment for the system shall meet all NFPA 72 requirements and be able to withstand and continue to operate normally in fire conditions.
- C. The system shall have redundant power sources. If primary power fails, emergency backup power shall be provided by a building emergency backup generator or battery power. The backup power shall be for not less than 24 hours at 100 percent of the design load.
- D. All equipment, wiring, devices, and conduit shall meet Underwriters Laboratory standards and be marked by the manufacturer with the UL rating.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in original unopened packages with intact and legible manufacturer's labels identifying product and manufacturer, date of manufacturer and shelf life if applicable.
- B. Store materials inside, under cover, above ground, and kept dry and protected from physical damage until ready for use. Remove from site and discard wet or damaged materials.

1.8 WARRANTY

- A. Warranty for parts and labor shall be for a period of one year from the date of substantial completion.

1.9 PROJECT COMPLETION

- A. The system shall be provided as turn-key to the project. All necessary conduit, wiring, boxes, 120 volt power, breakers, etc. shall be provided for a complete and operative system.

PART 2 - PRODUCTS

2.1 SYSTEM DESIGN

- A. The system shall be designed by a firm or individual licensed, certified, or otherwise qualified to design a two-way radio communications system within a high-rise building.
- B. The system shall meet all UTSW specifications, local codes, and state and federal laws.
- C. The system designer shall have five years of proven history successfully designing proposed radio and antenna systems.

2.2 COVERAGE

- A. NFPA 72 designates coverage based on general building or critical areas within the building. UT Southwestern requires 99 percent radio coverage in critical areas and for the general building.
- B. The system shall report to the Fire Alarm Control Panel a Supervisory alarm at any of the following:
 - 1. Loss of power.
 - 2. If battery emergency backup power is utilized, low battery capacity indication shall be reported when 30 percent of the battery power remains.
 - 3. Malfunction or failure of any critical system component.
- C. Buildings and structures that cannot support the required level of radio coverage shall be equipped with a distributed antenna system with FCC-certified signal boosters or with a system that is otherwise approved in order to achieve required adequate radio coverage.

2.3 SIGNAL STRENGTH

- A. The minimum inbound signal strength of -95 dBm shall be provided throughout the coverage area.
- B. The minimum outbound signal strength of -95 dBm at the donor site shall be provided from the coverage area.

PART 3 – EXECUTION

3.1 SYSTEM INSTALLATION

- A. The system shall be installed by a firm or individual licensed, certified, or otherwise qualified to install a two-way radio communications system within a high-rise building.
- B. The system installer shall have five years of proven history successfully installing proposed radio and antenna systems.

3.2 SYSTEM INSPECTION AND TESTING

- A. The system shall be tested for performance meeting or exceeding NFPA 72 and witnessed by and approved by the University of Texas Southwestern fire marshal or designee.
- B. Tests shall be witnessed by Director of Fire and Occupational Safety (University Fire Marshal) or appointed designee.
- C. Coordination of inspections shall be done through the UTSW project manager.
- D. Inspections require a minimum of 3 business day's notification to the UTSW Fire and Occupational Safety Director (Fire Marshal) or his designee.
- E. The test shall not be considered passed until the paperwork for the test is complete.

3.3 PLAN REVIEW AND PERMITTING

- A. Submit plans for review and approval a minimum of 5 business days through the UT Southwestern Project Manager.
- B. Plans shall include all appropriate information, calculations, and manufactures information as required in National Fire Protection Association National Fire Alarm and Signaling Code (NFPA 72). Failure to provide the necessary information will result in a delay in the review of the project until all of the information is provided.
- C. Submittal of plans does not constitute approval. Contractors working on the project will do so at their own risk and will replace, without cost to the owner, any components necessary as required by the approved plans.
- D. Three copies of submittal information shall be provided to the UT Southwestern Medical Center Office of Safety and Business Continuity – Attention Director of Fire and Occupational Safety. A copy of the approved, stamped, plans shall be maintained on the job at all times.
- E. A permit shall be provided with the approval of the submitted plans.

END OF SECTION 28 05 37

SECTION 28 08 00

COMMISSIONING OF FIRE ALARM SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SUMMARY

- A. This Section includes commissioning process requirements for Fire Alarm/Notification systems, assemblies, controls, and equipment.
 - 1. This project will have selected building systems commissioned. The equipment and systems to be commissioned are specified Section 01 91 00 - General Commissioning Requirements.

1.3 RELATED REQUIREMENTS

- A. Section 01 91 00 - General Commissioning Requirements.
- B. Section 21 08 00 - Commissioning of Fire Protection Systems.
- C. Section 22 08 00 - Commissioning of Plumbing Systems.
- D. Section 23 08 00 - Commissioning of HVAC Systems.
- E. Section 26 08 00 - Commissioning of Electrical Systems.
- F. Section 28 31 00 - Addressable Fire Alarm.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 DEFINITIONS

- A. Refer to Section 01 91 00 - General Commissioning Requirements.

1.6 SUBMITTALS

- A. Certificate of Readiness, signed by the Contractor, certifying that systems, assemblies, equipment, components, and associated controls are ready for testing.
- B. Manufacturer's completed start-up reports for equipment and systems.
- C. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

1.7 CONTRACTOR'S RESPONSIBILITIES

- A. Reference Project Specification Section 01 91 00 - General Commissioning Requirements for details of contractor's responsibilities related to commissioning.
- B. Perform commissioning tests at the direction of the CxA.
- C. Attend commissioning meetings.
- D. Provide information requested by the CxA for functional testing and for final commissioning documentation.
- E. 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.
- F. Functional testing of systems will be carried out solely by contractor's personnel, under the direction of CxA. Provide experienced personnel, familiar with the systems being installed under this project.

1.8 CXA'S RESPONSIBILITIES

- A. Reference Project Specification Section 01 91 00 - General Commissioning Requirements.
- B. CxA will direct commissioning testing.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 GENERAL TESTING REQUIREMENTS

- A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in Division 28 Sections. Provide submittals, test data, inspector record, and certification to the CxA.
 - B. Reference Project Specification Section 23 08 00 - Commissioning of HVAC Systems for detailed requirements of commissioning of Mechanical systems.
 - C. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
 - D. Test all operating modes, interlocks, control responses, and responses to normal, abnormal, and emergency conditions, and verify proper response of building automation system controllers and sensors.
 - E. Tests will be performed using design conditions whenever possible.
- 3.2 SYSTEM START-UP
- A. Contractor is solely responsible for system start-up. CxA may, at their discretion, witness start up procedures, but will not perform any Functional Testing of systems until Contractor has completed start-up, resolved all operating deficiencies, and has so certified start up.
- 3.3 TESTING PREPARATION
- A. Certify that Fire Alarm/Notification systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
 - B. Certify that testing procedures for Fire Alarm systems have been completed and submitted, discrepancies corrected, and corrective work approved.
 - C. Set 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).
 - D. Inspect and verify the position of each device and interlock identified on checklists.
 - E. Check safety cutouts, alarms, and interlocks with life-safety systems during each mode of operation.
- 3.4 FUNCTIONAL TESTING / GENERAL
- A. Reference Project Specification Section 28 31 00 - Addressable Fire Alarm for detailed requirements for testing of Fire alarm systems.
 - B. Provide measuring instruments to record test data as directed by the CxA.
- 3.5 RE-TESTING
- A. Reference Project Specification Section 28 31 00 - Addressable Fire Alarm for detailed requirements of re-testing of Fire Alarm systems.
- 3.6 SYSTEM COMMISSIONING
- A. Reference Project Specification Section 28 31 00 - Addressable Fire Alarm for Fire Alarm systems to be commissioned.
 - B. Documentation required at commissioning:
 1. State Fire Marshal documentation forms shall be provided at the completion of the testing and approval of the system to the Director of Fire and Occupational Safety (AHJ) or their designee. This includes the placement of all required service tags identifying that the system has been properly inspected and approved by the AHJ.
 2. A minimum of two copies signed by the appropriately licensed employee of the vendor, as defined in the Texas State Fire Marshal rules and regulations for licensing, shall be provided at the time of commissioning.
 3. Failure to provide the required paperwork will result in the failure of the inspection. The contractor is required to provide all documentation to receive approval to use the system.
 4. System as-builts shall be provided within 30 days of the system approval.
 5. Delays in the use of the system due to inaccurate or inadequate paperwork shall solely be the responsibility of the contractor or general contractor. The AHJ will not be held liable nor responsible for fines, fees, penalties, or the forfeiture of benefits as stipulated in the project contract documents.

END OF SECTION 28 08 00

SECTION 28 31 00

ADDRESSABLE FIRE ALARM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions established within the Conditions of the Contract and Division 01 General Requirements, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 SECTION INCLUDES

- A. This specification describes an addressable fire detection and alarm signaling system and is provided to indicate how the overall system should function. The existing fire alarm system shall be modified as required to accommodate the new construction. The features and capacities described in this specification are required as a minimum for this project and shall be maintained by the successful contractor.
- B. The system shall be in full compliance with National and Local Codes.
- C. The system shall include all required hardware, raceways, interconnecting wiring and software to accomplish the requirements of this specification and the contract drawings, whether or not specifically itemized herein.
- D. All equipment furnished shall be new and the latest state of the art products of a single manufacturer (Simplex), engaged in the manufacturing and sale of analog fire detection devices for over ten years.
- E. The existing system as specified shall be supplied, installed, tested and turned over to the owner in an operational condition without system troubles, supervisory, or alarm signals.
- F. In the interest of job coordination and responsibilities the installing contractor shall contract with a single State of Texas licensed supplier for fire alarm equipment, engineering, programming, inspection and tests.
- G. The fire alarm system shall be provided as turn key to the project. All necessary conduit, wiring, boxes, 120 volt power, breakers, etc shall be provided for a complete and operative system. Coordinate requirements with the general contractor.
- H. Fire alarm contractor shall provide all necessary equipment for a complete system conforming to all applicable codes; layout of equipment shall be reflected in the shop drawings.
- I. The Fire Works system shall be updated with the new building information as part of the completion of the system test. At the time of system acceptance, no alerts, trouble signals, supervisory, or alarms will be visible on the building node.
- J. The modification of the fire alarm system shall be performed under the direct supervision of a Texas State Fire Marshal Licensed Fire Alarm Contractor with the shop drawings, flow diagrams, bill of materials, component designation or identification number and sequence of operation all bearing the name of the manufacturer.
- K. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and not custom designed especially for this project. All systems and components shall have been thoroughly tested and proven in actual use for at least two years.

1.3 RELATED REQUIREMENTS

- A. Division 01 General Requirements.
- B. Division 07 Thermal and Moisture Protection Sections for Firestopping.
- C. Division 08 Openings for requirements for Door Hardware.
- D. Division 21 Fire Suppression Systems for requirements for Fire Sprinklers.
- E. Division 23 Heating, Ventilating and Air Conditioning.
- F. Division 26 Electrical.
- G. Division 27 Communications.

1.4 REFERENCE STANDARDS

- A. Texas Government Code Chapter 2252.001-005; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- C. NFPA 70 - National Electrical Code.
- D. NFPA 72 - National Fire Alarm and Signaling Code.
- E. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
- F. NFPA 92 - Standard for Smoke Control Systems.
- G. NFPA 101 - Life Safety Code.
- H. UL 38 - Standard for Manual Signaling Boxes for Fire Alarm Systems.
- I. UL 268 - Smoke Detectors for Fire Alarm Systems.
- J. UL 268A - Standard for Smoke Detectors for Duct Application.
- K. UL 464 - Standard for Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories.
- L. UL 497A - Standard for Secondary Protectors for Communications Circuits.
- M. UL 521 - Standard for Heat Detectors for Fire Protective Signaling Systems.
- N. UL 864 - Standard for Control Units and Accessories for Fire Alarm Systems.
- O. UL 1076 - Standard for Proprietary Burglar Alarm Units and Systems.
- P. UL 1283 - Standard for Electromagnetic Interference Filters.
- Q. UL 1449 - Standard for Surge Protective Devices.
- R. UL 1480 - Standard for Speakers for Fire Alarm and Signaling Systems, Including Accessories.
- S. UL 1971 - Standard for Signaling Devices for the Hearing Impaired.

1.5 UNIT PRICES

- A. Provide unit pricing for the following devices. Unit pricing shall include all materials and labor to completely install the device, connect it to the system, provide appropriate programming and completely test its operation.
 - 1. Smoke detector.
 - 2. Heat Detector.
 - 3. Duct Mounted Smoke Detector.
 - 4. Pull Station.
 - 5. Ceiling Mounted Horn.
 - 6. Ceiling Mounted Horn/Strobe (any candela rating).
 - 7. Ceiling Mounted Strobe (any candela rating).
 - 8. Ceiling Mounted Speaker.
 - 9. Ceiling Mounted Speaker/Strobe (any candela rating).

1.6 DEFINITIONS

- A. ASME: American Society of Mechanical Engineers.
- B. FACP: Fire alarm control panel.
- C. Furnish: To supply the stated equipment or materials.
- D. Install: To set in position and connect or adjust for use.
- E. LED: Light-emitting diode.
- F. NFPA: National Fire Protection Association. Definitions in NFPA 72 apply to fire alarm terms used in this section.
- G. NICET: National Institute for Certification in Engineering Technologies.
- H. Provide: To furnish and install the stated equipment or materials.
- I. UL: Underwriters Laboratories.

1.7 SYSTEM DESCRIPTION

- A. Basic System - The system shall be a complete, electrically supervised fire detection and notification system, with a microprocessor based operating system having the following capabilities, features, and capacities:
 - 1. Support of walk test system capable of providing point test reports in NFPA standard format without manual report entries.
 - 2. System shall provide an output port for monitoring purposes by external systems. Communications to an external system shall be RS-232 or RS-485 communications.
 - 3. A single node or system shall support at least 50 remote control panels.

4. At least 59 nodes shall be networkable.
5. Communications between network nodes, each supporting an interactive, self-standing, intelligent local control panel, with system wide display. Any network node shall be capable of supporting a local system of 2500 points or more.
6. The local system shall provide status indicators and control switches for all of the following functions:
 - a. Audible and visual notification alarm circuit zone control.
 - b. Status indicators for sprinkler system water-flow and valve supervisory devices.
 - c. Any additional status or control functions as indicated on the drawings, including but not limited to; emergency generator functions, fire pump functions, door unlocking and security with bypass capabilities, damper smoke duct detectors.
 - d. The system shall be listed by UL for configuration as an approved release system for deluge, pre-action or clean agent extinguishing agent release system.
7. The system shall be UL 1076 listed for monitoring and reporting security System Zoning.
8. Each intelligent addressable device or conventional zone on the system shall be displayed at the Central Alarm Receiving Terminal and the local fire alarm control panel by a unique alphanumeric label identifying its location.
9. Batteries shall be supplied to operate the system for 24 hours with the capability to announce a single alarm event at the end of this duration for 15 minutes.

1.8 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with NFPA 72 and all contract documents and specification requirements.
- B. All intercommunications between this system and the monitoring system shall be arranged so that the entire system can be UL Certified.
- C. System shall be complete, supervised, non-coded, addressable multiplex fire alarm system conforming to NFPA 72.
- D. The system shall have Style 6 circuits for each floor. The system shall operate in the alarm mode upon actuation of any alarm initiating device. The system shall remain in the alarm mode until all initiating device(s) are reset and the fire alarm control panel is manually reset and restored to normal. The ability to bypass devices in "alarm" shall be provided.
- E. The system shall provide the following functions and operating features:
 1. The FACP and auxiliary power panels shall provide power, annunciation, supervision and control for the system.
 2. Provide Class B initiating device circuits.
 3. Provide Class A Signaling Line Circuits for initiating devices.
 4. Provide Style 7 signaling line circuits for the network.
 5. Provide Class B notification appliance circuits (NAC). Arrange circuits to allow individual, selective, and all-call voice and visual notification by zone. Notification Appliance circuits shall be zoned to correspond with the building fire barriers.
 6. Stair Towers: Each stair tower NAC shall be separately zoned.
 7. Strobes shall be synchronized throughout the entire building.
 8. The system amplifiers for the voice evacuation system shall be configured as distributed, bulk or a combination of distributed and bulk audio.
 9. Provide multiple channels for live and recorded voice messaging.
 10. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel.
 11. Bypass for audio, visual, AHU shutdown, door release, fire suppression, flow and tamper switches, fire pump running, devices in "alarm", audible and visual notification by floor, smoke control and elevator recall, fire shutter, including isolation by individual floor. System shall have the capacity to provide 40 bypass function buttons. The "test" button shall not be programmed.
- F. The system shall provide a field test function where one person can test the complete system or a specific area while maintaining full operational function of other areas not being tested. Alarms, supervisory signals, and trouble signals shall be logged in system history during the walk test.
- G. Alarm functions shall override trouble or supervisory functions. Supervisory function shall override trouble functions.
- H. Fire alarm signal initiation shall be by one or more of the following devices:

1. Manual pull stations.
 2. Heat detector.
 3. Addressable area smoke detector.
 4. Duct smoke detector.
 5. Automatic sprinkler system water flow switch.
 6. Fire protection system activation (Ansul, FM200/ Halon, or similar).
- I. Activation of any system fire, supervisory, trouble or status initiating devices shall cause the following actions and indications at all fire alarm control panels.
1. Fire alarm condition:
 - a. Sound and audible alarm display a custom screen/message defining the building in alarm and the specific alarm point initiating the alarm.
 - b. Log into the system history archives all activity pertaining to the alarm condition.
 - c. Audible signals only shall be silenced from the fire alarm control panel by an alarm silence switch in accordance with NFPA 72 . Visual signals shall remain in activation until the fire alarm panel is fully reset in accordance with NFPA 72 .
 - d. A signal dedicated to sprinkler system water flow alarm shall not be silenced while the sprinkler system is flowing at a rate of flow equal to a single head.
 - e. Create a dry contact output to the Energy Management System (EMS).
 - f. Notification to the University Police and Safety Department via Fireworks System.
 2. Additional system operation for fire alarm condition for voice:
 - a. Sound a pre-announce tone on a general alarm. Voice evacuation mode will be self initiated if an actual alarm condition exists. The visual signals shall operate in a similar pattern.
 - b. Selective voice paging to speakers shall be done by floor and installed in stairways to inform occupants of the imminent shutdown of elevator circuits and the expected high traffic load in the stairwells.
 - c. An automatic announcement (UTSW Safety Message) or tone evacuation signal (Hospitals only) shall be capable of interruption by the operation of the system microphone to give voice evacuation instructions overriding the pre-programmed instructions.
 - d. Status lights next to speaker selection switches on the control panel shall indicate speaker circuit selection.
 3. Supervisory Condition:
 - a. Audible signals shall be used for supervisory signals. Once silenced, the devices shall remain silenced. Internal clocks shall not be programmed to reactivate audible signals.
 - b. Record within system history the initiating device and time of occurrence of the event.
 - c. Create a dry contact output to the Siemens Energy Management System (EMS).
 - d. Notification to the University Police, CDAS, and Safety Department via Fireworks System.
 4. Trouble Condition:
 - a. Audible signals shall be used for trouble signals. Once silenced, the devices shall remain silenced. Internal clocks shall not be programmed to reactivate audible signals.
 - b. Trouble conditions that have been restored to normal shall be automatically removed from.
 - c. The trouble display queue and not require operator intervention. This feature shall be software selectable and shall not preclude the logging of trouble events to the historical file.
 - d. Trouble reports for primary system power failure to the master control shall be automatically delayed for a period of time equal to 25 percent of the system standby battery capacity to eliminate spurious reports as a result of power fluctuations.
 - e. Record within system history, the occurrence of the event, the time of occurrence and the device initiating the event.
 - f. Create a dry contact output to the Energy Management System (EMS).
 - g. Notification to the University Police, CDAS, and Safety Department via Fireworks System.

1.9 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Complete manufacturer's catalog data including supervisory power usage, alarm power usage, physical dimensions, and finish and mounting requirements. The submittal will be reviewed and approved by The Director of Fire and Occupational Safety (University Fire Marshal) or his designee.

- B. Power calculations. Battery capacity calculations. Battery size shall be a minimum of 125 percent of the calculated requirement. Provide the following supporting information:
 - 1. Power supply rating justification showing power requirements for each of the system power supplies. Power supplies shall be sized to furnish the total connected load in a worst-case condition plus 20 percent spare capacity by zone.
 - 2. NAC circuit design shall incorporate a 20 percent spare capacity per zone for future expansion.
- C. Submit manufacturer's requirements for testing signaling line circuits and device addresses prior to connecting to control panel. At a minimum the following tests shall be required; device address, the usage (Alarm, Supervisory etc), environmental compensation, temperature ratings for thermal detectors and smoke detector sensitivities. This requirement shall need approval before any wiring is connected to the control panel.
- D. Shop Drawings: Include plans, elevations, sections, details, reflective ceiling plans and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
 - 2. Detailed equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components and location and size of each field connection.
 - 3. Indicated initiating and indicating device labeling sequence to be implemented to label every fire alarm system device. Device labeling shall match labeling on submittal documents.
 - 4. Complete drawings covering the following shall be submitted by the contractor for the proposed system:
 - a. Floor plan in a CAD compatible format at a scale of 1/8 inch equals 1 foot showing all equipment and major raceways, marked for size, conductor type with type and size.
 - b. Provide a fire alarm system function matrix as referenced by NFPA 72 , Figure A-7-5.5.5(9). Matrix shall illustrate alarm input/output events in association with initiation devices. Matrix summary shall include system supervisory and trouble output functions. Include any and all departures, exceptions, variances or substitutions from the specifications and/or drawings at time of bid.
 - 5. Installation drawings shop drawings, and as-built drawings shall be prepared by an individual experienced with the work specified herein and has the appropriate certification level from the state.
 - 6. Each of the pictorial diagrams included shall appear identical to the products which they are intended to depict, in order to speed the installation of the system, and to enhance the accuracy of the installation work. Typical wiring diagrams or catalog sheets are not acceptable.
 - 7. Incomplete submittals shall be returned without review.
 - 8. Manufactures specifications for each device, component, or part which is associated with installation of this system.
 - 9. Calculations prepared by the FAC (Fire Alarm Contractor) detailing power dispersion, voltage drop, battery load throughout the system.
- E. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Light fixtures.
 - 2. HVAC registers.
 - 3. Fire protection equipment interfaces.
 - 4. Special suppression system by fire alarm contractor.
- F. Source quality-control reports.
- G. Field quality-control reports.
- H. Operation and Maintenance Data: For all fire alarm equipment, to include in operation and maintenance manuals.
- I. Provide certification of adherence and compliance with Texas Government Code Chapter 2252.001-005 Contracts With Governmental Entity requirements.

1.10 WARRANTY

- A. Provide all services, materials and equipment necessary for the successful operation of the entire Fire Alarm System for a period of three years after beneficial use including parts and labor.
- B. The adjustment, required testing, and repair of the system includes all computer equipment, transmission equipment and all sensors and control devices. Routine testing as required by NFPA and maintenance is not included.

1.11 QUALITY ASSURANCE

- A. Qualification Data: For qualified Texas licensed Installer, Applicator, manufacturer, fabricator, professional engineer, testing agency, and factory-authorized service representative: The Contractor shall submit, as part of the complete bid documentation package, certification that the Supplier is a fully authorized and Factory Trained and Certified supplier of the system detailed within this specification.
- B. Supplier Qualifications:
 - 1. Provide the services of a factory trained and certified representative or technician, experienced in the installation and operation of the type of system and possess a valid Alarm Certificate of Registration (ACR) within the State of Texas.
 - 2. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system. The technician shall provide the required instruction to the owner's personnel in the system operation and maintenance. The technician shall be in possession of a valid Fire Alarm Technician (FAL) license.
 - 3. The supplies shall furnish evidence they have an experienced service organization, which carries a stock of spare and repair parts for the system being furnished.
 - 4. The equipment supplier shall be authorized and trained by the manufacturer to calculate, design, install, test, and maintain the air sampling system and shall be able to produce a certificate stating such upon request.
- C. Installer Qualifications:
 - 1. Before commencing work, submit data showing that the manufacturer has successfully installed fire alarm systems of the same scope, type and design as specified.
 - 2. The contractor shall submit copies of all required Licenses and Bonds as required by the State of Texas.
 - 3. The contractor shall employ on staff a minimum of one NICET level III technician or a professional engineer, registered in the State of Texas.
 - 4. The contractor shall be qualified by UL for certifying fire alarm systems. Upon completion of the installation the contractor shall certify the final system meets UL ongoing maintenance.
 - 5. Contractors unable to comply with the provisions of Qualification of Installers shall present proof of engaging the services of a subcontractor qualified to furnish the required services.
- D. Testing Agency Qualifications: Qualified for testing indicated.
- E. Source Limitations for fire alarm equipment: Obtain fire alarm equipment from single source.
- F. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 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.
 - 3. Combustion Characteristics: ASTM E136.
- G. 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.
- H. Pre-installation Conference: Conduct conference at Project site.
- I. All substitute equipment proposed as equal to the equipment specified herein, shall meet or exceed minimum standards. For equipment other than that specified, the contractor shall supply proof that such substitute equipment does in fact equal or exceed the features, functions, performance, and quality of the specified equipment.
- J. Upon request, the manufacturer engaged in manufacturing products for this project shall submit their Quality Assurance and Control Plan.

1.12 DELIVERY, 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 manufacturer and shelf life if applicable.
- B. Store materials inside, under cover, above ground, and kept dry and protected from physical damage until ready for use. Remove from site and discard wet or damaged materials.

1.13 PROJECT CONDITIONS

- A. Installed products or materials shall be free from any damage including, but not limited to, physical insult, dirt and debris, moisture, and mold damage. At time of system acceptance, all products shall be in their

factory delivery condition without exception. Cost to replace will be the responsibility of the contractor, not UTSW.

- B. Environmental Limitations: Do not deliver or install products or materials until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.14 WARRANTY

- A. Warranty for parts and labor shall be for a period of one year from the date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Simplex.

2.2 NOTIFICATION APPLIANCES

- A. All notification devices shall be field labeled for easy identification during inspection. The label shall be 1/2 inch white adhesive label with 1/4 inch black lettering identifying the floor and device number (ex. 1.1, 2.1, etc.). A corresponding excel file shall be provided to the Director of Fire and Occupational Safety / Fire Marshal, or their designee, containing the device number, type of device, and location.

- B. Strobes

1. All strobes shall be ceiling mounted only.
2. The strobes shall meet and be listed for UL Standard 1971 (Emergency Devices for the Hearing-Impaired) for Indoor Fire Protection Service.
3. Strobe shall be listed for indoor use, and shall meet the requirements of FCC Part 15 Class B.
4. Strobe appliances shall produce a flash rate of one (1) flash per second over the operating voltages of 20vdc to 31 vdc for 24 vdc rated appliances. Devices shall accept either filtered DC or unfiltered full-wave-rectified power. The visual appliance shall incorporate a xenon flashtube enclosed in a rugged Lexan lens or equivalent with solid state circuitry.
5. All inputs shall be compatible with standard, reverse polarity supervision of circuit wiring by a Fire-Alarm Control Panel (FACP).
6. The Strobe shall be of low-current design.
7. The strobe intensity shall have field-selectable settings, and shall be rated per UL Standard 1971 for 15/30/75/95cd or 115/177cd for ceiling mount where Multi-Candela appliances are specified.
8. The selector switch for selecting the candela shall be tamper resistant.
9. The appliance shall be compatible with power supplies with built-in sync protocol when synchronization is required.
10. The strobes shall not drift out of synchronization at any time during operation.
11. If the sync module or Power Supply fails to operate, (i.e. - contacts remain closed), the strobe shall revert to a non-synchronized flash rate.
12. The strobes shall be designed for indoor surface of flush mounting.
13. The Strobe Appliances shall incorporate a Patented, Integral Strobe Mounting Plate that shall allow mounting to single-gang, double-gang, 4-inch square, 100mm European type back boxes, or the Surface Back box.
14. The Strobe Plate shall mount to either a standard, 4-inch square back box for flush mounting, or shall mount to the back box for surface mounting.
15. All notification appliances shall be backward compatible.
16. Devices ceiling mounted shall be installed within 1 inch of the center of the ceiling tiles.
17. All ceiling devices shall have backboxes. All ceiling backboxes must be supported from the structure or the ceiling grid, not the ceiling tile.
18. A single strobe in a waterproof enclosure shall be provided by the Fire Department Connection (FDC) on the building as indicated by local fire department jurisdiction codes. This strobe shall be programmed to be bypassed during testing of devices and stop activation upon the silencing of the evacuation tones of the fire alarm panel.
19. All devices shall be identified and provided in a list to UTSW Fire Safety. The identification shall be as follows: (One or Two Letter Building Identification_Floor #_ device number). This identification shall be provided on a small label with black font and white background.

- C. Speaker and Speaker Strobes

1. All speaker and speaker strobes shall be ceiling mounted only.
 2. Speakers shall be UL Listed under Standard 1480 for Fire Protective Service, and speakers equipped with strobes shall be listed under UL Standard 1971 for Emergency Devices for the Hearing-Impaired.
 3. System design for ambient sound pressure design is based on NFPA 72.
 4. Speaker with strobes shall be certified to meet the requirements of FCC Part 15, Class B.
 5. All speakers shall be designed for a field-selectable input of either 25 or 70 VRMS; with selectable power taps from 1/8 watt to 2 watts.
 6. The device operating voltage is 2.
 7. All ceiling-mount models shall have listed sound output of up to 87 dB at 10 feet and a listed frequency response of 400 to 4000 Hz.
 8. Speaker shall incorporate a sealed-back construction.
 9. All inputs shall employ terminals that accept #12 to #18 AWG wire sizes.
 10. Strobe intensity, where Multi-Candela appliances are specified, shall have field-selectable settings, and shall be rated per UL Standard 1971 for:
 - a. 15/30/75/110cd (ceiling mounting).
 - b. 135/185cd (ceiling mounting).
 11. Selector switch for selecting the candela shall be tamper resistant.
 12. The strobe portion, when synchronization is required, shall be compatible with power supply with built-in protocol.
 13. The strobes shall not drift out of synchronization at any time during operation.
 14. The strobes shall revert to a non-synchronized flash-rate, if the sync module or Power Supply should fail to operate (i.e. – contacts remain closed).
 15. Wall-mounted speaker and speaker-strobe appliances must be approved by OSBC. Any approved shall be designed for indoor-flush mounting to 4 inch x 2-1/8 inch electrical boxes without need for an extension ring or surface mounting.
 16. Ceiling-mount, speaker-strobe appliances shall be designed for indoor-flush mounting.
 17. Speaker and speaker strobe shall incorporate a speaker-mounting plate with a snap-on grille cover.
 18. The finish of the speakers and speaker strobes shall be confirmed by OSBC.
 19. All speaker and speaker-strobe appliances shall listed for Special Applications: Strobes are designed to flash at 1-flash-per-second minimum over their "Regulated Input Voltage Range"
 20. Notification appliance shall be electronic and use solid state components.
 21. Electromechanical devices are not allowed.
 22. Each signaling device shall provide eight (8) field selectable alarm tones. The tones shall consist of: Tone, Horn, March time horn, Code-3 horn, Code 3 tone, Slow whoop, Siren, and Hi/low.
 23. All models shall have provisions for standard reverse polarity type supervision and in/out field wiring using terminal that accept #12 awg wiring.
 24. Devices ceiling mounted shall be installed within 1 inch of the center of the ceiling tiles.
 25. All ceiling devices shall have backboxes. All ceiling backboxes must be supported from the structure or the ceiling grid, not the ceiling tile.
 26. Speakers in the stairwells and elevator cabs shall be set up for paging only from the fire alarm control panel.
- D. Horn Strobes and Horns
1. All horn strobes / horns shall be ceiling mounted only.
 2. Appliances shall meet and be listed for UL Standard 1971(Emergency Devices for the Hearing-Impaired for Indoor Fire Protection Service).
 3. Horn shall be UL Listed under Standard 464 (Fire Protective Signaling).
 4. Horn strobe shall be listed for indoor use, and shall meet the requirements of FCC Part 15 - Class B.
 5. All inputs shall be compatible with standard reverse polarity supervision of circuit wiring by the Fire Alarm Control Panel (FACP).
 6. Audible portion of the appliance shall have a minimum of two (2) field-selectable settings for dBA levels (90 and 95 dBA), and shall have a choice of continuous or temporal (Code 3) audible output.
 7. Strobe portion of the appliance shall produce a flash rate of one (1) flash per second over the Regulated Input Voltage Range, and shall incorporate a Xenon flashtube enclosed in a rugged Lexan lens.
 8. Horn shall be of low-current design.

9. Strobe intensity – where ceiling mount, Multi-Candela appliances are specified – shall have field-selectable settings, and shall be rated per UL Standard 1971 for:
 - a. 15/30/75/95cd.
 - b. 115/117cd.
10. The selector switch for selecting the candela setting shall be tamper resistant.
11. The appliance, when synchronization is required, shall be compatible with Power Supplies.
12. The strobes shall not drift out of synchronization at any time during operation.
13. The strobes shall revert to a non-synchronized flash-rate, if the sync module or Power Supply should fail to operate (i.e. – contacts remain closed).
14. The appliance shall also be designed so that the audible signal may be silenced while maintaining strobe activation.
15. Horn Strobes and horn shall incorporate a Universal Mounting Plate that shall allow mounting to a single-gang, double-gang, 4-inch square, 100mm European type backboxes, or the Surface Backbox.
16. If required, an NATP (Notification Appliance Trim Plate) shall be provided.
17. All notification appliances shall be listed for Special Applications:
 - a. Strobes are designed to flash at 1-flash-per-second minimum over their “Regulated Input Voltage Range”.
18. All candela ratings represent minimum-effective Strobe intensity, based on UL Standard 1971.
19. Series NS Strobe products are listed under UL Standard 1971 for indoor use with a temperature range of 32°F to 120°F (0°C to 49°C) and maximum humidity of 93 percent (plus or minus 2 percent).
20. Horns shall be listed under UL Standard 464 for audible signal appliances (Indoor use only).
21. Devices ceiling mounted shall be installed within 1 inch of the center of the ceiling tiles.
22. All ceiling devices shall have backboxes. All ceiling backboxes must be supported from the structure or the ceiling grid, not the ceiling tile.

2.3 FIRE ALARM SYSTEM SEQUENCE OF OPERATION

- A. All system operations shall be programmed through a single (electrical) point in the system without the need to shut down any portion of the system in order to initialize the program or to make changes to the program.
- B. All system programming shall be done through a portable computer, which has the ability to print the current program which is being loaded to the system, for the purpose of archiving and supplying as-built programming details. A copy of the latest programming shall be recorded on a university provided fire alarm panel specific thumbdrive.
- C. The operation of a manual station or activation of any area smoke detector, elevator smoke detector, thermal detector, sprinkler waterflow switch, or any automatic alarm initiating device shall automatically activate the standard UTSW sequence of events.
- D. Activation of the system by a supervisory trouble condition such as a Duct Smoke Detector, Sprinkler Valve Tamper Switch, or any other ancillary contact, shall automatically activate the standard UTSW sequence of events.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions 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. Perform work in accordance with the requirements of NFPA 70, NFPA 72, and NECA 1, Standard of Good Workmanship in Electrical Contracting. Contracting company shall maintain a valid Alarm Certificate of Registration (ACR) and the technician(s) shall maintain a valid Fire Alarm Technician License (FAL) from the State of Texas throughout the installation and through the acceptance process.
- B. Fasten equipment to structural members of building or metal supports attached to structure, or to concrete surfaces.

- C. In the event that limited energy cable installation is allowed, all cable runs shall be run at right angles to building walls, supported from structure at intervals not exceeding 5 feet and where installed in environmental air plenums, be rated for such use and tied/supported by components listed for environmental air plenums installation.
- D. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
- E. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- F. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- G. New system wiring shall be installed with plenum rated cable where necessary, and wired per the manufacturer's recommendations and wiring diagrams provided in the submittals. Existing wiring may be reused.
- H. The contractor shall furnish all additional conduit, wiring, cable, outlet boxes, junction boxes, cabinets, and similar devices necessary for the complete installation.

3.3 BOXES, ENCLOSURES AND WIRING DEVICES

- A. Boxes shall be installed plumb and firmly in position.
- B. Extension rings with blank covers shall be installed on junction boxes where required.
- C. Junction boxes served by concealed conduit shall be flush mounted.
- D. Upon initial installation, all wiring outlets, junction, pull and outlet boxes shall have dust covers installed. Dust covers shall not be removed until wiring installation when permanent dust covers or devices are installed.
- E. Fire alarm box covers shall be red in color unless it is exposed as part of the final interior finish of the building, in which case it must match its background. "Fire alarm system" decal or silk-screened label shall be applied to all junction box covers. The back box and conduit can be standard grey in color.

3.4 CONDUCTORS

- A. Each conductor shall be identified as shown on the drawings at each with wire markers at terminal points. Attach permanent wire markers within 2 inches of the wire termination. Marker legends shall be visible.
- B. All wiring shall be supplied and installed in compliance with the requirements of the National Electric Code, NFPA 70, Article 760, and that of the manufacturer.
- C. Wiring for strobe and audible circuits shall be a minimum 14 AWG, signal line circuits; 18 AWG twisted shielded, speaker circuits; 16 AWG twisted.
- D. All splices shall be made using solderless connectors. All connectors shall be installed in conformance with the manufacturer recommendations.
- E. The installation contractor shall submit for approval prior to installation of wire, a proposed color code for system conductors to allow rapid identification of circuit types.
- F. Wiring within sub panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.
- G. Wiring for notification appliance circuits and associated circuits required to activate the notification appliance circuits shall be installed in a 2 hour enclosure or rated for 2 hour survivability until the circuit enters the associated evacuation zone (smoke zone).

3.5 DEVICES

- A. Relays and other devices to be mounted in auxiliary panels are to be securely fastened to avoid false indications and failures due to shock or vibration.
- B. Wiring within panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.
- C. All devices and appliances shall be mounted to or in an approved electrical box.

3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Permanently label or mark each conductor at both ends with permanent alphanumeric wire markers.
- C. A consistent color code for fire alarm system conductors throughout the installation.

- D. All initiating, indicating, monitor and relay modules will have self adhesive label attached to each device. Label will match labeling scheme on submittal drawings.

3.7 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Testing General:
 - 1. All Alarm Initiating Devices shall be observed and logged for correct zone and sensitivity. These devices and their bases shall be tagged with adhesive tags located in an area not visible when installed, showing the initials of the installing technician and date.
 - 2. Wiring runs shall be tested for continuity, short circuits and grounds before system is energized. Resistance, current and voltage readings shall be made as work progresses.
 - 3. The acceptance inspector shall be notified before the start of the required tests. All items found at variance with the drawings or this specification during testing or inspection by the acceptance inspector shall be corrected.
 - 4. Test reports shall be delivered to the acceptance inspector as completed.
 - 5. All test equipment, instruments, tools and labor required to conduct the system tests shall be made available by the installing contractor. The following equipment shall be a minimum for conducting the tests:
 - a. Ladders and scaffolds as required to access all installed equipment.
 - b. Multi-meter for reading voltage, current and resistance.
 - c. Two way radios, and flashlights.
 - d. A manufacturer recommended device for measuring air flow through air duct smoke detector sampling assemblies.
 - e. Decibel meter.
 - f. In addition to the testing specified to be performed by the installing contractor, the installation shall be subject to test by the acceptance inspector.

3.8 ACCEPTANCE TESTING

- A. A written acceptance test procedure (ATP) for testing the fire alarm system components and installation will be prepared by the contractor and approved by the UTSW Director of Fire and Occupational Safety or his designee in accordance with NFPA 72 and this specification. The contractor shall be responsible for the performance of the ATP, demonstrating the function of the system and verifying the correct operation of all system components, circuits, and programming. Acceptance testing will be performed by the AHJ (UTSW Director of Fire and Occupational Safety or his designee) at UTSW.
- B. A program matrix shall be prepared by the installing contractor referencing each alarm input to every output function affected as a result of an alarm condition on that input.
- C. The installing contractor prior to the ATP shall prepare a complete listing of all device labels for alphanumeric annunciator displays.
- D. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed and approved by the AHJ (UTSW Director of Fire and Occupational Safety or their representative and test results recorded for use at the final acceptance test.
- E. Preliminary Testing: Conduct preliminary tests to ensure that all devices and circuits are functioning properly. After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly. The letter shall also state that all panel functions were tested and operated properly. The Contractor and an authorized representative from each supplier of equipment shall be in attendance at the preliminary testing to make necessary adjustments.
- F. Final Acceptance Test: Final acceptance testing shall be scheduled through the UTSW project manager with a minimum of three business days notification provided to UTSW Fire and Safety.
 - 1. Verify that the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.
 - 2. Test each initiating and indicating device and circuit for proper operation and response. Disconnect the confirmation feature for smoke detectors during tests to minimize the amount of smoke or test gas needed to activate the detector.

3. Test the system for all specified functions in accordance with the contract drawings and specifications and the manufacturer's operating and maintenance manual.
 4. Visually inspect all wiring.
 5. Verify that all software control and data files have been entered or programmed into the FACP.
 6. Measure the current in circuits to assure that there is the calculated spare capacity for the circuits.
 7. Measure voltage readings for circuits to assure that voltage drop is not excessive.
 8. Measure the voltage drop at the most remote appliance on each notification appliance circuit.
 9. Verify that as built drawings reflect the actual installation.
- G. The UTSW Fire and Safety representative shall use the system record drawings in combination with the documents specified in this specification during the testing procedure to verify operation as programmed. In conducting the ATP, the UTSW Fire and Safety representative shall request demonstration of any or all input and output functions. The items tested shall include but not be limited to the following:
1. System wiring shall be 100 percent tested to demonstrate correct system response and correct subsequent system operation in the event of:
 - a. Open, shorted and grounded signal line circuits.
 - b. Open, shorted and grounded notification, releasing circuits.
 - c. Primary power or battery disconnected.
 2. System notification appliances shall be demonstrated as follows:
 - a. All alarm notification appliances actuate as programmed.
 - b. Audibility and visibility at required levels.
 3. System indications shall be demonstrated as follows:
 - a. Correct message display for each alarm input at the control display.
 - b. Correct annunciator light for each alarm input at each annunciator and graphic display as shown on the drawings.
 - c. Correct history logging for all system activity.
 4. System off-site reporting functions shall be demonstrated as follows:
 - a. Correct zone transmitted for each alarm input.
 - b. Trouble signals received for disconnect.
 - c. Supervisory signals for all devices.
 5. Secondary power capabilities shall be demonstrated as follows:
 - a. System primary power shall be disconnected for a period of time as specified herein. At the end of that period, an alarm condition shall be created and the system shall perform as specified for a period as specified.
 - b. System primary power shall be restored for forty-eight hours and system-charging current shall be normal trickle charge for a fully charged battery bank.
 - c. System battery voltages and charging currents shall be checked at the fire alarm control panel.

3.9 DOCUMENTATION

- A. System documentation shall be furnished to UTSW Fire and Safety and shall include but not be limited to the following:
1. System record drawings and wiring details including one set of reproducible drawings, and a CD ROM with copies of the record drawings in DXF format for use in a CAD drafting program.
 2. System operation, installation and maintenance manuals.
 3. System matrix showing interaction of all input signals with output commands.
 4. Documentation of system voltage, current and resistance readings taken during the installation, testing and ATP phases of the system installation.
 5. System program showing system functions, controls and labeling of equipment and devices.
 6. A printout showing the percent of obscuration for each smoke detector in the system.

3.10 PROTECTION

- A. Remove and replace devices and panel components that are wet, dirty, moisture damaged, or mold damaged. All devices shall be 100 percent clear and operating in the proper manner prior to the completion of the project.

3.11 DEMONSTRATION

- A. Instructor: Include in the project the services of an instructor, who shall have received specific training from the manufacturer for the training of other persons regarding the inspection, testing and maintenance

of the system provided. The instructor shall train the employees designated by the owner, in the care, adjustment, maintenance, and operation of the fire alarm system.

- B. Training sessions shall cover all aspects of system performance, including system architecture, signaling line circuit configurations, sensor and other initiating device types, locations, and addresses, fire alarm control panel function key operation, and other functions as designated by the owner.
- C. Required Instruction Time: Provide 8 hours of instruction after final acceptance of the system. The instruction shall be given during regular working hours on such dates and times as are selected by the owner.
- D. Comprehensive system troubleshooting training shall be provided for a single individual designated by the owner. This session shall be separate and distinct from the above described sessions.
- E. All training sessions shall be conducted following final system certification and acceptance. Three additional training sessions shall be provided for all security personnel on all shifts six months after final system certification.
- F. All training sessions shall be conducted by an authorized fire alarm system distributor representative, who has received specific training from the manufacturer for the training of other persons regarding the inspection, testing, and maintenance of the system provided.

3.12 PLAN REVIEW & PERMITTING

- A. Plans shall be submitted for review and approval a minimum of 5 business days through the UT Southwestern Project Manager.
- B. Plans shall include all appropriate information, calculations, and manufactures information as required in National Fire Protection Association National Fire Alarm and Signaling Code (NFPA 72). Failure to provide the necessary information will result in a delay in the review of the project until all of the information is provided.
- C. Submittal of plans does not constitute approval. Contractors working on the project will do so at their own risk and will replace, without cost to the owner, any components necessary as required by the approved plans.
- D. A digital copy of submittal information shall be provided to the UT Southwestern Medical Center Office of Safety and Business Continuity – Attention Director of Fire and Occupational Safety. A copy of the approved, stamped, plans shall be maintained on the job at all times.
- E. A permit shall be provided with the approval of the submitted plans.
- F. When fire alarm devices are added, moved, or modified to an existing space for modification, renovation, or reconstruction coordinate the following:
 - 1. For three or more devices, submit plans for review in accordance with plan review and permitting requirements specified.
 - 2. For ten or more devices, meet requirements above and submit calculations for review in accordance with plan review and permitting requirements specified.

3.13 INSPECTION

- A. A minimum of two (2) copies of all state paperwork for testing shall be copied at the time of the conclusion for the test and signed by the contractor and UTSW Fire Safety representative. A copy of the test shall be maintained by the contractor and a copy provided immediately to the Fire Safety representative. The test will not be considered passed under the paperwork for the test is complete.

3.14 DOCUMENT CABINET (BOX)

- A. A document cabinet (box) shall be provided next to the fire alarm panel. The box shall be red, keyed, and hinged along the side of the box. The door shall open in a manner which does not block the fire alarm panel.
- B. The box shall have 1 inch letters which state "Emergency Information" and the building alpha numeric identification.
- C. The box shall contain a means to secure documents in the box as well as on the door of the box.
- D. The minimum cabinet dimensions shall be 13 inch H by 12 inch wide by 2 1/4 inch deep.

3.15 AS BUILT

- A. As built drawings in digital format shall be provided on the same day of the final approval of the building.

END OF SECTION 28 31 00