PROJECT MANUAL

for

POB I – LEVELS 3 & 5
OFFICE & SUPPORT RENOVATION

Final Construction Documents for Bidding and Construction (IFC)

at

THE UNIVERSITY OF TEXAS SOUTHWESTERN MEDICAL CENTER DALLAS, TEXAS

UT SYSTEM PROJECT NO. 332374

NBB Architecture, Inc. Project no. 1133KZ

DATE: 20 September 2017

THE UNIVERSITY OF TEXAS SOUTHWESTERN MEDICAL CENTER
Department of Facilities Management
5323 Harry Hines Boulevard
Dallas, Texas 75390
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>SECTION</th>
<th>SECTION TITLE</th>
<th>ISSUE DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTORY INFORMATION</td>
<td>Table of Contents</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>DIVISION 1 - GENERAL REQUIREMENTS</td>
<td>Summary</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Alternates</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Submittal Procedures</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Project Management &amp; Coordination</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Alteration Project Procedures</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Regulatory Requirements</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>References</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Temporary Facilities and Controls</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Airborne Contaminants Control</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Product Requirements</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Execution</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>DIVISION 2 – EXISTING CONDITIONS</td>
<td>Selective Demolition</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>DIVISION 6 - WOOD AND PLASTICS</td>
<td>Rough Carpentry – Interior</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Interior Architectural Woodwork</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>DIVISION 7 - THERMAL AND MOISTURE PROTECTION</td>
<td>Penetration Firestopping</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Joint Sealants</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>DIVISION 8 - DOORS AND WINDOWS</td>
<td>Interior Hollow Metal Doors and Frames - Interior</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Flush Wood Doors</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Door Hardware</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Glazing - Interior</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>DIVISION 9 - FINISHES</td>
<td>Non-Structural Metal Framing</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Gypsum Board</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Tiling</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Acoustical Panel Ceilings</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Resilient Base and Accessories</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Sheet Carpeting</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Acoustical Blanket Insulation</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Interior Painting</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>DIVISION 10 - SPECIALTIES</td>
<td>Signage</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Toilet and Bath Accessories</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Fire Extinguisher Cabinets</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Fire Extinguishers</td>
<td>20 Sept 2017</td>
</tr>
</tbody>
</table>
DIVISION 11 - EQUIPMENT
115224  Flat Screen TV Mounts ................................................................. 20 Sept 2017

DIVISION 12 - FURNISHINGS
122113  Horizontal Louver Blinds .............................................................. 20 Sept 2017

END OF TABLE OF CONTENTS
<table>
<thead>
<tr>
<th>SECTION</th>
<th>SECTION TITLE</th>
<th>ISSUE DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DIVISION 21 – FIRE SUPPRESSION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>211313</td>
<td>Fire Protection Systems</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td><strong>DIVISION 22 – PLUMBING</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>220010</td>
<td>Basic Mechanical Requirements</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>220011</td>
<td>MEP AutoCad Procedures and Standards</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>220013</td>
<td>UTSW Plumbing Design Requirements</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>221116</td>
<td>Plumbing Piping</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>221119</td>
<td>Plumbing Specialties</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>224000</td>
<td>Plumbing Fixtures</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td><strong>DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>230000</td>
<td>UTSW Mechanical Design Requirements</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>230519</td>
<td>Meters and Gauges</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>230529</td>
<td>Supports and Anchors</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>230553</td>
<td>Mechanical Identification</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td></td>
<td>Piping Color Identification Matrix</td>
<td></td>
</tr>
<tr>
<td>230593</td>
<td>Testing, Adjusting and Balancing</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>230594</td>
<td>System Testing, Adjusting and Balancing</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>230701</td>
<td>Piping Insulation</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>230703</td>
<td>Ductwork Insulation</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>230900</td>
<td>Instrumentation and Control for HVAC</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>23090ox</td>
<td>Exhibit A - To Energy Management System (EMS)</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>230955</td>
<td>Control Sequence</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>233113</td>
<td>Ductwork</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>233300</td>
<td>Ductwork Accessories</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>233315</td>
<td>Air Outlets and Inlets</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>233350</td>
<td>Filters</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>233600</td>
<td>Air Terminal Units</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td><strong>DIVISION 26 – ELECTRICAL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>260000</td>
<td>Basic Electrical Requirements</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>260010</td>
<td>UTSW Electrical Design Requirements</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>260500</td>
<td>Basic Electrical Materials and Methods</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>260501</td>
<td>Electrical Demolition</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>260519</td>
<td>Building Wire, Cable and Connectors, 600 Volts and Below</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>260524</td>
<td>Temperature Controls</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>260526</td>
<td>Grounding</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>260529</td>
<td>Supporting Devices</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>260533</td>
<td>Conduits and Boxes</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>260553</td>
<td>Electrical Identification</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>262726</td>
<td>Wiring Devices and Floor Boxes</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>265100</td>
<td>Lighting Fixtures</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td><strong>DIVISION 27 – COMMUNICATIONS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>270500</td>
<td>Common Work Results for Communications</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>270528.15</td>
<td>Floorboxes and Poke-Thrus</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>270528.29</td>
<td>Hangers and Supports for Communications Systems</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>270528.33</td>
<td>Conduits and Boxes for Communication Systems</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>270528.36</td>
<td>Cable Trays for Communications Systems</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>270553</td>
<td>Identification for Communications Systems</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>270700</td>
<td>Communications Testing</td>
<td>20 Sept 2017</td>
</tr>
<tr>
<td>271116</td>
<td>Communications Cabinets, Racks, Frames, and Enclosures</td>
<td>20 Sept 2017</td>
</tr>
</tbody>
</table>
DIVISION 28 – ELECTRONIC SAFETY AND SECURITY
283100 Addressable Fire Alarm System ................................................................. 20 Sept 2017

END OF MEP TABLE OF CONTENTS
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section includes:
   1. Project information.
   2. Work covered by Contract Documents.
   3. Phased construction.
   4. Work by Owner.
   5. Owner-furnished products.
   6. Access to site.
   7. Coordination with occupants.
   8. Work restrictions.

1.3 PROJECT INFORMATION
A. Project Identification:
   1. Project Location: 5959 Harry Hines Blvd, Dallas, TX 75235. Building HP, levels 3 & 5 Renovation
   B. Owner: University of Texas Southwestern Medical Center, Dallas, Texas.
   1. Owner's Representative: Refer to the Project Directory.
   C. Architect of Record: NBB Architecture, Inc.

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. Demolition and renovation to an existing building located on the campus of UT Southwestern
      a. Level 3 renovation consist of 8,430 sf
      b. Level 5 renovation consist of 4,777 sf
   B. Type of Contract
      1. Project will be constructed under a single prime contract.

1.5 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 Products:
   1. Conference Room Equipment:
      a. Projection Screen on Level 5
      b. (5) TV wall mount brackets on Level 3
   2. Kitchen Equipment on Level 3 as follows:
      a. Full size refrigerator (2)
      b. Coffee Maker
      c. Microwave (2)

1.6 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.

1.7 COORDINATION WITH OCCUPANTS
A. Full Owner Occupancy: Owner will occupy site and/or existing/adjacent building(s) or room(s) during
entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner’s day-to-day operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.

2. Notify the Owner not less than 72 hours in advance of activities that will affect Owner's operations.

B. 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 72 hours' notice to Owner of activities that will affect Owner's operations.

1.8 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 two days in advance of proposed utility interruptions.

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. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor air intakes.

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.

1.9 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. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. 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.

3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.
PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION
SECTION 012300
ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section includes administrative and procedural requirements for alternates.
B. List of Alternates:
   1. Alternate No. 1: Demo ceiling grid, ceiling tiles, lights & HVAC diffusers in ceiling then provide new ceiling grid, tiles, LED lights and diffusers to replace in the public corridors of level 3 & 5.

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

1.4 PROCEDURES
A. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.
C. Execute accepted alternates under the same conditions as other work of the Contract.
D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Use)

PART 3 - EXECUTION (Not Use)

END OF SECTION
SECTION 013100

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
      1. General project coordination procedures.
      2. Coordination Drawings.
      3. Administrative and supervisory personnel.

1.3 COORDINATION
   A. Coordination: Coordinate construction operations included in various Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
      1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
      2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
      3. Make adequate provisions to accommodate items scheduled for later installation.
   B. If necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
      1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
   C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
      1. Preparation of Contractor's Construction Schedule.
      2. Preparation of the Schedule of Values.
      3. Installation and removal of temporary facilities and controls.
      4. Delivery and processing of submittals.
      5. Progress meetings.
      6. Preinstallation conferences.
      7. Project closeout activities.
   D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
      1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work.

1.4 SUBMITTALS
A. Coordination Drawings:
1. Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
   a. Indicate relationship of components shown on separate Shop Drawings.
   b. Indicate required installation sequences.
   c. Refer to Division 15 and Division 16 for specific Coordination Drawing requirements for mechanical and electrical installations.

1.5 ADMINISTRATIVE AND SUPERVISORY PERSONNEL
A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

1.6 PROJECT MEETINGS
A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
   1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
   2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
   3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within 3 days of the meeting.

B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
   1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; manufacturers; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
   2. Agenda: Discuss items of significance that could affect progress, including the following:
      a. Tentative construction schedule.
      b. Phasing.
      c. Critical work sequencing.
      d. Designation of responsible personnel.
      e. Procedures for processing field decisions and Change Orders.
      f. Procedures for processing Applications for Payment.
      g. Distribution of the Contract Documents.
      h. Submittal procedures.
      i. Preparation of Record Documents.
      j. Use of the premises.
      k. Responsibility for temporary facilities and controls.
      l. Parking availability.
      m. Office, work, and storage areas.
      n. Equipment deliveries and priorities.
      o. First aid.
      q. Progress cleaning.
      r. Working hours.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.

2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
   b. Options.
   c. Related Change Orders.
   d. Submittals.
   e. Review of mockups.
   f. Possible conflicts.
   g. Compatibility problems.
   h. Time schedules.
   i. Weather limitations.
   j. Manufacturer's written recommendations.
   k. Warranty requirements.
   l. Compatibility of materials.
   m. Acceptability of substrates.
   n. Temporary facilities and controls.
   o. Space and access limitations.
   p. Regulations of authorities having jurisdiction.
   q. Testing and inspecting requirements.
   r. Required performance results.
   s. Compatibility of materials.
   t. Acceptability of substrates.
   u. Temporary facilities and controls.
   v. Space and access limitations.
   w. Regulations of authorities having jurisdiction.
   x. Testing and inspecting requirements.
   y. Required performance results.
   z. Protect construction and personnel.

3. Record significant conference discussions, agreements, and disagreements.

4. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Conduct progress meetings at weekly intervals. Coordinate dates of meetings with preparation of payment requests.

1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
   a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
   b. Review present and future needs of each entity present, including the following:
      1) Interface requirements.
      2) Sequence of operations.
      3) Status of submittals.
      4) Deliveries.
      5) Off-site fabrication.
      6) Access.
      7) Site utilization.
8) Temporary facilities and controls.
9) Work hours.
10) Progress cleaning.
11) Change Orders.
12) Documentation of information for payment requests.

3. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.
   a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section includes 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.

1.4 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.

1.5 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.
   a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
   c. Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement.
   d. The following plot files will by 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. Initial Review: Allow 15 days for 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.
   2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
   3. Resubmittal Review: Allow 15 days for review of each resubmittal.
   4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
      a. Insert list of Specification Sections requiring sequential review.
   5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for 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 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
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.
   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.
   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.
2. Action Submittals: After Architect’s return of approved submittal, create 6 paper copies of each submittal and transmit to Owner for their review and archive purposes.

3. Informational Submittals: Submit two paper copies of each submittal, unless otherwise indicated. Architect will not return copies.

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.
   b. 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, unless submittal based upon Architect's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
   a. Identification of products.
   b. Schedules.
   c. Compliance with specified standards.
   d. Notation of coordination requirements.
   e. Notation of dimensions established by field measurement.
   f. Relationship and attachment to adjoining construction clearly indicated.
   g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches.

3. Submit Shop Drawings in the following format:
   a. PDF electronic file.
   b. 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.

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. 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.

4. 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.

5. 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 will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a Project record sample.
      1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

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.
      b. Number of Copies: Three paper copies of subcontractor list, unless otherwise indicated. Architect will return two copies.

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
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.

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. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

E. Incomplete submittals are not acceptable, will be considered non-responsive, and will be returned without review.

F. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes:
1. Products and installation for patching and extending Work within construction areas of existing facilities.
2. Providing transition and adjustments.
3. Repair of damaged surfaces and finishes.
B. Related Sections include the following:
1. Division 01 Section “Temporary Facilities and Controls” for construction of temporary fire-rated partitions to separate existing occupied areas from construction areas.

1.2 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.

1.3 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 two 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.

1.4 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.

1.5 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.
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.

1.6 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.

3.2 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.
   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.

3.3 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.

3.4 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.

3.5 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.

3.6 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
SECTION 014100
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:
   2. NFPA Codes as applicable, with emphasis on the following:
   11. American Concrete Institute (ACI – 318 current edition)
   13. Texas Department of Insurance Windstorm Inspection Program
   14. FEMA 100 year flood plain
   15. 2012 Texas Accessibility Standards.
   16. 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)
   19. 2010 Center for Medicare and Medicaid Services
   20. Texas Administrative Code For Health Services, Title 25.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION
SECTION 014200
REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply 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."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section includes 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 INFORMATIONAL 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.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10 mils 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.
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 EQUIPMENT
A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes 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] [Insert number] 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.
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. Electronic Communication Service: Provide a desktop 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.
      4. Display: 19-inch (480-mm) LCD monitor with 128 Mb dedicated video RAM.
      5. Full-size keyboard and mouse.
8. Productivity Software:
   a. Microsoft Office Professional, XP or higher, including Word, Excel, and Outlook.
   b. Adobe Reader 7.0 or higher.
   c. WinZip 7.0 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.

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 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. 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."
B. 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.
C. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
D. 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.
E. 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 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.

F. 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. Prohibit smoking in construction 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. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL


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
SECTION 015719
AIRBORNE CONTAMINANTS CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. This Section includes:
   1. Hospital airborne contaminants control policy and procedures.
   2. 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 immuno-compromised 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 immuno-compromised patients.
      a. Inhalation of aspergillus spores or other fungal spores by immuno-compromised 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 immuno-compromised 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. Work Plan: Drawings and details of construction of necessary temporary barriers and description of procedures to be used to achieve and maintain control of construction-related airborne contaminants.
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 airflow) 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 013100.
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 prefilter, 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:
      b. CRSI 2000 by Control Resource System Incorporated, 670 Marine Drive, Michigan City, IN 46360, 1-800-418-1264.

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 at 1.5” static pressure.
   5. Unit shall maintain a minimum 1” S.P. on duct at all times.

D. Air Compressor:
   1. Portable air compressor unit consisting of compressors, tanks, and controls ASME rated.
   3. Accessories: Hoses and velocity nozzles.

2.2 MATERIALS

A. 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, 133 Commerce Street, East Berlin, CT 06023, 1-800-828-5656.

B. Dust Caps: Block off existing ventilation ducts within construction area. Capping method shall be dust tight and withstand air flow.

C. Portable Enclosures: Sufficient to seal off area tight to ceiling.

D. Temporary Prefabricated Partition for work in Sterile Corridors:
   1. Acceptable product and manufacturer:
      a. Kontrol Kube by Fiberlock Technologies, Inc., P.O. Box 432, Cambridge, MA, 617-876-8020, including the following:
         1) Adjustable Aluminum Frame #6440.
         2) Vinyl Enclosure #6442.
         3) Wheel Base Platform #6443.
         4) Inspection window and pressure differential porthole.
         5) Nilfisk 87 cfm vacuum device and manometer.

F. Biocide: Copper-8-quinolinolate.
   1. Acceptable product and manufacturer: MAG Chemical, Vero Beach, FL.

G. Spray Adhesive:
   1. Acceptable product and manufacturer: Ram-Tack Adhesive from Aramsco, 906 Gray Street, Elgin, IL 60120.
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 017300, 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
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

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

1.3 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."

PART 2 - PRODUCTS
2.1 PRODUCT SELECTION PROCEDURES
A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
6. 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.

   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.

2.2 COMPARABLE PRODUCTS
   A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
   1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
   2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
   3. Evidence that proposed product provides specified warranty.
   4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
   5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION
SUBSTITUTION REQUEST FORM

DATE: _____________________

Owner’s Project No: _____________________

Project: _____________________________________________________________________________

To: _______________________________________ From: ________________________________

==============================================================================

Contractor (Bidder) hereby request acceptance of the following product or system as substitution in accordance with
provisions of Section 01600 of the Specifications:

1. SPECIFIED PRODUCT OR SYSTEM:

Substitution request for : ____________________________________________________

Specification Section No : ________________________ Article: __________

2. SUPPORTING DATA:

________ Product data adequate for evaluation of the request for proposed substitution is attached
(description of product, reference standard, performance and test data, specifications, drawings,
photographs).

________ Sample is attached.

________ Sample will be sent if requested.

3. QUALITY COMPARISON

<table>
<thead>
<tr>
<th>SPECIFIED PRODUCT</th>
<th>SUBSTITUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name, Brand:</td>
<td></td>
</tr>
<tr>
<td>Catalog No.:</td>
<td></td>
</tr>
<tr>
<td>Manufacturer:</td>
<td></td>
</tr>
<tr>
<td>Vendor:</td>
<td></td>
</tr>
<tr>
<td>Significant Variations:</td>
<td></td>
</tr>
</tbody>
</table>

Maintenance Service Available: Yes _________ No _________

Spare Parts Source: ______________________________________________________

Warranty Provided: Yes ________ No ________ Years _______

By Whom: _______________________________________________________________
4. PREVIOUS INSTALLATIONS:
Identification of similar projects on which proposed substitution was used:

Project: ___________________ Owner’s Representative: ____________________________
Address: ___________________ Owner: ________________________________________
_________________________________ Date Installed: ___________________________

5. REASON FOR NOT GIVING PRIORITY TO SPECIFIED ITEMS:
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

6. EFFECT OF SUBSTITUTION:
Does the proposed substitution affect other work (adverse or otherwise):
No ________  Yes ________  (if yes, explain)
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Substitution Changes Contract Time: No ________  Yes ________
Add/Deduct ________Days

Substitution requires dimensional revisions or redesign of the work: No _____ Yes _____ (if yes, attach explanation data)

Saving of credit to Owner: $ ________________________________
Extra Cost to Owner: $ ________________________________

7. CONTRACTOR’S (BIDDER’S) STATEMENT OF CONFORMANCE OF PROPOSED SUBSTITUTION TO
CONTRACT DOCUMENTS:

I/we have investigated the proposed substitution. I/we:
- believe that it is equal or superior in all respects including function, appearance and quality to
  specified product, except as stated above;
- will provide same warranty and servicing requirements as specified for specified product;
- have included complete cost data and implications of the substitution;
- will pay for changes to the building design and special inspection costs caused by the use of this
  product;
- will coordinate the incorporation of the proposed substitution in the work;
- waive future claims for added cost to Contract caused by the substitution.

Contractor (Bidder): _________________________________________________________
Date: _______________  By: ___________________________________________________

Answer all questions and complete all blanks - use "NA" if not applicable. Unresponsive or incomplete
request will be rejected.
OWNER’S REPRESENTATIVE’S REVIEW AND ACTION

_____ Resubmit substitution request

_____ Provide more information in the following areas:

___________________________________________________________________________________
___________________________________________________________________________________

_____ Sign Contractor’s (Bidder’s) Statement of Conformance

_____ Substitution is accepted.

_____ Substitution is accepted, with the following comments:

___________________________________________________________________________________
___________________________________________________________________________________

_____ Substitution rejected.

_____ Substitution Request received too late.

___________________________________________  Date: _________________

Owner’s Representative
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
2. Installation of the Work.
3. Cutting and patching.
4. Coordination of Owner-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. 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 QUALITY ASSURANCE
A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from the Architect before proceeding. Shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
   a. Primary operational systems and equipment.
   b. Fire separation assemblies.
   c. Air or smoke barriers.
   d. Fire-suppression systems.
   e. Mechanical systems piping and ducts.
   f. Control systems.
   g. Communication systems.
   h. Conveying systems.
   i. Electrical wiring systems.
   j. Operating systems of special construction.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
   a. Water, moisture, or vapor barriers.
   b. Membranes and flashings.
   c. Exterior curtain-wall construction.
   d. Equipment supports.
   e. Piping, ductwork, vessels, and equipment.
   f. Noise- and vibration-control elements and systems.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that
has been cut and patched in a visually unsatisfactory manner.

B. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

C. Manufacturer’s Installation Instructions: Obtain and maintain on-site manufacturer’s written recommendations and instructions for installation of products and equipment.

1.5 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 so as not to 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.

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
3.3 INSTALLATION
A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
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.

3.4 CUTTING AND PATCHING
A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
B. Temporary Support: Provide temporary support of work to be cut.
C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
D. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements of Division 01 Section “Summary.”
E. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer’s written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
   1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
   2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
      a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
      b. Restore damaged pipe covering to its original condition.
   3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
      a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
   4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
   5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.
   3.5 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.

3.6 PROGRESS CLEANING
   A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
      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.
      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.

3.7 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."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 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
SECTION 024119
SELECTIVE DEMOLITION

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 this Section.

1.2 SUMMARY
A. Section Includes:
1. Demolition and removal of selected portions of building or structure.
2. Salvage of existing items to be reused or recycled.

1.3 DEFINITIONS
A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.
C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP
A. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS
A. Pre-demolition Conference: Conduct conference at Project site.
1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS
A. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
B. Schedule of Selective Demolition Activities: Indicate the following:
1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
C. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
D. Pre-demolition Photographs or Video: Submit before Work begins.
E. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.
1.7  CLOSEOUT SUBMITTALS
   A.  Inventory:  Submit a list of items that have been removed and salvaged.
   B.  Landfill Records:  Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.8  QUALITY ASSURANCE
   A.  Refrigerant Recovery Technician Qualifications:  Certified by an EPA-approved certification program.

1.9  FIELD CONDITIONS
   A.  Owner will occupy portions of building immediately adjacent to selective demolition area.  Conduct selective demolition so Owner's operations will not be disrupted.
   B.  Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
      1.  Before selective demolition, Owner will remove the following items:
         a.  [Insert items to be removed by Owner.]  
   C.  Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
   D.  Hazardous Materials:  It is not expected that hazardous materials will be encountered in the Work.
      1.  Hazardous materials will be removed by Owner before start of the Work.
      2.  If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.  Hazardous materials will be removed by Owner under a separate contract.
   E.  Storage or sale of removed items or materials on-site is not permitted.
   F.  Utility Service:  Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
      1.  Maintain fire-protection facilities in service during selective demolition operations.

1.10  WARRANTY
   A.  Existing Warranties:  Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.  Notify warrantor before proceeding.
   B.  Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect.  Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1  PERFORMANCE REQUIREMENTS
   A.  Regulatory Requirements:  Comply with governing EPA notification regulations before beginning selective demolition.  Comply with hauling and disposal regulations of authorities having jurisdiction.
   B.  Standards:  Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1  EXAMINATION
   A.  Verify that utilities have been disconnected and capped before starting selective demolition operations.
   B.  Review record documents of existing construction provided by Owner.  Owner does not guarantee that existing conditions are same as those indicated in record documents.
   C.  Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
   D.  When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict.  Promptly submit a written report to Architect.
   E.  Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
      1.  Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
      2.  Steel Tendons:  Locate tensioned steel tendons and include recommendations for de-tensioning.
   F.  Survey of Existing Conditions:  Record existing conditions by use of measured drawings preconstruction photographs preconstruction videotapes and templates.
      1.  Comply with requirements specified in Division 01 Section "Photographic Documentation."
2. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.
3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
   1. Comply with requirements for existing services/systems interruptions specified in Division 01 Section "Summary."

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
   1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
   2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
   a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
   c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
   f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
   g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Comply with requirements for access and protection specified in Division 01 Section "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
   1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
   2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
   3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
   4. Cover and protect furniture, furnishings, and equipment that have not been removed.
   5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01 Section "Temporary Facilities and Controls."

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
   1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL
A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly. Comply with requirements in Division 01 Section "Construction Waste Management and Disposal."

B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify 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.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify 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. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Division 07 Section "[Insert Section name]" for new roofing requirements.

1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

3.6 DISPOSAL OF DEMOLISHED MATERIALS
A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
   1. Do not allow demolished materials to accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
   3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
   4. Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."
B. Disposal: Transport demolished materials and dispose of at designated spoil areas on Owner's property.

3.7 CLEANING
A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION
SECTION 061001
ROUGH CARPENTRY - INTERIOR

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 this Section.

1.2 SUMMARY
A. Section Includes:
   1. Wood blocking and nailers.
   2. Plywood backing panels.

1.3 DEFINITIONS
A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
   2. WCLIB: West Coast Lumber Inspection Bureau.
   3. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
   3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.

1.5 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.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL
A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
   3. Provide dressed lumber, S4S, unless otherwise indicated.
2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:
   1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
   2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
   3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
   1. Use treatment that does not promote corrosion of metal fasteners.

   2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.

   3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

   4. Design Value Adjustment Factors: Treated lumber shall be tested according ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

E. Application: Treat all rough carpentry unless otherwise indicated.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
   1. Blocking.
   2. Nailers.
   3. Rooftop equipment bases and support curbs.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber and any of the following species:
   1. Spruce-Pine-Fir (South); NeLMA, WCLIB, or WWPA.

C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, Exterior, AC, fire-retardant treated, in thickness indicated or, if
2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.


D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1.

F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.


PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

D. Do not splice structural members between supports unless otherwise indicated.

E. Provide blocking as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

F. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.

2. Use copper naphthenate for items not continuously protected from liquid water.

H. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:


2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

I. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
3.3 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION
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 this Section.

1.2 SUMMARY
   A. This Section includes the following:
      1. Flush wood paneling and wainscots.
      2. Wood cabinets.
      5. Shop finishing of interior woodwork.

1.3 DEFINITIONS
   A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.4 SUBMITTALS
   A. Product Data: For each type of product indicated cabinet hardware and accessories.
   B. Product Data: For panel products, high-pressure decorative laminate, fire-retardant-treated materials, cabinet hardware, and accessories and finishing materials and processes.
      1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
   C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
      1. Show details full size.
      2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
      3. Show locations and sizes of cutouts and holes for plumbing fixtures installed in architectural woodwork.
   D. Samples for Initial Selection:
      1. Shop-applied transparent finishes.
      2. Shop-applied opaque finishes.
      4. PVC edge material.
      5. Thermoset decorative panels.
   E. Samples for Verification:
      1. Lumber with or for transparent finish, not less than 50 sq. in., for each species and cut, finished on 1 side and 1 edge.
      2. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.
      3. Veneer-faced panel products with or for transparent finish, 8 by 10 inches, for each species and cut. Include at least one face-veneer seam and finish as specified.
      4. Lumber and panel products with shop-applied opaque finish, 50 sq. in. for lumber and 8 by 10 inches for panels, for each finish system and color, with [1/2 of] exposed surface finished.
      5. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with 1 sample applied to core material.
      6. Thermoset decorative-panels, 8 by 10 inches, for each type, color, pattern, and surface finish, with edge banding on 1 edge.
      7. Solid-surfacing materials, 6 inches square.
   F. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.5 QUALITY ASSURANCE
   A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to
those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.

B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.

C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood veneers.

D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

E. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

C. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.  Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

2.  Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 WOODWORK FABRICATORS

A. Available Fabricators: Subject to compliance with requirements, fabricators offering interior architectural woodwork that may be incorporated into the Work include, but are not limited to, the following:

2.2 MATERIALS

A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Species and Cut for Transparent Finish: Plain sliced red oak with clear finish or as otherwise indicated in Finish Legend.

C. Wood Products: Comply with the following:

1. Softwood Plywood: DOC PS 1, Medium Density Overlay.


D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated into the Work include, but are not limited
2.3 FIRE-RETARDANT-TREATED MATERIALS
A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this Article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified.
1. Do not use treated materials that do not comply with requirements of referenced woodworking standard or that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Comply with performance requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Use the following treatment type:
2. Interior Type A: Low-hygroscopic formulation.
3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking plant certified by testing and inspecting agency.
4. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
5. Kiln-dry materials before and after treatment to levels required for untreated materials.

2.4 CABINET HARDWARE AND ACCESSORIES
A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section "Door Hardware (Scheduled by Naming Products)."
B. Hardware Standard: Comply with BHMA A156.9 for items indicated by referencing BHMA numbers or items referenced to this standard.
C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing. Typically Blum 125 Series.
E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112. Unless otherwise noted, use KV model 255 steel recessed mounted standards and model 256ZC clips.
F. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings, BHMA A156.9, B05091, and rated for the following loads:
   Box Drawer Slides: 100 lbf.
   1. File Drawer Slides: 150 lbf.
   2. Pencil Drawer Slides: 45 lbf.
G. Door Locks: Cam Locks by CCL Security Products.
H. Drawer Locks: If single drawer, same as above. In banks of drawers, provide cylinder module system with central locking by Hafele.
I. Elbow Catch: Ives no. 2 at pairs of locked doors.
J. Grommets for Cable Passage through Countertops: 1-1/4-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage. Color as selected by Architect. Final location as directed by Owner.
   1. Product: Subject to compliance with requirements, provide "OG series" by Doug Mockett and Co., Inc.
K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
   Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
   1. Satin Stainless Steel: BHMA 630.
L. Concealed Hardware Finishes: Provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
M. Trash Can Trim Ring for Counter Tops: Model TM series by Doug Mockett Company, in polished stainless steel, 8 inch diameter, 2 inches deep.
2.5 MISCELLANEOUS MATERIALS
A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
B. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.
C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
D. Adhesives, General: Do not use adhesives that contain urea formaldehyde.
E. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Wood Glues: 30 g/L.
   2. Contact Adhesive: 250 g/L.
F. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
   1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.
G. Edgebanding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 3 mm thick at counter tops, doors, drawer fronts, and exposed shelving on front and back edges (front edge only for fixed shelving; 1 mm thick elsewhere, including edges of shelving within cabinets.

2.6 FABRICATION, GENERAL
A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.
B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
C. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
D. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
E. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
   2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
F. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
   1. Seal edges of openings in countertops with a coat of varnish.

2.7 FLUSH WOOD PANELING AND WAINSCOTS
A. Grade: Custom.
B. Wood Species and Cut: Plain-sliced red oak with clear finish or as otherwise indicated in Finish Legend.
   1. Lumber Trim and Edges: At fabricator's option, trim and edges indicated as solid wood (except moldings) may be either lumber or veneered construction compatible with grain and color of veneered panels.
C. Matching of Adjacent Veneer Leaves: Book match.
D. Veneer Matching within Panel Face: Running match.
E. Panel-Matching Method: Match panels within each separate area by the following method:
   1. Sequence-matched, uniform-size sets [as indicated].
F. Vertical Panel-Matching Method: Continuous match; veneer leaves of upper panels are continuations of veneer leaves of lower panels.
G. Fire-Retardant-Treated Paneling: Provide panels consisting of wood veneer. Panels shall have flame-spread index of 25 or less and smoke-developed index of 450 or less per ASTM E 84.
2.8 WOOD CABINETS FOR TRANSPARENT FINISH
A. Grade: Custom.
B. AWI Type of Cabinet Construction: Flush overlay.
C. Wood Species and Cut for Exposed Surfaces: Plain sliced red oak with clear finish or as otherwise indicated in Finish Legend.
   1. Veneer Matching within Room: Provide cabinet veneers in each room or other space from a single flitch with doors, drawer fronts, and other surfaces matched in a sequenced set with continuous match where veneers are interrupted perpendicular to the grain.
D. Semi-exposed Surfaces: Provide surface materials indicated below:
   1. Surfaces Other Than Drawer Bodies: Same species and cut indicated for exposed surfaces.
   2. Drawer Sides and Backs: Solid-hardwood lumber.
   3. Drawer Bottoms: Hardwood plywood.
E. Provide dust panels of 1/4-inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.
F. Provide hardwood “T” banding at door and drawer edges of species, cut and finish to match face veneer.

2.9 PLASTIC-LAMINATE CABINETS
A. Grade: Custom.
B. AWI Type of Cabinet Construction: Flush overlay.
C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
   1. Horizontal Surfaces Other Than Tops: Grade HGS.
   2. Post-formed Surfaces: Grade HGP.
   3. Vertical Surfaces: Grade VGS.
   4. Edges: Grade HGS.
D. Materials for Semi-exposed Surfaces:
   1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade CLS.
      a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch minimum thickness, matching laminate in color, pattern, and finish.
      b. For semi-exposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade CLS.
   2. Drawer Sides and Backs: Solid-hardwood lumber.
   3. Drawer Bottoms: Hardwood plywood.
E. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.
F. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   1. As indicated by laminate manufacturer's designations.
   3. As selected by Architect from laminate manufacturer's full range in the following categories:
      a. Solid colors, matte finish.
      b. Solid colors with core same color as surface, matte finish.
      c. Wood grains, matte finish.
      d. Patterns, matte finish.
G. Provide dust panels of 1/4-inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.
H. Edgebanding for Plastic Laminate Clad Cabinets: Rigid PVC extrusions, through color with satin finish, 3 mm thick at counter tops, doors, drawer fronts, and exposed shelving on front and back edges (front edge only for fixed shelving); and 1 mm thick elsewhere, including edges of shelving within cabinets.

2.10 PLASTIC-LAMINATE COUNTERTOPS
A. Grade: Custom.
B. High-Pressure Decorative Laminate Grade: HGS.
C. Grain Direction: Parallel to cabinet fronts.
D. Edge Treatment: Same as laminate cladding on horizontal surfaces.
E. Core Material: Plywood.
F. Backer Sheet: Provide plastic-laminate backer sheet, Grade BKL, on underside of countertop substrate.

2.11 SHOP FINISHING
A. General: Shop finish transparent-finished interior architectural woodwork at fabrication shop as specified
in this Section. Refer to Division 09 painting Sections for finishing opaque-finished architectural woodwork.

B. Shop Priming: Shop apply the prime coat including backpriming, if any, for transparent-finished items specified to be field finished. Refer to Division 09 painting Sections for material and application requirements.

C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
   1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.

D. Transparent Finish:
   1. Grade: Custom.
   2. AWI Finish System: Catalyzed polyurethane.
   3. Staining: Match approved sample for color.
   4. Wash Coat for Stained Finish: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
   5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
   6. Filled Finish for Open-Grain Woods: After staining (if any), apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.
      a. Apply wash-coat sealer after staining and before filling.
   7. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION
A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION
A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
F. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
G. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 60 inches long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.
   1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.
   2. Install wall railings on indicated metal brackets securely fastened to wall framing.
   3. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.
H. Paneling: Anchor paneling to supporting substrate with splined connection strips. Do not use face fastening, unless otherwise indicated.
   1. Install flush paneling with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.
I. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.
Complete installation of hardware and accessory items as indicated.
1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Maintain veneer sequence matching of cabinets with transparent finish.
3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish toggle bolts through metal backing or metal framing behind wall finish.

J. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
1. Align adjacent solid-surfac-ing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
3. Secure backsplashes to walls with adhesive.
4. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."

K. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

L. Refer to Division 09 Sections for final finishing of installed architectural woodwork not indicated to be shop finished.

3.3 ADJUSTING AND CLEANING
A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
B. Clean, lubricate, and adjust hardware.
C. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION
SECTION 078413
PENETRATION FIRESTOPPING

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 this Section.

1.2 SUMMARY
   A. Section Includes:
      1. Penetrations in fire-resistance-rated walls.
      2. Penetrations in horizontal assemblies.
      3. Penetrations in smoke barriers.

1.3 SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Product Schedule: For each penetration firestopping 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 firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping 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 firestopping 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 firestopping.

1.4 QUALITY ASSURANCE
   A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."
   B. Installer Qualifications: A firm experienced in installing penetration firestopping 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 firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
   C. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
      1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
      2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
         a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
         b. Classification markings on penetration firestopping 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."

1.5 PROJECT CONDITIONS
   A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
   B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.
1.6 COORDINATION
A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Grace Construction Products.
   2. Hilti, Inc.
   4. RectorSeal Corporation.
   5. Specified Technologies Inc.
   6. 3M Fire Protection Products.

2.2 PENETRATION FIRESTOPPING
A. Provide penetration firestopping 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 firestopping 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 firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
   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 firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
   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 firestopping 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 E 84.
F. VOC Content: Provide penetration firestopping 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.
G. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping 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.
   5. Steel sleeves.

2.3 MIXING
A. For those products requiring mixing before application, comply with penetration firestopping 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 firestopping to comply with manufacturer's written instructions and with the following requirements:
   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. 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 firestopping 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 firestopping's seal with substrates.

3.3 INSTALLATION
A. General: Install penetration firestopping 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 firestopping.
C. Install fill materials for firestopping 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.

3.4 IDENTIFICATION
A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. 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 firestopping manufacturers and that do not damage materials in which openings occur.
B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping 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 firestopping 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. Where FM Global-approved systems are indicated, they refer to design numbers listed in FM Global's "Building Materials Approval Guide" under "Wall and Floor Penetration Fire Stops."

D. 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.

E. 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

F. 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, 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.

G. 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, WL2126 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.

H. 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, FC3012, WL3065, WL3112 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.

I. Firestop Systems for Cable Trays (FS-6): Comply with the following:
1. Acceptable UL-Classified Systems with CAJ or WL 4000 Series Systems equivalent to, but not limited to, the following: CAJ4035, CAJ4054, WL4011, WL4034 by Hilti or CAJ4035, CBJ4023, WL4025, WL4030 by Grace.
2. Type of Fill Materials: One or more of the following:
   a. Intumescent sealant.
   b. Intumescent putty.
   c. Silicone foam.
   d. Pillows/bags.
   e. Foam blocks.
   f. Firestop mortar.
   g. Polyurethane firestop foam.

J. Firestop Systems for Insulated Pipes (FS-7): 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, 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.

K. Firestop Systems for Miscellaneous Electrical Penetrants (FS-8): 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 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.

L. Firestop Systems for Miscellaneous Mechanical Penetrations (FS-9): Comply with the following:
1. Acceptable UL-Classified Systems with CAJ 7000 Series Systems equivalent to, but not limited to, the following: CAJ7046, CAJ7051, CAJ7040, CAJ7021 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.

M. Firestop Systems for Groupings of Penetrations (FS-10): 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
SECTION 079200

JOINT SEALANTS

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 this Section.

1.2 SUMMARY
A. Section Includes:
1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.
5. Acoustical joint sealants.
6. Preformed sealants.

1.3 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 C 1087 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.

1.4 SUBMITTALS
A. Product Data: For each joint-sealant product indicated.
B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
C. Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
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.

1.5 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.

1.6 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.
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.

1.7 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 C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 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 C 1247. 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 C 1248 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 C 920, Type S, Grade NS, Class 50, for Use NT.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. BASF Building Systems; 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 C 920, Type S, Grade NS, Class 25, for Use NT.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. BASF Building Systems; Omniseal Plus.
2.3 URETHANE JOINT SEALANTS
   A. Multi-component, Non-sag, Urethane Joint Sealant (U-NS): ASTM C 920, 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; Tremsil 200 Sanitary.

   B. Multi-component, Self-Leveling, Traffic-Grade, Urethane Joint Sealant (U-TB): ASTM C 920, Type M, Grade SL, Class 50, for Use T.
      1. Products: Subject to compliance with requirements, provide one of the following:
         b. Tremco Incorporated; Dymeric 240 FC.
         c. Pecora; Dynatread.

2.4 LATEX JOINT SEALANTS
   A. Latex Joint Sealant (L): Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
      1. Products: Subject to compliance with requirements, provide one of the following:
         a. BASF Building Systems; Sonolac.
         c. May National Associates, Inc.
         d. Pecora Corporation; AC-20+.
         e. Tremco Incorporated; Tremflex 834.

2.5 ACOUSTICAL JOINT SEALANTS (AC)
   A. Acoustical Joint Sealant: Manufacturer's standard non-sag, paintable, non-staining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
      1. Products: Subject to compliance with requirements, provide one of the following:
         a. Pecora Corporation; AC-20 FTR.
         b. USG Corporation; SHEETROCK Acoustical Sealant.

2.6 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. 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: Subject to compliance with requirements, provide one of the following:
         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. BASF, WABO Weather Seal II

2.7 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.
   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 D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. 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.
   C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS
A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability:
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install 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 C 1193, unless otherwise indicated.
   4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
   5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
      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 C 919 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 07 “Sheet Metal Flashing and Trim;” Designation S-GP.

END OF SECTION
SECTION 081114
HOLLOW METAL DOORS AND FRAMES – INTERIOR

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 this Section.

1.2 SUMMARY
A. Section Includes:
   1. Standard hollow metal doors frames for interior applications.

1.3 DEFINITIONS
A. Minimum Thickness: Minimum thickness of base metal without coatings.
B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.4 SUBMITTALS
A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, 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.
C. Other Action Submittals:
   1. 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.
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.

1.5 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 UL10C.
   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 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.

1.6 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 nonvented 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-high wood blocking. Do not store in a manner that traps excess humidity.
   1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS
A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 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

1.9 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Amweld Building Products, LLC.
   2. Benchmark; a division of Therma-Tru Corporation.
   3. Ceco Door Products; an Assa Abloy Group company.
   4. Curries Company; an Assa Abloy Group company.
   5. Steelcraft; an Ingersoll-Rand company.

1.10 MATERIALS
A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS), Type B; suitable for exposed applications.
B. Hot-Rolled Steel Sheet: ASTM A 1011, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
C. Frame Anchors: ASTM A 591, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
   1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008 or ASTM A 1011, hot-dip galvanized according to ASTM A 153, Class B.
D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153.
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 C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
G. Glazing: Comply with requirements in Division 08 Section "Glazing."
H. Lead Lining: FS QQ-L-201.

1.11 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, polysiocyanurate, mineral-board, or vertical steel-stiffener core.
      a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
   5. Top and Bottom Edges: Closed with flush or inverted 0.042-inch-thick, end closures or channels of same material as face sheets.
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. Exterior Doors: Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
1. Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless)

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

1.12 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 (16 gage) thick steel sheet.
4. Frames for Wood Doors: 0.053-inch (16 gage) thick steel sheet.
5. Frames for Borrowed Lights: 0.053-inch (16 gage) thick steel sheet.

C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

1.13 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 thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-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 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 height adjustment. Terminate bottom of frames at finish floor surface.

1.14 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch 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 high unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch 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 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.

1.15 LOUVERS

A. Provide louvers for interior doors, where indicated, that comply with SDI 111C, with blades or baffles formed of 0.020-inch- () thick, cold-rolled steel sheet set into 0.032-inch-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.

1.16 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

1.17 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:
   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 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 from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
         1) Two anchors per jamb up to 60 inches high.
         2) Three anchors per jamb from 60 to 90 inches high.
         3) Four anchors per jamb from 90 to 120 inches high.
         4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
      b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
         1) Three anchors per jamb up to 60 inches high.
         2) Four anchors per jamb from 60 to 90 inches high.
         3) Five anchors per jamb from 90 to 96 inches high.
         4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
         5) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.
      c. Compression Type: Not less than two anchors in each jamb.
      d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches 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 nontemplated, 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.

1.18 STEEL FINISHES
A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
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

1.19 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.

1.20 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, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.
C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

1.21 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 postinstalled expansion anchors.

a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.


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 postinstalled 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 postinstalled 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, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch, 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 plus or minus 1/16 inch.
   b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
   c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.

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 o.c. and not more than 2 inches o.c. from each corner.

1.22 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
SECTION 081416
FLUSH WOOD DOORS

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 this Section.

1.2 SUMMARY
A. Section Includes:
1. Solid-core doors with wood-veneer, plastic-laminate faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

1.3 SUBMITTALS
A. Product Data: For each type of door indicated. Include details of core and edge construction, louvers, and trim for openings. Include factory-finishing specifications.
B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.
5. Indicate fire-protection ratings for fire-rated doors.
C. Samples for Initial Selection: For plastic-laminate door faces factory-finished doors.
D. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE
A. Source Limitations: Obtain flush wood doors from single manufacturer.
1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.
2. Provide WI-Certified Compliance Certificate indicating that doors comply with requirements of grades specified.
C. Fire-Rated Wood Doors: Doors 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 or 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 above ambient after 30 minutes of standard fire-test exposure.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Comply with requirements of referenced standard and manufacturer's written instructions.
B. Package doors individually in plastic bags or cardboard cartons.
C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS
A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
B. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet
work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between
60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction
period.

1.7 WARRANTY
A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors
that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
      b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
   2. Warranty shall also include installation and finishing that may be required due to repair or
      replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Algoma Hardwoods, Inc.
   2. Ampco, Inc.
   3. Eggers Industries.
   4. Graham; an Assa Abloy Group company.
   5. Marshfield Door Systems, Inc.
   6. Mohawk Flush Doors, Inc.; a Masonite company.
   7. VT Industries Inc.

2.2 DOOR CONSTRUCTION, GENERAL
A. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not
   contain urea formaldehyde.
B. WDMA I.S.1-A Performance Grade: Standard Duty.
C. Particleboard-Core Doors:
   1. Particleboard: ANSI A208.1, Grade LD-1.
   2. Particleboard: Straw-based particleboard complying with ANSI A208.1, Grade LD-2 or M-2, except
      for density.
   3. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-
      bolting hardware.
      a. 5-inch top-rail blocking, in doors indicated to have closers.
      b. 5-inch bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor
         plates.
      c. 5-inch midrail blocking, in doors indicated to have exit devices.
   4. Provide doors with either glued-wood-stave or structural-composite-lumber cores instead of
      particleboard cores for doors indicated to receive exit devices.
D. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fire-protection
   rating indicated.
   1. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile.
      Comply with specified requirements for exposed edges.
   2. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without
      formed-steel edges and astragals. Comply with specified requirements for exposed edges.
      a. Finish steel edges and astragals with baked enamel same color as doors.
      b. Finish steel edges and astragals to match door hardware (locksets or exit devices).
E. Mineral-Core Doors:
   1. Core: Noncombustible mineral product complying with requirements of referenced quality standard
      and testing and inspecting agency for fire-protection rating indicated.
   2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in
      doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
      a. 5-inch top-rail blocking.
      b. 5-inch bottom-rail blocking, in doors indicated to have protection plates.
      c. 5-inch midrail blocking, in doors indicated to have armor plates.
      d. 4-1/2-by-10-inch lock blocks, in doors indicated to have exit devices.
   3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-
holding capability and split resistance. Comply with specified requirements for exposed edges.

F. Lead Sheet: FS QQ-L-201.

2.3 PLASTIC-LAMINATE-FACED DOORS

A. Interior Solid-Core Doors:
   1. Grade: Custom.
   2. Plastic-Laminate Faces: High-pressure decorative laminates complying with NEMA LD 3, Grade HGS.
   3. Colors, Patterns, and Finishes: As indicated.
   4. Exposed Vertical and Top Edges: Hardwood edges for staining to match faces.
   5. Core: Particleboard.
   6. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before faces and crossbands are applied. Faces are bonded to core using a hot press.

2.4 LIGHT FRAMES

A. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch thick, cold-rolled steel sheet; factory primed for paint finish; and approved for use in doors of fire-protection rating indicated.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
   1. Comply with requirements in NFPA 80 for fire-rated doors.
B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
   1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
   2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
C. Openings: Cut and trim openings through doors in factory.
   1. Light Openings: Trim openings with moldings of material and profile indicated.
   2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Division 08 Section "Glazing."
D. Lead-Lined Doors:
   2. Core: Formed particleboard, bonded to stiles and rails.
   3. Lead Sheet: Bonded or secured with lead covered bolts to each side of core or centered in divided core.
      a. Maximum combined lead thickness: Match thickness of lead in adjacent lead lined walls.

2.6 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
   1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
B. Finish doors at factory.
C. Finish doors at factory that are indicated to receive transparent finish. Field finish doors indicated to receive opaque finish.
D. Finish doors at factory where indicated in schedules or on Drawings as factory finished.
E. Transparent Finish:
   1. Grade: Custom.
   2. Finish: AWI system.
   3. Staining: As selected by Architect from manufacturer's full range.
   4. Effect: Open-grain finish.
   5. Sheen: Satin.
F. Opaque Finish:
   1. Grade: Custom.
   2. Finish: AWI catalyzed polyurethane system.
3. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine doors and installed door frames before hanging doors.
   1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
   2. Reject doors with defects.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION
A. Hardware: For installation, see Division 08 Section "Door Hardware."
B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
   1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING
A. Operation: Re-hang or replace doors that do not swing or operate freely.
B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION
SECTION 087100
DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes: Provide all items of finish hardware required to adequately trim, hang, and operate all doors, as is hereinafter 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.

1.2 REFERENCES
A. The following reference standards and model code documents shall be used in estimating and detailing door hardware, and shall considered as a standard of quality, function, and performance, as applicable:
   2. NFPA-80 Fire Doors & Windows (current year adopted).
   4. NFPA-105 Smoke Control Door Assembly. (current year adopted)
   5. ANSI-117.11992 Edition Providing Accessibility and Usability for
   7. T.A.S. Texas Accessibility Standards.

1.3 ACTION 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. Complete designations of every item required for each door or opening including name and manufacturer.
      c. Fastenings and other pertinent information.
      d. 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.
      e. Explanation of abbreviations, symbols, and codes contained in schedule.
      f. Mounting locations for door hardware.
      g. Door and frame sizes and materials.
h. 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.

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.

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.

1.4 CLOSEOUT SUBMITTALS

A. 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.

1.5 QUALITY ASSURANCE

A. 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.

B. 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.

C. 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, masterkeying, 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.
D. 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.

E. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

F. Regulatory Requirements: Comply with provisions of the following:

G. 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.

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. 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.

1.6 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.

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.

1.7 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.

1.8 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.
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. 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.
   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. Standard warranty shall be for the life of opening.
      2. Acceptable Manufacturers:
         a. Ives*
         b. Select.
         c. Pemko.
   C. Locks: All locks shall incorporate a seven pin 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 Owner. Locks shall be Grade 1 cylindrical as hereinafter listed in the Hardware Schedule.
      1. Acceptable Manufacturers:
         b. Existing projects: Schlage ND Series with RHO trim.
         c. Schlage Everest cylinder B123, B124, B125 as required by project).
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 combine key-in-lever design 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. Trilogy*
   b. No Substitutions.

F. Flush Bolts: Manual flush bolts to have 12-inch rods for doors 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 removable cores 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. Acceptable Manufacturers:
   a. Von Duprin*
   b. No Substitutions.

J. Exit Device (EL): 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 insure flexibility of control and management.
1. Acceptable Manufacturers:
   a. Related Section.

L. 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 wherever possible (i.e., room side of corridor doors,
etc.) with parallel arm mounting on out-swinging doors. Mount closers to jamb or on brackets and/or drop plates, where special conditions require.

1. Acceptable Manufacturers:
   a. LCN*
   b. No Substitutions.

M. 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.

N. 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.

O. 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.

P. Door Stops and Holders: Where a door strikes a wall at approximately 90 degrees, a suitable door stop shall be provided, either a wall bumper or floor stop. 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 061053. Provide reinforcing in frame and door for overhead stops.

1. Acceptable Manufacturers:
   a. Ives*
   b. Rockwood.
   c. Trimco.
   d. Glynn-Johnson*

Q. 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.
   c. Dorma.

R. 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.

S. 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
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, Owner, and hardware supplier. Key schedule shall be prepared and submitted to the Owner for approval. Copies of final key schedule with the bidding instructions shall be submitted as part of the Project Record Documents.

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.

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:

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. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

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."

3.4 FIELD QUALITY CONTROL

A. Perform final inspection with hardware installer and hardware supplier present to ensure correct installation and operation, and check for any damaged or defective items. Observe and inspect that all hardware has been installed to its correct destination in proper working order.

B. 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 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 Division 01 Section “Demonstration and Training.”

3.8 HARDWARE SCHEDULE

A. Manufacturer abbreviation list:
1. AL: Alarm Lock
2. IV: Ives
3. LC: LCN
4. MC: McKinney
5. Me: Medeco
6. PE: Pemko
7. SC: Schlage
8. TR: Trimco
9. VD: Von Duprin
10. ZE: Zero International

B. HDWR 01.1 IT Closet Hardware
1. (Access Control hardware, verify with Keif Dahlman, UT Southwestern Police)
2. 3 HINGES TA2714 4 1/2 X 4 1/2 626 MC
3. 1 ELECTRIFIED HINGE PROVIDED BY SECURITY CONTRACTOR
4. 1 ELECTRIFIED FAIL-SECURE LOCKSET WITH INTEGRATED REX (REQUEST TO EXIT) PROVIDED BY SECURITY CONTRACTOR
5. 1 CARD READER HID RP40 MULTICLASS SE PROVIDED BY SECURITY CONTRACTOR
6. 1" FLUSH-MOUNTED DOOR POSITION SWITCH
7. 1 CORE 7 PIN 80-036, EVEREST SMALL I.C. FORMAT, B124 KEYWAY + KEY BLANKS (2) PER DOOR SC.
8. 1 CLOSER 4041 (PARALLEL OR UNIVERSAL ARM AS REQUIRED TO MOUNT ON ROOM SIDE OF DOOR) 626 LCN
9. 1 FLOOR STOP W1211 TR
10. 1 HARNESS-THRU DOOR PROVIDED BY SECURITY CONTRACTOR
11. 1 CONTACT SWITCH PROVIDED BY SECURITY CONTRACTOR
12. 1 POWER SUPPLY PROVIDED BY SECURITY CONTRACTOR
13. 1 MORTAR GUARD PROVIDED BY SECURITY CONTRACTOR
14. 1 SMOKE GASKET 328 MILL ZE
15. Functional Description:
   a. Manual ingress by Reader plus lever trim
   b. Free manual Egress; Rx-switch to shunt alarm
   c. Fire alarm: No change to operation
      1) Loss of Power: Latch to remain engaged, maintaining security. Only means of entering is by Key in Trim

C. HDWR 01.2 Suite Entry Doors
1. (Access Control hardware, verify with Keif Dahlman, UT Southwestern Police)
2. 3 HINGES TA2714 4 1/2 X 4 1/2 626 MC
3. 1 ELECTRIFIED HINGE PROVIDED BY SECURITY CONTRACTOR
4. 1 ELECTRIFIED FAIL-SECURE LOCKSET WITH INTEGRATED REX (REQUEST TO EXIT) PROVIDED BY SECURITY CONTRACTOR
5. 1 CARD READER HID RP40 MULTICLASS SE PROVIDED BY SECURITY CONTRACTOR
6. 1" FLUSH-MOUNTED DOOR POSITION SWITCH
7. 1 CORE 7 PIN 80-036, EVEREST SMALL I.C. FORMAT, B124 KEYWAY + KEY BLANKS (2) PER DOOR SC.
8. 1 CLOSER 4041 (PARALLEL OR UNIVERSAL ARM AS REQUIRED TO MOUNT ON ROOM SIDE OF DOOR) 626 LCN
9. 1 WALL BUMPER 1270WX TR
10. 1 HARNESS-THRU DOOR PROVIDED BY SECURITY CONTRACTOR
11. 1 CONTACT SWITCH PROVIDED BY SECURITY CONTRACTOR
12. 1 POWER SUPPLY PROVIDED BY SECURITY CONTRACTOR
13. 1 MORTAR GUARD PROVIDED BY SECURITY CONTRACTOR
14. 1 SMOKE GASKET 328 MILL ZE
15. Functional Description:
   a. In by Card Reader or override by key
   b. Free egress by inside trip: LBM to shunt alarm

D. HDWR 02.1
1. 3 HINGES TA2714 4 1/2 X 4 1/2 626 MC
2. 1 Office Lockset ND92PD RHO 626 SC
3. 1 Core 7 pin 80-036, Everest small I.C. Format, B124 keyway + (2) key blanks / door SC
4. 1 Wall Bumper 1270WX TR (floor stop where wall stop not practical)
5. Head and jamb seals, S88D PE
6. 1 Automatic Door Bottom, 4801 PE

E. HDWR 02.2
1. 3 HINGES TA2714 4 1/2 X 4 1/2 626 MC
2. 1 Office Lockset ND92PD RHO 626 SC
3. 1 Core 7 pin 80-036, Everest small I.C. Format, B124 keyway + (2) key blanks / door SC
4. 1 Wall Bumper 1270WX TR (floor stop where wall stop not practical)
5. Head and jamb seals, S88D PE

F. HDWR 02.3
1. 3 HINGES TA2714 4 1/2 X 4 1/2 626 MC
2. 1 Office Lockset ND92PD RHO 626 SC
3. 1 Core 7 pin 80-036, Everest small I.C. Format, B124 keyway + (2) key blanks / door SC
4. 1 Closer 4041 (parallel or universal arm as required to mount on room side of door) 626 LCN
5. 1 Wall Bumper 1270WX TR (floor stop where wall stop not practical)
6. 1 SMOKE GASKET 328 MILL ZE if door is rated, 3 Door Silencers SR64 IV for non-rated doors

G. HDWR 03
1. 3 HINGES TA2714 4 1/2 X 4 1/2 626 MC
2. 1 Storeroom Lockset ND96PD RHO 626 SC
3. 1 Core 7 pin 80-036, Everest small I.C. Format, B124 keyway + (2) key blanks / door SC
4. 1 Closer 4041 (parallel or universal arm as required to mount on room side of door) 626 LCN
5. 1 Wall Bumper 1270WX TR (floor stop where wall stop not practical)
6. 1 SMOKE GASKET 328 MILL ZE if door is rated, 3 Door Silencers SR64 IV for non-rated doors

H. HDWR 04
1. 3 HINGES TA2714 4 1/2 X 4 1/2 626 MC
2. 1 Passage ND10S RHO 626 SC
3. 1 Wall Bumper 1270WX TR (floor stop where wall stop not practical)
4. Head and jamb seals, S88D PE
I. HDWR 05
1. 3 HINGES TA2714 4 1/2 X 4 1/2 626 MC
2. 1 Privacy Lock ND40S RHO 626 SC
3. 1 Closer 4041 (parallel or universal arm as required to mount on room side of door) 626 LCN
4. 1 Wall Bumper 1270WX TR (floor stop where wall stop not practical)
5. Head and jamb seals, S88D PE
6. 1 Kick Plate 8400 (10” x 34” LDW) 626 IV

J. HDWR 06
1. 1 Ladder Pull, 24”, CRL, EULP60032BS
2. 1 Side glass door system by CRL, US Aluminum, SRL 290/295, refer drawings for details

END OF SECTION
SECTION 088001
GLAZING - INTERIOR

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 this Section.

1.2 SUMMARY
A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
1. Windows.
2. Doors.
3. Interior storefront framing.
4. Glazed entrances.
5. Interior borrowed lites.

1.3 DEFINITIONS
A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
C. Interspace: Space between lites of an insulating-glass unit.

1.4 PERFORMANCE REQUIREMENTS
A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

1.5 PRECONSTRUCTION TESTING
A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
3. Test no fewer than [eight] [Insert number] Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.6 SUBMITTALS
A. Product Data: For each glass product and glazing material indicated.
B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
1. Wired glass.
2. Fire-resistive glazing products.
C. Glazing Accessory Samples: For sealants, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
F. Product Certificates: For glass and glazing products, from manufacturer.
1. within previous 36-month period.

G. Preconstruction adhesion and compatibility test report.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

E. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

F. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

G. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
   1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
   2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
   1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.

2.2 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
   1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
   2. For uncoated glass, comply with requirements for Condition A.
   3. For coated vision glass, comply with requirements for Condition C (other coated glass).

C. Polished Wired Glass: ASTM C 1036, Type II, Class 1 (clear), Form 1, Quality-Q6, complying with ANSI Z97.1, Class C.
1. Mesh: M1 (diamond).

2.3 FIRE-PROTECTION-RATED GLAZING
A. Fire-Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies.

B. Monolithic Ceramic Glazing: Clear, ceramic flat glass; 3/16-inch nominal thickness.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Nippon Electric Glass Co., Ltd. (distributed by Technical Glass Products); Premium FireLite
      b. Safi First; SuperLite C/P.
      c. Vetrotech Saint-Gobain; SGG Keralite FR-R.

C. Fire-Protection-Rated Tempered Glass: 1/4-inch thick, fire-protection-rated tempered glass, complying with testing requirements in 16 CFR 1201 for Category II materials.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Safi First; SuperLite20.
      b. Vetrotech Saint-Gobain; SSG Pyroswiss.

   1. Products: Subject to compliance with requirements, provide one of the following:

2.4 GLAZING GASKETS
A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
   1. Neoprene complying with ASTM C 864.
   2. EPDM complying with ASTM C 864.
   4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

2.5 GLAZING SEALANTS
A. General:
   1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
   2. Suitability: Comply with sealant and glass manufacturers’ written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
   3. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.
   4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Corning Corporation; 790.
      b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
      c. Pecora Corporation; 890.
      d. Tremco Incorporated; Spectrem 1.

C. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.

2.6 GLAZING TAPES
A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomer tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated, and complying with ASTM C 1281 and AAMA 800 for products indicated below:
   1. AAMA 804.3 tape, where indicated.
   2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
   3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.7 MISCELLANEOUS GLAZING MATERIALS
A. **General:** Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. **Cleaners, Primers, and Sealers:** Types recommended by sealant or gasket manufacturer.

C. **Setting Blocks:** Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. **Spacers:** Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. **Edge Blocks:** Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. **Cylindrical Glazing Sealant Backing:** ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

G. **Perimeter Insulation for Fire-Resistant Glazing:** Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

### 2.8 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

### 2.9 MONOLITHIC-GLASS TYPES

A. **Glass Type GL-1:** Heat Tempered float glass, Clear.
   1. Thickness: 1/4”
   2. Provide safety glazing labeling.

B. **Glass Type GL-2:** Fire Protection-Rated Tempered Glass.
   1. Thickness: 1/4”
   2. Provide safety glazing labeling.

C. **Glass Type GL-3:** Heat Tempered float glass, Clear.
   1. Thickness: 1/2”
   2. Provide safety glazing labeling.

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### PART 3 - EXECUTION

#### 3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
   2. Presence and functioning of weep systems.
   3. Minimum required face and edge clearances.
   4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

#### 3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project...
site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
G. Provide spacers for glass lites where length plus width is larger than 50 inches:
   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING
A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
E. Do not remove release paper from tape until right before each glazing unit is installed.
F. Apply heel bead of elastomeric sealant.
G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)
A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)
A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION
SECTION 092216
NON-STRUCTURAL METAL FRAMING

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 this Section.

1.2 SUMMARY
A. Section Includes:
   1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
   2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS
A. Evaluation Reports: For firestop tracks, from ICC-ES.

PART 2 - PRODUCTS

2.1 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 E 119 by an independent testing agency.
B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 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 C 754 for conditions indicated.
   1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
   1. Steel Studs and Runners:
      a. Depth: As indicated on Drawings.
      b. Minimum Base Metal Thickness: 20 gage unless indicated otherwise on Drawings.
      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: 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 gage studs.
      g. At partitions scheduled to receive tile backing panels or ceramic tile finish, provide minimum 20 gage 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) Dietrich Metal Framing; 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: 0.018 inch.

G. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch-wide flanges.
   1. Depth: As indicated on Drawings.
   2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
   1. Minimum Base-Metal Thickness: 0.018 inch.
   2. Depth: 7/8 inch.

I. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.

J. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.
   1. Depth: 3/4 inch.
   2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch.
   3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-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 E 488 by an independent testing agency.
      a. Type: Postinstalled, 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 E 1190 by an independent testing agency.

C. Wire Hangers: ASTM A 641, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch-wide flanges.
   1. Depth: 1-1/2 inches.

E. Furring Channels (Furring Members):
   1. Cold-Rolled Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
      a. Minimum Base-Metal Thickness: 0.018 inch
   3. Resilient Furring Channels: 1/2-inch-deep members designed to reduce sound transmission.

F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, 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:
      b. Chicago Metallic Corporation; Drywall Grid System.
      c. USG Corporation; Drywall Suspension System.

2.4 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 thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
B. Coordination with Sprayed Fire-Resistive Materials:
1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling 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 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 C 754.
1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 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 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 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 o.c.
F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch 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 o.c.
   3. Furring Channels (Furring Members): 16 inches o.c.
B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
C. Suspend hangers from building structure as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
      a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
      a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
   3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
   4. 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 measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION
SECTION 092900
GYPSUM BOARD

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 this Section.

1.2 SUMMARY
A. Section Includes:
   1. Interior gypsum board.
   2. Tile backing panels.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Samples: For the following products:
   1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.

1.4 QUALITY ASSURANCE
A. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. 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.

1.5 DELIVERY, STORAGE AND HANDLING
A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.6 FIELD CONDITIONS
A. Environmental Limitations: Comply with ASTM C 840 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 E 119 by an independent testing agency.
B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL
A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that
correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Gypsum.
2. CertainTeed Corp.
3. Georgia-Pacific Gypsum LLC.
5. Temple-Inland.
6. USG Corporation.

B. Gypsum Board, Type X: ASTM C 1396.
1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

C. Flexible Gypsum Board: ASTM C 1396. 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.
2. Long Edges: Tapered.

D. Gypsum Ceiling Board: ASTM C 1396.
1. Thickness: 1/2 inch.
2. Long Edges: Tapered.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.
4. Locations: All corridors, dock and service corridors.

F. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396. With moisture- and mold-resistant core and paper surfaces.
1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.
4. Locations: Restrooms, janitor closets, other locations where water exposure is probable.

2.4 SPECIALTY GYPSUM BOARD

A. Gypsum Board, Type C: ASTM C 1396. 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. Temple-Inland; Type TG-C.
   f. USG Corporation; Firecode C Core.
2. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.

B. Mold Resistant Glass-Mat Interior Gypsum Board: ASTM C 1658. 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, Type X.

2.5 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corp.; GlasRoc Tile Backer.
   b. Georgia-Pacific Gypsum LLC; DensShield Tile Backer.
2. Core: 5/8 inch, Type X.

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.
1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.

2. Shapes:
   a. Cornerbead.
   b. Bullnose bead.
   c. LC-Bead: J-shaped; exposed long flange receives joint compound.
   d. L-Bead: L-shaped; exposed long flange receives joint compound.
   e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
   f. Expansion (control) joint.
   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 B 221, Alloy 6063-T5.
   3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.7 JOINT TREATMENT MATERIALS
A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:
   1. Interior Gypsum Board: Paper.
   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. Prefilling: At open joints, rounded or bevelled 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. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.8 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 C 1002, unless otherwise indicated.
   1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
   2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
   1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to
ASTM E 90.

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.
   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).

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 C 840.
B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch 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. 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- 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- 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 C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
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.
   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 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-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 o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

3.4 APPLYING TILE BACKING PANELS
A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at showers, tubs, and where indicated. Install with 1/4-inch gap where panels abut other construction or penetrations.
B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 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 C 840 and in specific locations approved by Architect for visual effect.
C. Interior Trim: Install in the following locations:
   1. Cornerbead: Use at outside corners unless otherwise indicated.
   2. 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.

3.6 FINISHING GYPSUM BOARD
A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   2. Level 2: Panels that are substrate for tile Panels that are substrate for acoustical tile Where indicated on Drawings.
   3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
      a. Primer and its application to surfaces are specified in other Division 09 Sections.
   4. Level 5: 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.

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION
SECTION 093000
TILING

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 this Section.

1.2 SUMMARY
A. Section Includes:
1. Ceramic tile.
2. Stone thresholds.
3. Waterproof membrane.
5. Metal edge strips.

1.3 DEFINITIONS
A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
C. Module Size: Actual tile size plus joint width indicated.
D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PERFORMANCE REQUIREMENTS
A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
1. Level Surfaces: Minimum 0.60.
2. Step Treads: Minimum 0.60.
3. Ramp Surfaces: Minimum 0.80.

1.5 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
C. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.
D. Product Certificates: For each type of product, signed by product manufacturer.
E. Material Test Reports: For each tile-setting and -grouting product[ and special purpose tile].

1.6 QUALITY ASSURANCE
A. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.
1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.
C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
1. Stone thresholds.
2. Waterproof membrane.
3. Crack isolation membrane.
4. Joint sealants.
5. Metal edge strips.
D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockup of each type of floor and wall tile installation.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
D. Store liquid materials in unopened containers and protected from freezing.
E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT CONDITIONS
A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.9 EXTRA MATERIALS
A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL
A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
1. Provide tile complying with Standard grade requirements unless otherwise indicated.
B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.
C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.
E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.2 TILE PRODUCTS
A. Refer to Finish Legend.

2.3 THRESHOLDS
A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.
B. Marble Thresholds: ASTM C 503, with a minimum abrasion resistance of 10 per ASTM C 1353 or ASTM C 241 and with honed finish.
1. Description: Uniform, fine- to medium-grained white stone with gray veining.
2. Description: Match Architect's sample.

2.4 WATERPROOF MEMBRANE
A. General: Manufacturer’s standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
B. Chlorinated Polyethylene Sheet: Non-plasticized, chlorinated polyethylene faced on both sides with non-woven polyester fabric; 0.030-inch nominal thickness.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Noble Company (The); Nobleseal TS.

2.5 CRACK ISOLATION MEMBRANE
A. General: Manufacturer’s standard product, selected from the following, that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch nominal thickness.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Noble Company (The); Nobleseal CIS.

2.6 SETTING MATERIALS
   1. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 2 by 2 inches by 0.062-inch diameter; comply with ASTM A 185 and ASTM A 82 except for minimum wire size.
   2. Latex Additive: Manufacturer’s standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Bonsal American; an Oldcastle company.
      b. Custom Building Products.
      c. Laticrete International, Inc.
      d. MAPEI Corporation.
   2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
   3. Provide prepackaged, dry-mortar mix combined with [acrylic resin] [or] [styrene-butadiene-rubber] liquid-latex additive at Project site.
   4. For wall applications, provide mortar that complies with requirements for non-sagging mortar in addition to the other requirements in ANSI A118.4.

2.7 GROUT MATERIALS
A. Polymer-Modified Tile Grout: ANSI A118.7.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Bonsal American; an Oldcastle company.
      b. Bostik, Inc.
      c. Custom Building Products.
      d. Laticrete International, Inc.
      e. MAPEI Corporation.
   2. Polymer Type: Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.
B. Water-Cleanable Epoxy Grout: ANSI A118.3.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Bonsal American; an Oldcastle company.
      b. Bostik, Inc.
      c. Custom Building Products.
      d. Laticrete International, Inc.
      e. MAPEI Corporation.
      f. Mer-Kote Products, Inc.

2.8 ELASTOMERIC SEALANTS
A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Division 07 Section "Joint Sealants."
1. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Refer to Section 079500 for specific acceptable sealants.

2.9 MISCELLANEOUS MATERIALS
A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
D. Grout Sealer (for use on cementitious grout): Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Bonsal American; an Oldcastle company; Grout Sealer.
   b. Custom Building Products; Grout and Tile Sealer.
   c. MAPEI Corporation; KER 003, Silicone Spray Sealer for Cementitious Tile Grout.

2.10 MIXING MORTARS AND GROUT
A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
B. Add materials, water, and additives in accurate proportions.
C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
   a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
   b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.
C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 TILE INSTALLATION
A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile
installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
   a. Exterior tile floors.
   b. Tile floors in wet areas.
   c. Tile floors composed of tiles 8 by 8 inches or larger.
   d. Tile floors composed of rib-backed tiles.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
   1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
   2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
   3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

E. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
   2. Quarry Tile: 1/4 inch.

F. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

G. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
   1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
   2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

H. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

I. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

J. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.

B. Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.5 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.

B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

3.6 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
   1. Remove latex-portland cement grout residue from tile as soon as possible.
   2. Clean grout smears and haze from tile according to tile and grout manufacturer's written
3. Instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

B. Protect installed tile work with Kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.7 INTERIOR TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. Tile Installation F113: Thin-set mortar; TCA F113.
   b. Grout: Water-cleanable epoxy grout.

2. Tile Installation F115: Thin-set mortar; epoxy grout; TCA F115.
   b. Grout: Water-cleanable epoxy grout.

3. Tile Installation F121: Cement mortar bed (thickset) on waterproof membrane; TCA F121 and [ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C].
   b. Grout: Water-cleanable epoxy grout.

   b. Grout: Water-cleanable epoxy grout.

5. Tile Installation F125A: Thin-set mortar on crack isolation membrane; TCA F125A.
   b. Grout: Water-cleanable epoxy grout.

B. Interior Wall Installations, on Studs or Furring:

   b. Grout: [Polymer-modified sanded Polymer-modified unsanded grout.] [Water-cleanable epoxy grout.]

2. Tile Installation W245: Thin-set mortar on coated glass-mat, water-resistant gypsum backer board; TCA W245.
   b. Grout: [Polymer-modified sanded Polymer-modified unsanded] [Water-cleanable epoxy grout.]

C. Bathtub Wall Installations, Wood Metal Studs or Furring:

1. Tile Installation B419: Thin-set mortar on coated glass-mat, water-resistant backer board; TCA B419.
   b. Grout: [Polymer-modified sanded Polymer-modified unsanded] [Water-cleanable epoxy grout.]

D. Shower Receptor and Wall Installations, Concrete or Masonry:

1. Tile Installation B414: Cement mortar bed (thickset); TCA B414 and ANSI A108.1B.
   b. Grout: Water-cleanable epoxy grout.

   b. Grout: Water-cleanable epoxy grout.

E. Shower Receptor and Wall Installations, Metal Studs or Furring:

1. Tile Installation B420: Thin-set mortar on coated glass-mat, water-resistant backer board; TCA B420.
   b. Grout: Water-cleanable epoxy grout.

END OF SECTION
SECTION 095113
ACOUSTICAL PANEL CEILINGS

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 this Section.

1.2 SUMMARY
A. This Section includes acoustical panels and exposed suspension systems for ceilings.
B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.3 DEFINITIONS
A. AC: Articulation Class.
B. CAC: Ceiling Attenuation Class.
C. LR: Light Reflectance coefficient.
D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS
A. Product Data: For each type of product indicated.
B. 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.
   2. Method of attaching hangers to building structure.
      a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
   3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
   4. Minimum Drawing Scale: 1/4 inch = 1 foot
C. Samples for Initial Selection: For components with factory-applied color finishes.
D. Maintenance Data: For finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE
A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.
B. Source Limitations:
   1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
   2. Suspension System: Obtain each type through one source from a single manufacturer.
C. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.
D. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
   1. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
      a. Smoke-Developed Index: 450 or less.
E. 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.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination,
and other causes.
B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS
A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.8 COORDINATION
A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.9 EXTRA MATERIALS
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. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.
3. Hold-Down Clips: Equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL
A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.
B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
C. [Broad Spectrum Anti-microbial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard anti-microbial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.]

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING
A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
B. Products: Subject to compliance with requirements, provide one of the following:
1. Armstrong World Industries, Inc.
2. BPB USA.
3. Chicago Metallic Corporation.
4. USG Interiors, Inc.
C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on the Finish Legend or a comparable product by one of the above.

2.3 METAL SUSPENSION SYSTEMS, GENERAL
A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal
Products* for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: 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 five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
   a. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 for Class SC 1 service condition.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching 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 E 1190, conducted by a qualified testing and inspecting agency.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641, Class 1 zinc coating, soft temper.
2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.

E. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.

F. [Clean-Room Gasket System: Where indicated, provide manufacturer's standard system, including manufacturer's standard] [closed-cell PVC] [neoprene] [antimicrobial] gasket and related adhesives, tapes, seals, and retention clips, designed to seal out foreign material from and maintain positive pressure in clean room.]

2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

B. Products: Subject to compliance with requirements, provide one of the following:

1. Armstrong World Industries, Inc.
2. BPB USA.
3. Chicago Metallic Corporation.
4. USG Interiors, Inc.

C. Wide-Face, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation, with finished 15/16-inch-wide metal caps on flanges.

2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
3. Face Design: Flat, flush.

D. [Aluminum Grid: For use in MRI rooms.]

2.5 METAL EDGE MOLDINGS AND TRIM

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

B. Products: Subject to compliance with requirements, provide one of the following:

1. Armstrong World Industries, Inc.
2. BPB USA.
3. Chicago Metallic Corporation.
4. Fry Reglet Corporation.
5. Gordon, Inc.
6. USG Interiors, Inc.

C. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
2. For lay-in panels with reveal edge details, provide [stepped edge molding that forms reveal of same
depth and width as that formed between edge of panel and flange at exposed suspension member.

3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

D. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:

1. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B 221 for Alloy and Temper 6063-T5.

2. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.

   a. Organic Coating: Thermosetting, primer/topcoat system with a minimum dry film thickness of 0.8 to 1.2 mils.

2.6 ACOUSTICAL SEALANT

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

B. Products: Subject to compliance with requirements, provide one of the following:

1. Acoustical Sealant for Exposed and Concealed Joints:
   a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
   b. USG Corporation; SHEETROCK Acoustical Sealant.

C. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard non-sag, paintable, non-staining latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

D. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, non-hardening, non-skimming, non-staining, gunnable, synthetic-rubber sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), recommended for sealing interior concealed joints to reduce airborne sound transmission.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

3. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.

5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.

8. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.

9. Do not attach hangers to steel deck tabs.

10. Do not attach hangers to steel roof deck. Attach hangers to structural members.

11. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.

12. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.

3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange directionally patterned acoustical panels as follows:
   a. As indicated on reflected ceiling plans.
   b. Install panels with pattern running in one direction parallel to [long] [short] axis of space.
   c. Install panels in a basket-weave pattern.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.

3. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.

4. For reveal-edged panels on suspension system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.

5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

6. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.

7. Install clean-room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.

8. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 CLEANING
A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION
SECTION 096513
RESILIENT BASE 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 this Section.

1.2 SUMMARY
A. Section Includes:
   1. Resilient base.
   2. Resilient stair accessories.
   3. Resilient molding accessories.

1.3 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Samples for Initial Selection: For each type of product indicated.
C. Product Schedule: For resilient products. Use same designations indicated on Drawings.

1.4 QUALITY ASSURANCE
A. Mockups: Provide resilient products with mockups specified in other Sections.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 PROJECT CONDITIONS
A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:
   1. 48 hours before installation.
   2. During installation.
   3. 48 hours after installation.
B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
C. Install resilient products after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS
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 not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE
A. Resilient Base:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allstate Rubber Corp.; Stoler Industries.
      b. Armstrong World Industries, Inc.
      c. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
      d. Johnsonite.
      e. Musson, R. C. Rubber Co.
      f. Roppe Corporation, USA.
      g. VPI, LLC; Floor Products Division.
   1. Material Requirement: Type TS (rubber, vulcanized thermoset).
   C. Minimum Thickness: 0.125 inch.
   D. Height: 4 inches typically; 6 inches where indicated.
   E. Lengths: Coils in manufacturer's standard length.
   F. Outside Corners: Job formed.
   G. Inside Corners: Job formed.
   H. Finish: Satin.
   I. Colors and Patterns: Refer to Finish Legend.

2.2 RESILIENT MOLDING ACCESSORY
A. Resilient Molding Accessory:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
      b. Flexco, Inc.
      c. Johnsonite.
      d. R.C.A. Rubber Company (The).
      e. Roppe Corporation, USA.
      f. VPI, LLC; Floor Products Division.
   B. Description: Carpet edge for glue-down applications Nosing for resilient floor covering; Reducer strip for resilient floor covering; Joiner for tile and carpet; Transition strips.
   C. Material: Rubber.
   D. Profile and Dimensions: As indicated.
   E. Colors and Patterns: Refer to Finish Legend.

2.3 INSTALLATION MATERIALS
A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
   1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
      a. Cove Base Adhesives: Not more than 50 g/L.
      b. Rubber Floor Adhesives: Not more than 60 g/L.
   C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

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.
B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
C. Do not install resilient products until they are same temperature as the space where they are to be installed.
   1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
   D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION
A. Comply with manufacturer's written instructions for installing resilient base.
B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other
permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Job-Formed Corners:
   1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
   2. Inside Corners: Use straight pieces of maximum lengths possible.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Stair Accessories:
   1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
   2. Tightly adhere to substrates throughout length of each piece.
   3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet and resilient floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:
   1. Remove adhesive and other blemishes from exposed surfaces.
   2. Sweep and vacuum surfaces thoroughly.
   3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.
   1. Apply two coat(s).

E. Cover resilient products until Substantial Completion.

END OF SECTION
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 this Section.

1.2 SUMMARY
A. Section Includes:
   1. Broadloom carpet.

1.3 ACTION SUBMITTALS
A. Product Data: For the following, including installation recommendations for each type of substrate:
   1. Carpet: For each type indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
   2. Carpet Cushion: For each type indicated. Include manufacturer's written data on physical characteristics and durability.
B. Shop Drawings: Show the following:
   1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
   2. Carpet type, color, and dye lot.
   3. Locations where dye lot changes occur.
   4. Seam locations, types, and methods.
   5. Type of subfloor.
   6. Type of installation.
   7. Pattern type, repeat size, location, direction, and starting point.
   8. Pile direction.
   9. Type, color, and location of insets and borders.
   10. Type, color, and location of edge, transition, and other accessory strips.
   11. Transition details to other flooring materials.
   12. Type of carpet cushion.
C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
   1. Carpet: 12-inch- square Sample.
   2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch long Samples.
D. Product Schedule: For carpet and carpet cushion. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS
A. Product Test Reports: For carpet, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS
A. Maintenance Data: For carpet to include in maintenance manuals. Include the following:
   1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
   2. Precautions for cleaning materials and methods that could be detrimental to carpet and carpet cushion.

1.6 QUALITY ASSURANCE
A. Installer Qualifications: An experienced Installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.
B. Fire-Test-Response Ratings: Where indicated, provide carpet[ and carpet cushion] identical to those of assemblies tested for fire response per NFPA 253 by a qualified testing agency.
C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockups at locations and in sizes shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Comply with CRI 104.

1.8 FIELD CONDITIONS
A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
B. Environmental Limitations: Do not deliver or install carpet and carpet cushion until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
C. Do not install carpet over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.
D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

1.9 WARRANTY
A. Special Warranty for Carpet: Manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.
1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, excess static discharge, and delamination.
3. Warranty Period: 10 years from date of Substantial Completion.
B. Special Warranty for Carpet Cushion: Manufacturer agrees to repair or replace components of carpet cushion installation that fail in materials or workmanship within specified warranty period.
1. Warranty includes consequent removal and replacement of carpet and accessories.
2. Warranty does not include deterioration or failure of carpet cushion due to unusual traffic, failure of substrate, vandalism, or abuse.
3. Failure includes, but is not limited to, permanent indentation or compression.
4. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET
A. Products: Subject to compliance with requirements, provide one of the following:
1. Refer to Finish Legend.
2. Color: Refer to Finish Legend.
B. Provide product with manufacturer’s standard anti-microbial treatment.

2.2 INSTALLATION ACCESSORIES
A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet cushion manufacturer.
B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet and carpet cushion manufacturers.
1. Use adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use adhesives that comply with the product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
C. Seam Adhesive: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.
D. Metal Edge/Transition Strips: Refer to Section 096513.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet cushion manufacturer.

2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet.

3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI 104, Section 7.3, "Site Conditions; Floor Preparation," and with carpet manufacturer's written installation instructions for preparing substrates.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet cushion manufacturer.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

3.3 INSTALLATION

A. Comply with CRI 104 and carpet manufacturer's written installation instructions for the following:

1. Direct-Glue-Down Installation: Comply with CRI 104, Section 9, "Direct Glue-Down Installation."

B. Comply with carpet manufacturer's written recommendations and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.

C. Do not bridge building expansion joints with carpet.

D. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.

E. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

G. Install pattern parallel to walls and borders to comply with CRI 104, Section 15, "Patterned Carpet Installations" and with carpet manufacturer's written recommendations.

H. Comply with carpet cushion manufacturer's written recommendations.

3.4 CLEANING AND PROTECTING

A. Perform the following operations immediately after installing carpet:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.

2. Remove yarns that protrude from carpet surface.


B. Protect installed carpet to comply with CRI 104, Section 16, "Protecting Indoor Installations."

C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer and carpet cushion manufacturer and carpet cushion and adhesive manufacturers.
SECTION 098116
ACOUSTICAL BLANKET INSULATION

PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes the following:
   1. Concealed building insulation.
B. Related Sections include the following:
   1. Division 09 Sections "Gypsum Board Assemblies" for installation in metal-framed assemblies of insulation specified by reference to this Section.

1.2 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE
A. Source Limitations: Obtain each type of building insulation through one source.
B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1.4 DELIVERY, STORAGE, AND HANDLING
A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Glass-Fiber Insulation:
      a. CertainTeed Corporation.
      c. Owens Corning.
   2. Slag-Wool-/Rock-Wool-Fiber Insulation:
      a. Fibrex Insulations Inc.
      b. Owens Corning.
      c. Thermafiber.

2.2 INSULATING MATERIALS
A. General: Provide insulating materials that comply with requirements and with referenced standards.
   1. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thicknesses, widths, and lengths.
B. Unfaced Mineral-Fiber Blanket Insulation (in walls): ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
C. Unfaced, Flexible Glass-Fiber Board Insulation (above ceilings): ASTM C 612, Type IA; ASTM C 553, Types I, II, and III; or ASTM C 665, Type I; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; and of the following properties:
   1. Nominal density of 1.0 lb/cu. ft. thermal resistivity of 3.7 deg F x h x sq. ft./Btu x in. at 75 deg F.
   2. Nominal density of not less than 1.5 lb/cu. ft. nor more than 1.7 lb/cu., thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F.
PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL
A. Comply with insulation manufacturer’s written instructions applicable to products and application indicated.
B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice and snow.
C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
D. Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF GENERAL BUILDING INSULATION
A. Install mineral-fiber blankets in cavities formed by framing members according to the following requirements:
   1. Use blanket widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
   2. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3.5 PROTECTION
A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION
SECTION 099001
INTERIOR PAINTING

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 this Section.

1.2 SUMMARY
A. This Section includes surface preparation and the application of paint systems to various interior substrates.

1.3 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Samples for Initial Selection: For each type of topcoat product indicated.
C. 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.

1.4 QUALITY ASSURANCE
A. MPI Standards:
   1. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.
B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
      a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft..
      b. Other Items: Architect will designate items or areas required.
   2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
   3. Final approval of color selections will be based on benchmark samples.
      a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
   1. Maintain containers in clean condition, free of foreign materials and residue.
   2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS
A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS
A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
   1. Quantity: Furnish an additional 5 percent, but not less than 1 gallon of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Benjamin Moore & Co.
2. ICI Paints.
4. PPG Architectural Finishes, Inc.
5. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL
A. Material Compatibility:
1. Provide materials for use within each paint 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 paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
4. Floor Coatings: VOC not more than 100 g/L.
5. Shellacs, Clear: VOC not more than 730 g/L.
6. Shellacs, Pigmented: VOC not more than 550 g/L.
7. Flat Topcoat Paints: VOC content of not more than 50 g/L.
8. Nonflat Topcoat Paints: VOC content of not more than 150 g/L.
9. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
10. Floor Coatings: VOC not more than 100 g/L.
11. Shellacs, Clear: VOC not more than 730 g/L.
12. Shellacs, Pigmented: VOC not more than 550 g/L.
13. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
14. Dry-Fog Coatings: VOC content of not more than 400 g/L.
15. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 340 g/L.
16. Pre-Treatment Wash Primers: VOC content of not more than 420 g/L.

C. Colors: As selected by Architect from manufacturer's full range.
D. Provide all products with manufacturer’s standard anti-microbial treatment.

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 work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Masonry (Clay and CMU): 12 percent.
2. Wood: 15 percent.
3. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION
A. Comply with manufacturer’s written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

G. Wood Substrates:
   1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
   2. Sand surfaces that will be exposed to view, and dust off.
   3. Prime edges, ends, faces, undersides, and backsides of wood.
   4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

H. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.
   1. Use applicators and techniques suited for paint and substrate indicated.
   2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
   3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
   1. Mechanical Work:
      a. Uninsulated metal piping.
      b. Uninsulated plastic piping.
      c. Pipe hangers and supports.
      d. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
      e. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
      f. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
   2. Electrical Work:
      a. Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.
Utilize Harmony in patient care areas; Pro Green 200 in all others.

3.5 INTERIOR PAINTING SCHEDULE

1. Wood - Painted Eggshell
   a. One coat Sand-N-Go Waterborne Wood Primer, 1.3 mils DFT.
   b. Two coats Pro-Classic Waterborne Acrylic Semi-gloss, 1.4 mils DFT/coat.

2. Wood - Clear
   a. Two coats Wood Classics Waterborne Polyurethane Varnish, 1.0 DFT/coat.

3. Wood - Semi-Transparent - Stained
   a. One coat Minwax Wood Finish.
   b. Two coats Wood Classics Waterborne Polyurethane Varnish, 1.0 DFT/coat.

4. Gypsum Board - Flat
   a. One coat texture as approved by Architect.
   b. One coat [ProGreen] [Harmony] Primer, 1.3 mils DFT.
   c. Two coats [ProGreen 200] [Harmony], Latex Flat, 1.7 mils DFT/coat.

5. Gypsum Board - Eggshell
   a. One coat texture as approved by Architect.
   b. One coat [ProGreen] [Harmony] Primer, 1.3 mils DFT.
   c. Two coats [ProGreen 200] [Harmony], Latex Eggshell, 1.4 mils DFT/coat.

6. Gypsum Board - Semi-gloss
   a. One coat texture as approved by Architect.
   b. One coat [ProGreen Primer] [Harmony], 1.3 mils DFT.
   c. Two coats [ProGreen 200] [Harmony], Latex Semi-Gloss, 1.4 mils DFT/coat.

7. Ferrous Metal Items - Eggshell (including hollow metal doors, frames, access doors/frames, handrails, etc):
   a. One coat Pro-Cryl Universal Water Based Primer, 2-4 mils DFT.
   b. Two coats Pro-Classic Waterborne Acrylic Semi-Gloss Enamel, 1.4 mils DFT/coat.

8. Concrete Masonry Units:
   a. Primer: Heavy Duty Block Filler, 10 mils DFT.
   b. Second Coat: [ProGreen 200] [Harmony] Latex Semi-Gloss, 1.3 mils DFT.
   c. Third Coat: Same as second coat.

9. Miscellaneous Items Exposed to View and Not Otherwise Scheduled: Finish with compatible paint to match adjacent surface finish and color.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Related Documents: Provisions established in Conditions of the Contract, Division 01 - General Requirements, and the Drawings are collectively applicable to this Section.
B. Section Includes
1. Identifying devices where shown on the Drawings complete and as specified including the following:
   a. Pin mounted building identification signs.
   b. Interior code required signs.
2. Coordinate installation of signage with Owner.

1.2 SUBMITTALS
A. Product Data: Include manufacturer’s construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.
B. Shop Drawings: Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, accessories, layout, and installation details.
C. Samples for Verification:
   1. Physical: Submit samples of one competed sign for review and approval. Approved sample may be incorporated into Project.
   2. Color: Submit manufacturer's standard color selection chart. Do not proceed until colors have been selected.

1.3 QUALITY ASSURANCE
A. Single-Source Responsibility: For each separate type of sign required, obtain signs from one source from a single manufacturer.
B. Manufacturer shall have a minimum of five years experience in the manufacturing of signs specified.
C. Codes and Standards:
   1. Panel signs shall have 1/32-inch raised copy and grade 2 Braille, and shall comply with all existing federal, state, and local accessibility standards.
   3. Comply with the State of Texas Accessibility Act as administered by the Texas Department of Licensing and Regulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Acceptable Manufacturers: Subject to compliance with requirements herein, provide products from one of the following:
   4. ASI Signs, Dallas, Texas.
B. Substitutions: Under provisions of Section 012500.

2.2 ROOM SIGNAGE SYSTEMS
A. Acceptable Manufacturers:
   1. ASI Sign Systems, 3890 W. Northwest Highway, Suite 102, Dallas, TX 75220; (214) 352 9140 telephone; (214) 352 9741 facsimile; (800) ASI-SPEC [274-7446]
   2. Substitutions: Submit in accordance with Section 01600.
B. Acceptable Product: ASI Unframed SP Series Signs with requirements indicated for materials, thickness, finish colors, designs, shapes, sizes and details.
C. Sign Face: Clear acrylic, 0.080 inch thick, matte first surface.
D. **Tactile Graphics and Text:**
   1. Fabrication: Provide tactile copy and grade 2 Braille raised 1/32 inch minimum from plaque first surface by manufacturer’s stratification process as follows:
      a. ASI Intouch™, photo-mechanical method.
   2. Provide lettering and graphics precisely formed, uniformly opaque to comply with relevant ADA regulations and requirements indicated for size, style, spacing, content, position, and colors.

E. **Non-Tactile Graphics and Text:**
   1. Fabrication options:
   2. Text or graphic technique:
      a. Screen process using subsurface method.
   3. Provide lettering and graphics precisely formed, uniformly opaque, and consistent in size, style, spacing, content, position, and colors.

F. Overall panel size: Refer to Drawings.

G. Panel colors: As selected by Architect.

H. Text or graphic colors: As selected by Architect.

I. Letter styles, colors, letter sizes and layout position: As selected by Architect.

J. Installation Method: System SA, silicone adhesive

**PART 3 - EXECUTION**

3.1 **DELIVERY AND STORAGE**
   A. Deliver and store identifying devices in protective wrappings until ready for installation. Install letters in protective wrappings and remove wrappings just prior to substantial completion.

3.2 **INSTALLATION**
   A. Install signs plumb, level and square and in proper planes with other work, at heights required by accessibility codes and standards.
   B. Anchor each plastic laminate sign with adhesive.
   C. Install signs with sufficient amount of foam tape for proper installation.
   D. Attach as recommended by sign manufacturer.
   E. Anchor each sign with adhesive.
   F. Coordinate arrival and installation of graphic signs with hardware installation. Graphic signs function as and are coordinated with the hardware as shown on the Drawings.
   G. Room name signs shall be placed on the public side of the door except where noted otherwise.
   H. Single Door Sign: Provide one sign as specified above, mounted to wall adjacent to door on knob side.
   I. Pair of Doors: Provide one sign as specified above, mounted to adjacent wall closest to active leaf of door. Do not install sign where it will be obstructed by door when door is in the ‘open’ position.
   J. Attachment: Mounting to surfaces shall be done by pressure sensitive frame double-faced tape. Signs shall be delivered to the project site with the tape in place and trimmed on each sign, but with the protective paper layer not removed. Paper layer shall be removed just prior to installation of signs.

3.3 **DAMAGE**
   A. Any identifying device which is scratched or defaced will be rejected.

3.4 **CLEANING**
   A. Remove protective materials and clean all signs. Clean surfaces with plain water or water with soap or household detergent.

**END OF SECTION**
SECTION 102800
TOILET AND BATH 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 this Section.

1.2 SUMMARY
A. Section Includes:
1. Toilet accessories
2. Under-lavatory guards.
3. Custodial accessories.

1.3 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. 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.

1.4 QUALITY ASSURANCE
A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

1.5 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.

1.6 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. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
B. Steel Sheet: ASTM A 1008, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
C. Galvanized-Steel Sheet: ASTM A 653, with G60 hot-dip zinc coating.
E. 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.
F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
2.2 TOILET ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Specialties, Inc.
   2. Bobrick Washroom Equipment, Inc.
   4. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.

B. Toilet Tissue (Roll) Dispenser: Drawing Designation: C
   2. Description: Double-roll dispenser.
   5. Capacity: (2) 10” rolls, Coordinate with Building Maintenance

C. Combination Towel (Folded) Dispenser/Waste Receptacle: Drawing Designation: D
   1. Basis-of-Design Product: Bobrick B-3944
   2. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
   a. Designed for nominal 4-inch wall depth.
   4. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
   6. Material and Finish: Stainless steel, No. 4 finish (satin)
   7. Liner: Reusable, vinyl waste-receptacle liner
   8. Lockset: Tumbler type for towel-dispenser compartment

D. Liquid-Soap Dispenser: Drawing Designation: H
   1. Provided by Building Maintenance, installed by GC.

E. Grab Bar: Drawing Designation: A & B
   1. Basis-of-Design Product: Bobrick B-6806
   3. Material: Stainless steel, 0.05 inch thick.
   a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
   4. Outside Diameter: 1-1/2 inches
   5. Configuration and Length: As indicated on Drawings

F. Mirror Unit: Drawing Designation: G
   1. Basis-of-Design Product: Bobrick; B-165 2436
   2. Frame: Stainless-steel channel.
   a. Corners: Manufacturer's standard.
   3. Integral Shelf: 5 inches deep.
   a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to
      hold mirror unit in position with no exposed screws or bolts.
   b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
   5. Size: 24” x 36”

G. Seat Cover Dispenser: Drawing Designation: F
   1. Basis-of-Design: Bobrick B-301
   2. Materials: type 304 Stainless Steel with all-welded construction; exposed surfaces shall have satin finish.
   3. Capacity: 500 paper toilet seat covers

H. Robe Hook: Drawing Designation: J
   1. Basis-of-Design: Bobrick B-6717
   2. Surface mounted robe hook, type 304 stainless steel, satin finish, concealed mounting bracket

2.3 UNDERLAVATORY GUARDS

A. Manufacturers: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Plumberex Specialty Products, Inc.
   2. Truebro by IPS Corporation.

B. Under-lavatory Guard: Insert drawing designation:
   1. Basis-of-Design: Truebro, Lav Guard 2
2. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.


2.4 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: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

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
SECTION 104413
FIRE EXTINGUISHER CABINETS

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 this Section.

1.2 SUMMARY
A. Section Includes:
   1. Fire protection cabinets for the following:
      a. Portable fire extinguishers.

1.3 SUBMITTALS
A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for 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.
   2. Show location of knockouts for hose valves.
B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
   1. Size: 6 by 6 inches square.

1.4 QUALITY ASSURANCE
A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
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.

1.5 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.

1.6 SEQUENCING
A. Apply mylar decal on field-painted, fire protection cabinets after painting is complete.
B. Apply mylar decal on aluminum door after installation

PART 2 - PRODUCTS

2.1 MATERIALS
A. Cold-Rolled Steel Sheet: ASTM A 1008, 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:
C. Stainless-Steel Sheet: ASTM A 666, Type 304.
D. Laminated Safety Glass
E. Mylar Decal “FIRE EXTINGUISHER”

2.2 FIRE PROTECTION CABINET
A. Cabinet Type: Suitable for fire extinguisher.
   1. Products: Subject to compliance with requirements, provide one of the following available products
that may be incorporated into the Work include, but are not limited to, the following:

a. Larsen's Manufacturing Company
   1) Fire rated model number FS-AL-2409-6R
   2) Non-fire rated model number AL-2409-6R

B. 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-Rated Cabinets: Construct non-rated cabinets with cold-rolled steel sheet.

C. Cabinet Material: Steel sheet.
   1. Shelf: Same metal and finish as cabinet.

D. Semi-recessed Cabinet: 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). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semi-recessed cabinet installation.
   1. Rolled-Edge Trim: 2-1/2-inch backbend depth.

E. Cabinet Trim Material: Aluminum sheet

F. Door Material: Aluminum sheet

G. Door Style: Vertical duo panel with frame.

H. Door Glazing: Laminated Safety Glass.

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
   1. Provide projecting door pull and friction latch.
   2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

J. Accessories:
   1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
   2. Identification: Lettering complying with size of cabinet. Locate on door as directed by Manufacturer.
      a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
         1) Location: Applied to cabinet door.
         2) Application Process: Mylar decal provided by manufacturer.
         3) Lettering Color: Black.
         4) Orientation: Vertical.

K. Finishes:
   1. Manufacturer's standard baked-enamel paint for the following:
      a. Exterior of cabinet.
      b. Interior of cabinet.
   2. Clear Anodized Aluminum door and trim

2.3 FABRICATION

A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
   1. Weld joints and grind smooth.
   2. Provide factory-drilled mounting holes.
   3. Prepare doors and frames to receive locks.
   4. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
   1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
   2. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 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.

2.5 ALUMINUM FINISHES  
A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

2.6 STEEL FINISHES  
A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, “White Metal Blast Cleaning”.
B. Factory Prime Finish: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 EXAMINATION  
A. Examine roughing-in for cabinets to verify actual locations of piping connections before cabinet installation.
B. Examine walls and partitions for suitable framing depth and blocking where semi-recessed recessed and semi-recessed cabinets will be installed.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION  
A. Prepare recesses for 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. Fire Protection Cabinets: 54 inches above finished floor to top of cabinet.
B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
   1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semi-recessed fire protection cabinets.
   2. Provide inside latch and lock for break-glass panels.
   3. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.
C. Identification: Apply vinyl lettering at locations indicated.

3.4 ADJUSTING AND CLEANING  
A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION
SECTION 104416  
FIRE EXTINGUISHERS  

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 this Section.  

1.2 SUMMARY  
A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.  
B. Owner-Furnished Material: fire extinguishers.  

1.3 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. 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.  
D. Contractor shall maintain a valid State of Texas Extinguisher Certificate of Registration (ECR). Installing employees must maintain a valid Type B portable License.  

1.4 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.  

1.5 COORDINATION  
A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.  

1.6 WARRANTY  
A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.  
   1. Failures include, but are not limited to, the following:  
      a. Failure of hydrostatic test according to NFPA 10.  
      b. Faulty operation of valves or release levers.  
   2. Warranty Period: Six years from date of Substantial Completion.  

PART 2 - PRODUCTS  

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS  
A. Fire Extinguishers: Type, size, and capacity for each mounting bracket indicated.  
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:  
      a. Amerex  
      1) Model B456, UL-rated 4-A:60-B:C  
      2) Valves: Manufacturer's standard.  
   3. Handles and Levers: Manufacturer's standard.  
   4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.  

B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.  

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.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Larsen's Manufacturing Company.
B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
   1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

2.3 FIRE EXTINGUISHER CABINETS
A. Fire Extinguisher Cabinet, see Fire Extinguisher Cabinets 104413
   1. Building Interior: Larsen semi-recessed fire extinguisher with laminated safety glass, exposed handle, and aluminum finish.
   2. Cabinets shall be sized appropriately to hold the type and size extinguisher(s) proposed
   3. Triangle fire extinguisher signs shall be mounted about all semi-recessed fire extinguisher boxes, 6'-7" above finish floor to bottom of sign.
   4. Fire extinguisher boxes installed in fire rated walls shall be fire rated as required.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine fire extinguishers for proper charging and tagging.
   1. Remove and replace damaged, defective, or undercharged fire extinguishers.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION
General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of UT Southwestern Office of Safety and Business Continuity.
   1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.
B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION
SECTION 115224
FLAT SCREEN TV MOUNTS

PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes flat screen TV hanger assembly.

1.2 ACTION SUBMITTALS
A. Product Data: GC to review product data for Flat Screen TV Hanger Assembly.
B. Shop Drawings: Not applicable, provided by Owner
C. Coordinate locations with Owner.

1.3 INFORMATIONAL SUBMITTALS
A. Informational Submittals: GC to review the following:
   1. Certifications specified in Quality Assurance article.
   2. Qualification Data: Manufacturer's qualification data.
   3. Manufacturer's instructions.

1.4 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing Products specified in this Section with minimum five years documented experience.
B. Certifications: Submit manufacturer’s certification that products furnished for Project meet or exceed specified requirements.

PART 2 - PRODUCTS

2.1 Provided by Owner, installed by GC

PART 3 - EXECUTION

3.1 EXAMINATION
A. General: Comply with applicable provisions of Section 017200.
B. Examine conditions under which work of this Section is to be installed. Do not proceed until unsatisfactory conditions have been corrected.
C. Verify wood blocking has been integrated into wall construction to accept secure attachment of flat screen TV hanger assemblies. Do not attach to assemblies to gypsum board.

3.2 INSTALLATION
A. Flat Screen TV Hanger Assembly: Install in accordance with Section 017200 and approved shop drawings.
   1. Install units plumb, level, square, and free from warp or twist while maintaining dimensional tolerances and alignment with surrounding construction.
B. Use fasteners which are appropriate to substrate and recommended by manufacturer of unit.
C. Install units firmly anchored in locations and at heights indicated.

3.3 ADJUSTING
A. Adjust parts for smooth, uniform operation.

3.4 CLEANING AND PROTECTION
A. Clean as recommended by manufacturer. Do not use materials or methods which may damage finish or surrounding construction.
B. Protect finished work in accordance with Section 016100.

END OF SECTION
SECTION 122113
HORIZONTAL LOUVER BLINDS

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 this Section.

1.2 SUMMARY
A. This Section includes the following:
   1. Horizontal louver blinds with aluminum slats
   2. All existing exterior windows in scope of work have existing horizontal louver blinds, some existing are damaged and need to be repaired, replace up to 25% with new to match existing and comply with this specification.

1.3 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Shop Drawings: Show fabrication and installation details for horizontal louver blinds.
C. Samples for Initial Selection: For each type and color of horizontal louver blind indicated.
   1. Include similar Samples of accessories involving color selection.
D. Window Treatment Schedule: For horizontal louver blinds. Use same designations indicated on Drawings.

1.4 QUALITY ASSURANCE
A. Source Limitations: Obtain horizontal louver blinds through one source from a single manufacturer.
B. Fire-Test-Response Characteristics: Provide horizontal louver blinds with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
C. Product Standard: Provide horizontal louver blinds complying with WCSC A 100.1.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Deliver horizontal louver blinds in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.6 PROJECT CONDITIONS
A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet and dirty finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
B. Field Measurements: Where horizontal louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units’ operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 EXTRA MATERIALS
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. Horizontal Louver Blinds: Before installation begins, for each size, color, texture, pattern, and gloss indicated, full-size units equal to 2 percent of amount installed.

PART 2 - PRODUCTS

2.1 HORIZONTAL LOUVER BLINDS, ALUMINUM SLATS
A. Available Products: Subject to compliance with requirements, products that may be incorporated into the
Work include, but are not limited to, the following:

2. Levolor, a Newell Rubbermaid Company.
3. Springs Window Fashions Division, Inc.
4. Bali

B. Slat: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile.
   1. Width: 1 inch.
   2. Thickness: Not less than 0.008 inch.
   3. Finish: Char Brown
      a. Reflective Coating: Manufacturer's special coating enhancing the reflection of solar energy on the outside-facing slat surface.

C. Headrail: Formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and end plugs and the following:
   1. Capacity: One blind per headrail.
   2. Integrated Headrail/Valance: Curved face.
   3. Light-blocking lower back lip.
   4. Tilt limiter with pre-selected degree settings.

D. Bottom Rail: Formed-steel or extruded-aluminum tube, with plastic or metal capped ends top contoured to match crowned shape of slat; with enclosed ladders and tapes to prevent contact with sill.

E. Ladders: Evenly spaced to prevent long-term slat sag.
   1. For Blinds with Nominal Slat Width 1 Inch or Less: Braided string.

F. Lift Cords: Manufacturer's standard.

G. Tilt Control: Enclosed worm-gear mechanism and linkage rod, and the following:
   2. Length of Tilt Control: Length required to make operation convenient from floor level.
   3. Tilt: Full.

H. Lift Operation: Manual, cord lock; locks pull cord to stop blind at any position in ascending or descending travel.

I. Tilt-Control and Cord-Lock Position: Right and left side of headrail, respectively, unless otherwise indicated.

J. Valance: Two slats.
   1. Finish Color Characteristics: Match color, texture, pattern, and gloss of slats.

K. Mounting: Wall mounting, permitting easy removal and replacement without damaging blind or adjacent surfaces and finishes; with spacers and shims required for blind placement and alignment indicated.
   1. Provide intermediate support brackets if end support spacing exceeds spacing recommended by manufacturer for weight and size of blind.

L. Colors, Textures, Patterns, and Gloss: As selected by Architect from manufacturer's full range.

2.2 HORIZONTAL LOUVER BLIND FABRICATION

A. Concealed Components: Non-corrosible or corrosion-resistant-coated materials.

B. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F:
   1. Blind Units Installed between (inside) Jambs: Width equal to 1/4 inch per side or 1/2 inch total, plus or minus 1/8 inch, less than jamb-to-jamb dimension of opening in which each blind is installed.
      Length equal to 1/4 inch, plus or minus 1/8 inch, less than head-to-sill dimension of opening in which each blind is installed.
   2. Blind Units Installed outside Jambs: Width and length as indicated, with terminations between blinds of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Installation Brackets: Designed for easy removal and reinstallation of blind, for supporting headrail, valance, and operating hardware, and for hardware position and blind mounting method indicated.

D. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to blind hardware and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.

E. Component Color: Provide rails, cords, ladders, and exposed-to-view metal, and plastic matching or coordinating with slat color, unless otherwise indicated.
PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine existing blinds and repair where possible, provide up to 25% of exterior windows with new mini-blinds, grouping new blinds in same room. All mini-blinds on exterior windows within the scope of work to be in proper working order; GC to inspect existing exterior mini-blinds within the scope of work prior to demolition and inform Architect if more than 25% new mini-blinds will be required.
B. Where new mini-blinds are required, Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION
A. Install horizontal louver blinds level and plumb and aligned with adjacent units according to manufacturer's written instructions, and located so exterior slat edges in any position are not closer than 1 inch to interior face of glass. Install intermediate support as required to prevent deflection in headrail. Allow clearances between adjacent blinds and for operating glazed opening's operation hardware if any.
B. Head Mounted: Install headrail on face of opening head.

3.3 ADJUSTING
A. Adjust horizontal louver blinds to operate smoothly, easily, safely, and free of binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION
A. Clean horizontal louver blind 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 horizontal louver blinds are without damage or deterioration at time of Substantial Completion.
C. Replace damaged horizontal louver blinds that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION
SECTION 211313
FIRE PROTECTION SYSTEMS

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Wet-pipe sprinkler system.
B. Dry-pipe sprinkler system.
C. Pre-action sprinkler system.
D. System design, installation, and certification.
E. Fire department connections.

1.2  RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3  REFERENCES

B. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings, Class 150 and 300.
C. ANSI/ASME B16.4 - Cast Iron Threaded Fittings, Class 125 and 250.
D. ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings.
F. ANSI/ASME B16.11 - Forged Steel Fittings, Socket-welding and Threaded.
G. ANSI/ASME B16.18 - Cast Copper Alloy Solder-Joint Pressure Fittings.
H. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
I. ANSI/ASME B16.25 - Butt welding Ends.
J. ANSI/ASME B36.10 - Welded and Seamless Wrought Steel Pipe.
K. ANSI/ASME Sec 9 - Welding and Brazing Qualifications.
N. ANSI/ASTM B32 - Solder Metal.
O. ANSI/AWS A5.8 - Brazing Filler Metal.
R. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless.
S. ASTM A120 - Pipe, Steel, Black and Hot-Dipped, Zinc-coated (Galvanized) Welded and Seamless, for Ordinary Uses.
T. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
V. ASTM B75 - Seamless Copper Tube.
W. ASTM B88 - Seamless Copper Water Tube.
X. ASTM B251 - General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
AA. ASTM F439 - Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
BB. ASTM F442 - Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR).
1.4 SYSTEM DESCRIPTION

A. System to provide coverage for entire building.

B. Provide system to NFPA 13 for occupancy requirements as shown on the drawings unless otherwise noted.

C. Determine volume and pressure of incoming water supply from residual pressure water flow test.

D. Interface system with building fire and smoke alarm system.

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 City Dallas, Texas Fire Department.

1.5 SUBMITTALS

A. Submit under provisions of Section 22 0010.

B. Preliminary Shop Drawings: Prior to detailed submission, submit preliminary layout of finished ceiling areas indicating only head locations coordinated with ceiling installation.

C. Shop Drawings: Indicate hydraulic calculations, detailed pipe layout, hangers and supports, components and accessories. Indicate system controls.

D. Product Data: Provide data on sprinkler heads, valves, and specialties, including manufacturers' catalogue information. Submit performance ratings rough-in details, weights, support requirements, and piping connections.

E. Submit shop drawings, product data, and hydraulic calculations to the University of Texas Southwestern Medical Center Fire and Safety Representative as directed by the Owner. Submit copies of all information, and proof of approval to Architect/Engineer and Owner.

F. Samples: Submit two of each style of sprinkler head specified.

G. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds requirements specified, and suggested by listed codes.

H. Manufacturer's Field Report: Submit under provisions of Section 22 0010.

I. Manufacturer's Field Report: Indicate time of start-up of treatment systems and include analysis of system water after cleaning and treatment.

1.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 22 0010.
B. Record actual locations of sprinkler heads and deviations of piping from drawings. Indicate drain and test locations.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 22 0010.

B. Maintenance Data: Include components of system, servicing requirements, Record Drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

1.8 QUALITY ASSURANCE


B. Standpipe and Hose Systems: Perform to NFPA 14.


D. Valves: Bear FM label or marking. Provide manufacturer's name and pressure rating marked on valve body.

E. Maintain one copy of each document on site.

1.9 QUALIFICATIONS

A. Installer: Company specializing in performing work of this Section with minimum three years experience.

B. Design sprinkler system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State of Texas. All design submittal documents and shop drawings shall bear the responsible engineers signed and dated seal.

1.10 REGULATORY REQUIREMENTS

A. Hydraulic Calculations, Product Data, Shop Drawings: Bear stamp of approval of Factory Mutual.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and protect products to site under provisions of Section 22 0010.

B. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.12 EXTRA MATERIALS

A. Furnish under provisions of Section 22 0010.

B. Provide extra sprinkler heads as suggested under provisions of NFPA 13.

C. Provide suitable wrenches for each head type.

D. Provide metal storage cabinet in location designated.

PART 2 - PRODUCTS

2.1 GENERAL

A. General: The Contractor shall provide all components required for the complete installation of automatic sprinkler systems as hereinafter specified and indicated on the Drawings.
2.2 QUALIFICATIONS OF THE INSTALLER

A. The 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 Fire Protection and Engineering Bureau of Texas, or by an authorized agent of such firm. Evidence to support the above requirements may be required and any proposed installer who cannot show suitable experience will be rejected.

2.3 SYSTEM LAYOUT

A. The fire sprinkler areas, piping, head locations, etc. as indicated is only for Contractor's reference as to areas to be protected and possible piping routes. If header or manifold sizes are given in the drawings, then the sizes given shall be the minimum sizes installed. Actual number, spacing and location of heads, size and routes of piping shall be provided in accordance with the applicable Specifications and acceptable Shop Drawings. All layouts, head spacing, coverage, etc., as may be 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. Modifications to head spacing, pipe routes, etc. shall be closely coordinated with the work of all other trades. The Fire Sprinkler Subcontractor shall be responsible for the design and installation of the fire sprinkler system as described herein and on the project drawings.

2.4 SHOP DRAWINGS

A. Shop Drawings shall be submitted prior to fabrication. The Shop Drawings shall include detail plans of sprinkler systems including piping sizes, sections and plot plan indicating the locations of underground supply connections, control valves, fire department connections, and other equipment to be used. The Shop Drawings shall become an integral part of these Specifications.

2.5 MATERIALS AND EQUIPMENT

A. All 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, or the Factory Mutual Testing Laboratories List of Approved Equipment, Fire Protection Devices and Devices Involving Fire Hazard, and shall be the latest design of the manufacturer. All piping, control valves, drain valves, fittings, etc. shall be as specified under this Section, Fire Protection System, utilizing welded, flanged, and threaded fittings only. Roll-grooved couplings and mechanical fittings are also permitted and shall be manufactured by Victaulic. Roll-grooved couplings and mechanical fittings shall be UL listed and FM approved. Cut-grooved couplings and mechanical fittings shall not be permitted. Where valves are not specified by Figure No. they shall be of specified manufacture, U.L. listed for service, and of same quality level as Figure Nos. specified. All pipe 2-1/2" and larger shall be welded, except as may be allowed herein. All pipe 2" and smaller shall be threaded using 300 pound malleable iron, A120 Schedule 40 black steel pipe and fittings. Note that if galvanized pipe or fittings are installed, the contractor shall be responsible to remove the galvanized pipe or fittings and replace them with specified materials as soon as possible prior to further installation of the system.

2.6 SPRINKLER HEADS

A. Unless otherwise specified or indicated on the Drawings, sprinkler heads shall be regular automatic closed type spray heads of the upright or pendant 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 National Fire Protection Association Standard No. 13.

B. Heads shall be located in a symmetrical pattern related to ceiling features such as grid, beams, light fixtures, diffusers, etc., and where applicable, heads shall be located symmetrically with the ceiling grid, centered in two directions.
C. The Contractor shall provide spare heads equal to one percent (1%) of the total number of heads installed under the Contract, but not less than ten (10). The heads shall be packed in a suitable wall mounted sprinkler cabinet and shall be representative of, and in proportion to, the number of each type and temperature rating heads installed. In addition to the spare heads, the Contractor shall provide not less than one special sprinkler head wrench for each type of head. The cabinet shall be located where directed by the Construction Inspector.

D. Only sprinkler heads manufactured by Reliable Sprinkler Corp. shall be used. Install intermediate and high temperature sprinklers whenever necessary to meet the requirements of NFPA 13, including 212 degree F sprinklers in electrical rooms and 286 degree F sprinklers in machine rooms adjacent to any steam lines.

2.7 PIPING

A. Installation of piping, fittings and valves shall be as specified in Chapter 3, System Components, NFPA Standard No. 13, except where noted otherwise. Piping shall be concealed in all areas with finished ceilings. Piping shall be sterilized as specified. The O.S. & Y. valves shall be provided under this section. Materials shall be as specified. Note that the use of piping bushings for any purpose is explicitly prohibited.

2.8 WATER FLOW ALARM SWITCH

A. Provide, where indicated on the Drawings, McDonnell UL approved line size flow switches. See Division 26 for electrical signal connection by others to these flow switches.

2.9 FIRE DEPARTMENT CONNECTIONS

A. Exposed type UL approved polished chrome plated brass Siamese pumper connections shall be provided and connected to the sprinkler systems as indicated on the Drawings. Each Siamese pumper connection shall match the "standpipe" pumper connections specified before. Size and thread shall conform to the City of Dallas, Texas Fire Department Standard Construction. Each Siamese shall be manufactured by W.D. Allen Co., Fig. 276, 2-way, with plate lettered "AUTO SPRINKLER", and shall be of "flush", configuration as indicated on the Drawings. Plugs and caps shall have color finish as required by the City of Dallas, Texas, Fire Department.

2.10 ALARM VALVES

A. The alarm valves shall be Underwriters' Laboratories approved, wet type, connected to water supply and indicated on the Shop Drawings. Each alarm valve shall be provided with a circuit closer. Valves shall conform to the equipment of NFPA Standard No. 13, complete with retarding chamber and pressure switch.

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 No. 13, and shall provide the Construction Inspector with a certificate as required therein. The test pressures shall be 300 psi. and the test shall be performed before the addition of the heads. The duration of the test(s) shall be a minimum of twenty-four hours.

2.12 PIPING

A. All pipe used for fire protection standpipe systems and fire sprinkler systems shall be Schedule 40 black steel pipe. This pipe shall, in every detail, conform to Standard Specifications for WELDED AND SEAMLESS
2.13 FITTINGS

A. All welding type steel fittings employed in fabricating fire protection system including fire sprinkler systems shall conform to A.S.T.M. Specification A-234 and ANSI Standard B16.9-1964. All threaded fittings shall be 300 pound malleable iron fittings. Grooved type fittings will not be accepted for use in standpipe systems. Pipe size changes shall be performed through the use of reducing tees or reducers designed for that purpose. The use of bushings is explicitly prohibited.

B. Unless otherwise shown or required, all fittings shall be welding type steel fittings as manufactured by Ladish, Taylor Forge or Tube Turn. In no case shall the thickness of the wall of a fitting be less than the thickness of the pipe to which it is joined. Such fittings shall conform to A.S.T.M. Specification A234 and ANSI Standard B16.9-1964. See Section 22 0010.

C. 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. Threaded fittings shall be Crane or Grinnell Company's 300 pound malleable iron fittings.

D. Extra heavy "Thread-o-lets" shall be used at each point of departure from the riser to the fire hose or valve cabinet. A "Thread-o-let" shall be installed below the level of the valve in the cabinet and a minimum of two (2) threaded ells shall be used to provide a swing joint connection from the riser to the valve in the cabinet.

E. Roll-grooved couplings and mechanical fittings are permitted and shall be manufactured by Victaulic. Roll-grooved couplings and mechanical fittings shall be UL listed and FM approved. Cut-grooved couplings and mechanical fittings shall not be permitted.

2.14 VALVES

A. 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. 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. All valves must be of threaded or flanged type. No solder connected fitting valves shall be used on this project. 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.

B. Class 300 valves shall be constructed of all ASTM B-61 composition. 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.

C. 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. 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.
D. All cast steel body valves shall have the pressure containing parts constructed of ASTM designation A-216-GR-WCB carbon steel. 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. 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". Sizes 8" 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% chromium A-182-F6 stainless. Handwheels shall be A47 Grade 35018 malleable iron or Ductile Iron ASTM A536.

E. 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.

F. 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" and larger which may have either malleable iron or ASTM A-126 Class B, gray iron hand wheels.

G. 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.

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: 2" and smaller, bronze body, outside screw and yoke, rising stem, solid wedge, Underwriters' Laboratories Listed and Factory Mutual Approved, screw pattern. Iron body, 2-1/2" and larger wedge, flanged pattern, OS&Y rising stem. Underwriters Laboratories Listed and Factory Mutual Approved. Butterfly valves U. L. 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 and Factory Mutual approved. Complete with ball drip assembly.

K. Standards of Quality for Valves:

<table>
<thead>
<tr>
<th>Standard of Quality for Valves:</th>
<th>Milwaukee</th>
<th>Nibco</th>
<th>Stockham or as Noted</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot; &amp; smaller</td>
<td>Gate Valve</td>
<td>Fire Protection</td>
<td>--</td>
</tr>
<tr>
<td>2-1/2&quot; &amp; larger</td>
<td>Gate Valve</td>
<td>Fire Protection</td>
<td>--</td>
</tr>
<tr>
<td>2&quot; &amp; smaller</td>
<td>Check Valve</td>
<td>All Water Systems</td>
<td>510</td>
</tr>
</tbody>
</table>
2.15 STRAINERS

A. Strainers, 2" 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, 2-1/2" 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). Special Note: All strainers 6" and larger shall have studs mounted in the body flange in lieu of bolts for removal of cap. Baskets for strainers 6" 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.

2.16 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. 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. Unions in 2" and smaller in ferrous lines shall be Class 300 AAR malleable iron unions with iron to brass seats, and 2-1/2" 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 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.

2.17 WELDED PIPING

A. SCOPE: This 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, steam, steam condensate, and fire protection systems.

B. MATERIALS: All 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. 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. Only one manufacturer of weld fittings will be approved for the project. 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. 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.
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. 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. 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. The owner will, at the owners 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. The contractor shall be responsible for all labor, material and travel expenses involved in the reinspection 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/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. 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. Complete test reports may be required for any fittings selected at random. Only one manufacturer of weld fittings will be approved for each project. Fittings which have been machined, remarked, printed or otherwise produced domestically from imported forgings or materials will not be acceptable. Each fitting shall have the manufacturer's trademark permanently identified 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.
2.18 FLANGES

A. All 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. 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. 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. Bolts shall have a tensile strength of 60,000 psi and an elastic limit of 30,000 psi. Flat faced flanges shall be furnished where required to match flanges on pumps, check valves, strainers, etc. Only one manufacturer of weld flanges will be approved for each project.

B. All flanges shall be gasketed. Contractor shall place gasket between flanges of flanged joints. Gaskets shall fit within the bolt circle on raised face flanges and shall be full face on flat face flanges. 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.

2.19 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.)

2.20 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. 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. Plates will not be required for piping where pipe sleeves extend 3/4" above finished floor. 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.

2.21 SLEEVES, INSERTS, AND FASTENINGS

A. General: 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. All penetrations must pass through sleeves except soil pipe installed under concrete slabs on fill. 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. 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", except that the minimum clearance shall accommodate a Thunderline Link-seal closure where piping exits the building, or penetrates a wall below ground level. Contractor shall be responsible for the accurate location of penetrations in the slab for his pipe, duct, etc. All penetrations shall be of ample size to accommodate the pipe, duct, etc. plus any specified insulation. 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. Refer to the details on the project drawings. 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: 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.

F. Fasteners: 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.

Note: Under no circumstances will the use of plastic anchors or plastic expansion shields be permitted for any purpose whatsoever.

G. Ratproofing: The open space around all ductwork, piping, etc., passing through the ground floor and/or exterior walls shall be ratproofed 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: 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, vermintight barrier that is capable of containing smoke and fire up to 2000 degrees F for two hours. Sealing of cable trays and conduits that extend through rated walls from ends of cable tray shall be done after conductors have been installed. For wet locations, the foam material shall be a silicone RTV foam or an approved equal. For dry locations, a premixed putty equal to Nelson Flameseal Firestop putty may be used.

2.22 FOUNDATIONS, HANGERS, AND SUPPORTS

A. General: All 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” high and extend 4” on all sides beyond the limits of the mounted equipment unless otherwise
noted and shall be poured in forms built of new-dressed lumber. All corners of the foundations shall be neatly chamfered by means of sheet metal or triangular wood strips nailed to the form. Foundation bolts shall be placed in the forms when the concrete is poured, the bolts being correctly located by means of templates. Each bolt shall be set in a sleeve of size to provide 1/2" clearance around bolt. Allow 1" below the equipment bases for alignment and grouting. After grouting, the forms shall be removed and the surface of the foundations shall be hand rubbed with Carborundum. Foundations for equipment located on the exterior of the building shall be provided as indicated. 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. 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.
   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. All rod sizes indicated in this Specification are minimum sizes only. This trade shall be responsible for structural integrity of all supports, anchors, guides, etc. All 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" 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" 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" dia. pipe or smaller in size and supporting all ferrous lines 6" and smaller in size shall be clevis type hangers.
   3. Hangers supporting and contacting lines larger than 6" in size and outside of insulation on lines with the outside dia. equivalent to 10" 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 in Section F, INSULATION. Protect insulation from crushing by means of a section of rigid insulation to be installed at hanger points. 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.
   6. Hanger Rods:
7. 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.

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. 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. 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. All pipe supports shall be designed and installed to avoid interference with other piping, hangers, ducts, electrical conduit, supports, building structures, equipment, etc. 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: 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. 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. 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: 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. 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: 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. 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. 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" larger than the diameter of the hanger rod. 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. Cinch anchors, lead shields, expansion bolts, and studs driven by explosion charges are not allowed under any circumstances in the lower 15" of each stem and in the "shadow" of the stem on the top side of the "double tees".

H. Spacing:

1. The following table gives maximum hanger spacing for copper and steel lines. Hangers shall be more closely spaced where required by the conditions of the installation in order to prevent sagging, excess load on structure and hangers, undue strain on equipment, noise transmission, etc. A hanger shall be placed within 2 feet of each elbow or tee.

<table>
<thead>
<tr>
<th>Size of Line</th>
<th>Hanger Spacing in Feet</th>
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<tr>
<td>3/4&quot; and Smaller</td>
<td>5</td>
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<tr>
<td>1&quot; through 4&quot;</td>
<td>7</td>
</tr>
<tr>
<td>5&quot; through 8&quot;</td>
<td>8</td>
</tr>
<tr>
<td>10&quot; and Larger</td>
<td>10</td>
</tr>
</tbody>
</table>

I. Trapezes: Where multiple lines are run horizontally at the same elevation and grade, they may be supported on trapezes of Kindorf, Elen, or approved equal, channel-suspended on rods or pipes. 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: All hangers on piping including clevis hangers, rods, inserts, clamps, stanchions, brackets, shall be dipped in Zinc Chromate Primer before installation. Rods shall be galvanized or cadmium plated after threading, in lieu of dipping in zinc chromate primer. Universal concrete inserts shall be cadmium plated.

2.23 SIAMESE CONNECTIONS

A. At the points designated on the accompanying Drawings, install Siamese fittings required for fire protection purposes. From a point on the incoming water supply line, this Contractor shall extend water line for fire protection purposes to Siamese connections.

B. Wall type Siamese shall be equal to W.D. Allen Company's 276 double clapper flush type Siamese connections having threads complying with the requirements of the Fire Department of the City Dallas, Texas. They shall have proper caps with pin type lugs attached to the body of the Siamese connections with substantial chains. The plate fitting against the building shall have raised letters reading "AUTO SPRINKLER" or "STANDPIPE". All external surfaces shall be chromium plated surfaces.

C. Sidewalk type Siamese shall be equal to W.D. Allen Company's No. 231 cast brass body and escutcheon. They shall have proper caps with pin type lugs attached to the body of connection with substantial chains. "STANDPIPE" or "AUTO SPRINKLER" to be cast on head of connection. All external surfaces shall be chromium plated polished surfaces.

2.24 ROOF MANIFOLDS

A. Roof manifolds shall be equal to W.D. Allen Company's No. 439 cast brass Underwriters' Laboratory listed horizontal roof manifold. Complete with Allenco No. 17OU 2-1/2" Underwriters' listed angle valve and Allenco
No. 120 2-1/2" brass caps and chains, 2-way, 2-1/2" x 2-1/2" x 4". 2-1/2" outlets shall be 7-1/2 threads per inch iron pipe size.

2.25 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 225 pounds per square inch and shall be flushed at each valve through a temporary hose until the system is clean. Any leaks found shall be remedied in each instance in a manner approved in advance by the Owner's duly authorized representative. The systems shall be alternately tested and repaired where necessary until they have demonstrated their capability to withstand such a minimum 225 pound per square inch gauge hydraulic pressure for a period of 24 hours without any appreciable drop in the test pressure initially applied.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate work of this Section with other affected work.

3.2 GENERAL INSTALLATION

A. Install equipment in accordance with manufacturer's 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 campus Fire Marshall.

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.
3.4 INSTALLATION

A. Install piping in accordance with NFPA 13 for sprinkler systems, NFPA 14 for standpipe and hose systems, and NFPA 24 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 0529.

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 PIPE (except for welded piping):

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 lying 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.

END OF SECTION
SECTION 220010
BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Basic Mechanical Requirements specifically applicable to Divisions 22 and 23 Sections, in addition to Division 01 - General Requirements.

1.2 RELATED DOCUMENTS

A. THE UNIFORM GENERAL CONDITIONS, SUPPLEMENTARY GENERAL CONDITIONS, and DIVISION 1 of the Specifications apply to the work specified in this Section.

B. All 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.

1.3 GENERAL

A. The Contractor shall execute all work hereinafter specified or indicated on accompanying Drawings. 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.

B. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation and thereby to provide an integrated satisfactory operating installation.

C. 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.

D. 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. 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. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

E. 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.

F. 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. The contractor shall not start work until this drawing has been provided.

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.
The drawings do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas.

1.4 DEFINITIONS: (Note: These definitions are included here to clarify the direction and intention of this specification. The list given here is not by any means complete. For further clarification as required, contractor shall contact the designated owner's representative.)

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 rooms.

1.5 PERMITS, UTILITY CONNECTIONS AND INSPECTIONS

A. General: Refer to DIVISION 1 for construction phasing and time increments.

B. Fees and Costs: If, during the course of the construction, a need arises to buy utilities, the Contractor shall pay all fees attendant thereto. 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. 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: The Contractor shall comply in every respect with all requirements of National Fire Protection Association, local Fire Department regulations, and utility company requirements. 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. 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.

1.6 CONTRACT DOCUMENTS

A. All dimensional information related to new structures shall be taken from the appropriate Drawings. 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: The Specifications determine the nature and setting of the several materials, the Drawings establish the quantities, dimensions and details, and the schedules give the performance characteristics. If the Contractor requires additional clarification, he shall request it in writing, following 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.

1.7 OWNER FURNISHED PRODUCTS

A. Products furnished to the site and paid for by Owner will be noted on the drawings.

1.8 FUTURE WORK
A. Future work will be noted on the Drawings.

1.9 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 1 of the Specifications. 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.

1.10 SUBMITTALS

A. Refer to the enclosed Specifications.

B. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.

C. Mark dimensions and values in units to match those specified.

D. Submit Fabrication Drawings whenever (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; and (4) where specifically requested by the Architect/Engineer. 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" = 1'-0". Fabrication Drawings for ductwork, air handling units, and sections in Mechanical Rooms shall be drawn at a minimum scale of 3/8" = 1'-0". Submit three blueline prints of each Fabrication Drawing to the Architect/Engineer for review. Reproduction and submittal of the Construction Documents is not acceptable. The Architect/Engineer will review the drawing and return one print with comments.

1.11 SUBSTITUTION OF MATERIALS AND EQUIPMENT

A. Refer to General Conditions for substitution of materials and equipment.

B. General: 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. The list shall be arranged in accordance with the organization of the Specifications. 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. 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. 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. 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.

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. Some proprietary products are mentioned to set a definite standard for acceptance and to serve as a reference in comparison with other products. 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. The successful manufacturer or supplier shall meet all of the provisions of the appropriate specification(s).

D. 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. The burden of proof of equality rests with the Contractor. 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: The burden of timeliness in the complete cycle of submittal data, shop Drawings, and sample processing is on the Contractor. 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. 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. 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 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. 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. 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 and found to be correct with respect to dimensions and available space and that the equipment complies with all requirements of the Specifications.

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: Three (3) 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. The lists shall be accompanied by three (3) sets of pictorial and descriptive data derived from the manufacturers' catalogs, sales literature, or incorporated in the Shop Drawings. 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.
1.12 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. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by mechanics skilled in their respective trades, and the installations shall provide a neat, precise appearance. 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 the specific manufacturers during the installation.

1.13 FLAME SPREAD PROPERTIES OF MATERIALS

A. Materials and adhesives incorporated in this project shall conform to NFPA Standard 255 (1984), "Method of Test of Surface Burning Characteristics of Building Materials". 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.

1.14 REGULATORY REQUIREMENTS

A. The "Authority Having Jurisdiction" over the project described by these documents is the Owner, as an Agency of the State of Texas. As such, it is required that the installation shall meet the minimum standards prescribed in the latest editions of the following listed codes and standards, which are made a part of these Specifications.

B. National Fire Protection Association Standards (NFPA):
   1. NFPA No. 13, Sprinkler System, Installation
   2. NFPA No. 14, Standpipes and Hose Systems
   3. NFPA No. 20, Centrifugal Fire Pumps
   4. NFPA No. 37, Stationary Combustion Engines & Gas Turbines
   5. NFPA No. 45, Fire Protection for Laboratories Using Chemicals
   7. NFPA No. 54, Gas Appliances, Piping, National Fuel Gas Code
   8. NFPA No. 70, National Electrical Code
   9. NFPA No. 72D, Proprietary Signaling Systems
  10. NFPA No. 78, Lightning Protection Code
  11. NFPA No. 88A, Standard for Parking Structures
  12. NFPA No. 90A, Air Conditioning Systems
  13. NFPA No. 91, Blower & Exhaust Systems
  14. NFPA No. 99, Health Care Facilities
  16. NFPA No. 200, Series, Building Construction
  17. NFPA No. 211, Chimneys, Fireplaces, Vent Systems
  19. NFPA No. 255, Method of Test of Surface Burning Characteristics of Building Materials
  21. Ashrae 90.1, 2010

C. American National Standards Institute (ANSI):
   1. A40.8, 1984 National Plumbing Code
   2. B31.1, 1984 Power Piping

D. American Gas Association Publications (AGA): Directory of Approved Gas Appliances and Tested Accessories

E. American Society of Mechanical Engineers (ASME): Boiler and Pressure Vessel Codes

F. Air Conditioning and Refrigeration Institute Standards (ARI): All standards related to refrigeration and air conditioning equipment and piping furnished under these Specifications.

G. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA): All current editions of applicable manuals and standards.

H. Air Moving and Conditioning Association (AMCA): All current editions of applicable manuals and standards.


J. American Water Works Association (AWWA): All current editions of applicable manuals and standards.

K. National Electrical Manufacturers’ Association (NEMA): All current editions of applicable manuals and standards.

L. International Codes, current edition or as listed elsewhere in the contract.

M. Texas Occupational Safety Act: All applicable safety standards.

N. Occupational Safety and Health Act (OSHA).

O. 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.

P. Refer to Specification Sections hereinafter bound for additional Codes and Standards.

Q. All materials and workmanship shall comply with all applicable state and national codes, Specifications, and industry standards. In all cases where Underwriters’ Laboratories, Inc. has established standards for a particular type material, such material shall comply with these standards. Evidence of compliance shall be the UL "label" or "listing" under Re-Examination Service.

R. The Contract Documents are intended to comply with the aforementioned rules and regulations; however, some discrepancies may occur. Where such discrepancies occur, the Contractor shall immediately notify the Architect/Engineer in writing of said discrepancies and apply for an interpretation. 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. 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.

1.15 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, drip, humidity, and dust damage.

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: 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. The label of the Underwriters Laboratories, Inc., applied to the item will be acceptable as sufficient evidence that the items conform to such requirements. The ASME stamp or the AMCA label will be acceptable as sufficient evidence that the items conform to the respective requirements.

D. Nameplates: 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. All data on nameplates shall be legible at the time of Final Inspection.

E. Prevention of Rust: Standard factory finish will be acceptable on equipment specified by model number; otherwise, surfaces of ferrous metal shall be given a rust inhibiting coating. The treatment shall withstand 200 hours in salt spray fog test, in accordance with Method 6061 of Federal Standard No. 141. 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" on either side of the scratch mark. 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. 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: Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts shall be fully enclosed or properly guarded for personnel protection. Guards shall be compliant with OSHA requirements.

G. Verification of Dimensions: 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. 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. 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.

1.16 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. 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. Plates will not be required for piping where pipe sleeves extend 3/4" above finished floor. 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.

1.17 SLEEVES, INSERTS, AND FASTENINGS
A. General: 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. All penetrations must pass through sleeves except soil pipe installed under concrete slabs on fill. 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. If a penetration is cored into an existing solid concrete or stone structure, then the installation of a sleeve will not be necessary. Sleeves set in floors shall extend 4" 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", except that the minimum clearance shall accommodate a Thunderline Link-seal closure where piping exits the building, or penetrates a wall below ground level. Contractor shall be responsible for the accurate location of penetrations in the slab for his pipe, duct, etc. All penetrations shall be of ample size to accommodate the pipe, duct, etc. plus any specified insulation. Sleeve materials shall be rigid metal of adequate strength. Void between sleeve and pipe shall be filled with Nelson Flameseal Firestop or approved equal caulking or putty.

C. Installation of sleeves in walls shall be the same as for floors. Refer to the details on the project drawings. 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: 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.

F. Fasteners: 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.

Note: Under no circumstances will the use of plastic anchors or plastic expansion shields be permitted for any purpose whatsoever.

G. Ratproofing: The open space around all ductwork, piping, etc., passing through the ground floor and/or exterior walls shall be ratproofed 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: 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, vermintight barrier capable of containing smoke and fire up to 2000 degrees F for two hours. Sealing of cable trays and conduits that extend through rated walls from ends of cable tray shall be done after conductors have been installed. For wet locations, the foam material shall be a silicone RTV foam or an approved equal. For dry locations, a premixed putty equal to Nelson Flameseal Firestop putty may be used.

1.18 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. Obtain permission of Architect/Engineer before proceeding.

1.19 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. 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. Should the Contractor perform any such work that does not comply with the manufacturers' directions or such instructions from the Architect/Engineer, he shall bear all costs arising in connection with the deficiencies.

1.20 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. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment he proposes to furnish will fit in the space. 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. 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.

1.21 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. Following placement in the space, such apparatus shall be thoroughly, completely protected from damage as hereinafter specified.

1.22 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. 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. 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. 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. 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.

1.23 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. Each trade, subcontractor, and/or Contractor must pursue its work promptly and carefully so as not to delay the general progress of the job. This Contractor shall work in harmony with Contractors working under other contracts on the premises.

1.24 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. The Electrical Trades shall provide all disconnect switches as required for proper operation, as indicated on the Drawings or required by applicable code. 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.

C. The Mechanical Trades shall provide complete wiring diagrams indicating power wiring and interlock wiring. Diagrams shall be submitted for review within thirty (30) days after the submittals for equipment have been reviewed. 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. After these diagrams have been reviewed, copies shall be transmitted to the Electrical Trades by the Contractor. They shall be followed in detail. See Section 23 0923, ENERGY MANAGEMENT SYSTEM (EMS), for additional clarification.

1.25 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 himself with the work to be done by other trades. He shall coordinate his work with other trades and before material is fabricated or installed, make sure that his work will not cause an interference with another trade. Where interferences are encountered, they shall be resolved at the job site by the superintendents involved. Where interferences cannot be resolved without major changes to the Drawings, the matter shall be referred to the A/E for ruling.

1.26 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.

1.27 PRECEDENCE OF MATERIALS

A. The specifications determine the nature and setting of materials and equipment. The drawings establish quantities, dimensions and details.
B. The 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

1.28 CONNECTIONS FOR OTHERS

A. The Mechanical 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. 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.

D. 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.

E. Provide all sheet metal ductwork, transition pieces, etc., required for a complete installation of vent hoods, fume hoods, etc., provided by others.

1.29 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: 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. 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: 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. Sleeves shall be as herein specified. Approval shall be obtained from the Architect/Engineer for each penetration. 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.

E. All pipe, conduits, etc., shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. 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. Piping, ducts and conduits run in furred ceilings, etc., shall be similarly installed, except as otherwise shown. Conduits in furred ceilings and in other concealed spaces shall be neatly grouped and racked indicating good workmanship. All conduit and pipe openings shall be kept closed until the systems are closed with final connections.

1. All piping not directly buried in the ground shall be considered as "interior piping".
2. 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. The Contractor shall give as much advance notice as possible no less than 10 working days.
3. All above-ceiling areas will be subject to a formal inspection before ceiling panels are installed, or installation is otherwise concealed from view. All mechanical 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. Adequate lighting shall be provided to permit thorough inspection of all above-ceiling items. The inspection will include representatives of the following: General Contractor and each Subcontractor having work above the ceiling, Physical Plant, and the Resident Construction Manager's Construction Inspector Areas to be included and time of inspection shall be coordinated with the Construction Inspector.
4. 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. The ceiling supports (tee bar or lath) shall be in place so that access panel and light fixture locations are identifiable and so that clearances and access provisions may be evaluated.
5. No ceiling materials may be installed until the resulting deficiency list from this inspection is worked off and the Construction Inspector has given approval.

1.30 RECORDS FOR OWNER

A. The Contractor shall maintain a set of "blueline" prints in the Field Office for the sole purpose of recording "installed" conditions. 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. The contractor shall transfer the information from the "blueline" prints maintained as described above, and turn over this neatly marked set of reproducible Drawings representing the "as installed" work to the Architect/Engineers for verification and subsequent transmittal to the Owner. The Contractor shall refer to Division 1 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.
C. Electronic Media Transfer: AutoCAD files specific to a floor shall be provided (under formal transmittal letter) to the owner within 1 week of floor acceptance. The electronic files shall have the latest changes incorporated, and represent the most accurate design issued for construction. The files shall comply with Specification 15011. The files shall be in AutoCAD Version 2000 or higher.

D. "As installed" mylars shall bear a stamp, "stick on decal", 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 duplicate, prepared in a neat brochure 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 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.

1.31 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: 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. 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: Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. 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: All mechanical work in areas containing plaster shall be completed prior to the application of the finish plaster coat. 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. Rebar placement shall be determined prior to floor coring operations. Any rebar, which has been cut, shall be submitted in writing to the Architect/Engineer for evaluation.

1.32 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. This shall be the responsibility of the General Contractor.

1.33 EXCAVATION, TRENCHING AND BACKFILL

A. Excavation (See Divisions 0 and 1 for special requirements related to excavation and trenching.):

1. The Mechanical and Electrical subcontractors 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. All exterior lines shall be installed with a minimum cover of 24", unless otherwise indicated. Generally, more cover shall be provided if grade will permit. All excavation materials not required for backfill or fill shall be removed and wasted as acceptable to the Construction Inspector. All excavations shall be made only by open cut. The banks of trenches shall be kept as nearly vertical as possible and where required, shall be properly sheeted and braced. Trenches shall be not less than 12" wider or more than 16" 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" nor more than 8" in width is provided on each side of the pipe. 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.

2. 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" 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. Bell holes shall be dug after the trench bottom has been graded. Where inverts are not shown, grading shall be determined by the Plumbing Code for the service intended and the size used. Bell holes for lead pipe joints shall be 12" in depth below the trench bottom and shall extend from a point 6" back of the face of the bell. Such bell holes shall be of sufficient width to provide ample room for caulking. 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. 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. In general, grading for electrical ductbanks and conduits shall be from building to manhole, and from a high point between manholes to each manhole. Special pipe beds shall be provided as hereinafter.

3. The lower 4" 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 men especially skilled in this type of work. Where damage is likely to result from withdrawing sheeting, the sheeting shall be left in place. 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. Where rock excavation is required, the rock shall be excavated to a minimum overdepth of 6" below the trench depths specified. The overdepth rock excavation and all excess trench excavation shall be backfilled with sand. 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.

4. All grading in the vicinity of excavation shall be controlled to prevent surface ground water from flowing into the excavations. Any water accumulated in the excavations shall be removed by pumping or other acceptable method. 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. Material unsuitable for backfilling shall be wasted and removed from the job site as directed by the Construction Inspector.

5. All shoring and sheeting required to perform and protect the excavations and to safeguard employees and/or adjacent structures shall be provided.

6. Excavate as required under the building in order that all piping, ductwork, etc., shall clear the ground a minimum of 12" for a distance of 24" on either side. Edges of such excavations shall slope at an angle...
of not over 45 degrees with the horizontal unless otherwise approved by the Construction Inspector. The bottom of such excavation shall be graded to drain in a manner acceptable to the Construction Inspector.

7. Trenches for cast iron drain, storm water and sewer lines inside the building shall be properly excavated, following, in general, the procedures set out for exterior lines. Where floors are to be poured over these lines, they shall be backfilled, tamped and settled with water. Where no flooring is to cover the lines, they shall be backfilled to form a level grade.

8. 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. The trenches shall be carefully backfilled with sand to a depth of 12 inches above the top of the pipe. 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" in diameter, flooded until the pipe has cover of not less than one foot. The remainder of the backfill material shall then be thrown into the trenches, moistened, and tamped or flooded in one foot layers. Blasted rock, broken concrete or pavement, and large boulders shall not be used as backfill material. 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.

2. 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 Reclosing Pavement and Lawns: 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. The sizes of the cut shall be held to a minimum, consistent with the work to be accomplished. 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. 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: All trees including low hanging limbs within the immediate area of construction shall be adequately protected to a height of at least 5 ft. to prevent damage from the construction operations and/or equipment. All excavation within the outermost limb radius of all trees shall be accomplished with extreme care. 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. The Construction Inspector will give immediate instructions for the disposition of same. 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" from the outside of any concrete structure or pipeline. No chips, parts of stumps, or loose rock shall be left in the excavation. 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.

1.34 ACCESS DOORS

A. General: This Contractor shall provide wall or ceiling access doors for unrestricted access to all concealed items of mechanical equipment or devices.

B. Doors: Access doors mounted in painted surfaces shall be of Milcor (Inland-Ryerson Construction Products Company) manufacture, Style K for plastered surfaces and Style M or DW for non-plastered surfaces. The
Style K doors shall be set so that the finished surface of the door is even with the finished surface of the adjacent finishes. Access doors mounted on tile surfaces shall be of similar construction as noted above, except they shall be of stainless steel materials. Access doors shall be a minimum of 12" x 12" in size.

1.35 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, he may do so, providing that he properly supervises the operation, and has the Construction Inspector's written permission to do so. 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.

B. 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. The date of acceptance and performance certification will be the same date.

1.36 EXISTING FACILITIES

A. The Contractor shall be responsible for loss or damage to the existing facilities caused by him and his workmen, and shall be responsible for repairing or replacing such loss or damage. 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. 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. This is to include 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. The Contractor shall allow the Owner two weeks in order to schedule required outages. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, shall be included in the contract amount.

1.37 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. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. 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. 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. The Contractor may, at his 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. 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. All relocations shall be performed by workmen 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. 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. 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. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Owner. 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. 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 hereinbefore specified.

1.38 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. 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. The decision of the owner concerning the appropriateness of the representative shall be final. 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: "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.

1.39 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. The Contractor shall provide all equipment, materials, and labor for making such tests. Reasonable amounts of fuel and electrical energy costs for system tests will be paid by the Owner. 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. 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 hereinafter for additional tests and requirements.

1.40 LOG OF TESTS

A. All tests shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel, description, and extent of system tested, test conditions, test results, specified results, and other pertinent data. Data shall be delivered to the Architect/Engineer as specified under “Requirements for Final Acceptance”. All Test Log entries shall be legibly signed by the Project Contractor or his authorized job superintendent.

1.41 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 of his 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.

1.42 CLEANING AND PAINTING

A. All equipment, piping, conduit, ductwork, grilles, insulation, etc., furnished and installed in exposed areas under Divisions 15 and 16 of these Specifications and as hereinafter specified shall be cleaned, prepared, and painted according to the following specification. In the event of a conflict between the specifications referenced, the provisions of this specification shall prevail only for Division 15 and 16 work.

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. The following materials shall not be painted: copper, galvanized metal, stainless steel, fiberglass, PVC, and PVDF.

C. 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. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Exposed metal work shall be carefully brushed down with the steel brushes to remove rust and other spots and left smooth and clean.

D. Color of finish painting in Mechanical Rooms shall be painted in accordance with The University of Texas Standard Color Schedule for machinery spaces using Kelly Moore or Pratt and Lambert enamel, or approved equal. For painting purposes, the equipment and piping inside of builtup air handling units shall be painted the same as if they were within the walls of a Mechanical Room. Two coats shall be applied with a light tint first coat and deep color for final coat. Colors shall be as follows:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>COLOR</th>
<th>PAINT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>STRUCTURE</td>
<td>LIGHT GRAY</td>
<td>SILVER 1700-111-W-37-1</td>
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<tr>
<td>FLOOR DRAIN LINES</td>
<td>BLACK</td>
<td>GALAXY BLACK 1700-68</td>
</tr>
<tr>
<td>FIRE SPRINKLER LINE</td>
<td>RED</td>
<td>SIREN RED 1700-62</td>
</tr>
<tr>
<td>BOILER</td>
<td>CLEAVER BROOKS BLUE</td>
<td>SEA BREEZE 1300-222-98-541 DC</td>
</tr>
<tr>
<td>Material</td>
<td>Color</td>
<td>Code</td>
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<td>--------------------------</td>
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<tr>
<td>Steam</td>
<td>White</td>
<td>WHITE 5392</td>
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<tr>
<td>Steam</td>
<td>White</td>
<td>WHITE 5301 Activator</td>
</tr>
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<td>Condensate Return</td>
<td>White</td>
<td>WHITE 1700-61</td>
</tr>
<tr>
<td>Softwater</td>
<td>Medium Blue</td>
<td>IRIS QUEEN 1700-222-V-23-2</td>
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<tr>
<td>Natural Gas</td>
<td>Yellow</td>
<td>DAISY YELLOW Y361M</td>
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<tr>
<td>Fuel Oil</td>
<td>Yellow</td>
<td>SUNBURST YELLOW 1700-63</td>
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<td>Lubricant Oil</td>
<td>Brown</td>
<td>PIGSKIN 1275-555-AC-13-N</td>
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<td>City Water</td>
<td>Light Blue</td>
<td>CASANOVA 1700-111-W-2-1</td>
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<tr>
<td>Chiller</td>
<td>Purple</td>
<td>PLUM 1700-333 z-10-3</td>
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<td>Dark Purple</td>
<td>CHILLER PURPLE 1700-333 z-10-3</td>
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<td>FOREST GREEN 1700-51</td>
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<td>Compressed Air</td>
<td>Light Green</td>
<td>SHAMROCK 1700-333-M-25-3</td>
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<td>Refrigerant Recovery</td>
<td>Purple</td>
<td>REFRIGERANT RECOVERY 1700-333-Z-10-3</td>
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<td>Pump Room Walls</td>
<td>Light Gray</td>
<td>NATIONAL CHEMSEARCH</td>
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<td>Dark Gray Epoxy</td>
<td>NAVY GRAY RUSTOLEUM 6086</td>
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<td>Pump Pads</td>
<td>Epoxy Activator</td>
<td>NAVY GRAY RUSTOLEUM 6001</td>
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<td>HEAT RESISTANT 4215 ALUM. FLOOR-</td>
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<td>Primer</td>
<td>Clear</td>
<td>POLYTECH</td>
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<tr>
<td>Floor-Finish/Hardner</td>
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<td>Floor-Color Additive</td>
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<td>Hanger Rods</td>
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<tr>
<td>Steam Traps and</td>
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<tr>
<td>Metal Exposed To</td>
<td>High Temp Rated</td>
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<tr>
<td>High Temperatures</td>
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<tr>
<td>Atmospheric</td>
<td>Same as &quot;Piping&quot; above</td>
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</tr>
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<td>Relief Lines</td>
<td>Same as &quot;Piping&quot; above</td>
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<tr>
<td>Ductwork, AHU, Fans</td>
<td>Buff</td>
<td>Y354M (TAWNY GOLD)</td>
</tr>
<tr>
<td>And Insulation</td>
<td></td>
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</tbody>
</table>

**E.** Aluminum jacketing on insulation shall not be painted.

**F.** No nameplates on equipment shall be painted, and suitable protection shall be afforded to the plates to prevent their being rendered illegible due to the painting operation.

**G.** Scope of painting for Divisions 22, 23, and 26 work in areas other than those defined as "exposed" is as follows:

1. All uncovered steel pipe, supports, exposed pipe and hanger rod threads, and hangers in underfloor spaces shall be cleaned and painted with two coats of Tropical Paint Co. No. 77-black asphaltic emulsion. Galvanized steel and copper lines in these spaces shall not be painted.

2. All canvas finishes including those underfloor and in concealed spaces shall be painted with one sizing coat if not already sized, containing mildew resistant additive and Arabol adhesive prior to any other specified finish paint.

3. All fuel piping (natural gas, LPG, etc.) all and fire protection piping shall be painted whether concealed or exposed, in all areas of the project without exception. Fuel piping shall be painted safety yellow, and fire protection piping shall be painted safety red. These "safety" colors shall be as defined by OSHA.

4. 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.**
H. 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 of Kelly Moore or Pratt and Lambert, Inc.'s "Effector" enamel of color selected by the Architect/Engineer.

I. Additional areas to be defined as "exposed" for purposes of painting, are defined on the Drawings.

J. The surfaces to be finish painted shall first be prepared as follows:
   1. On canvas finishes pretreat as specified above. Insulated surfaces having vapor barrier jacket exposed to view shall first be painted with one (1) coat of sealer.
   2. 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.
   3. Aluminum surfaces shall first be painted with one (1) coat of P&L zinc chromate primer.
   4. Cast iron pipe shall first be primed with a "nonbleed" primer.
   5. The underside of all cast iron sinks not recessed in a cabinet are included as items to be painted in exposed areas.

K. 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. 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.

L. All 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.

PART 2 – PRODUCTS Not Used

PART 3 – EXECUTION Not Used

END OF SECTION
PART 1 - GENERAL

1.1 PURPOSE

A. The University of Texas Southwestern Medical Center (UTSW) deals with many Architectural and Engineering firms. Each firm normally has in-house CAD procedures.

B. However, these procedures differ between firms, and even divisions within firms. The result is a campus-wide drawing record system with drawings that vary in scale, font, text size, and layers from project to project.

C. The purpose of this Specification is to establish standardized procedures for UTSW project engineering drawings generated by computer.

1.2 APPLICABILITY

A. This Specification applies to all MEP projects completed in-house or completed by any Architect/Engineering (A/E) firms. No substitutions to the Specification are acceptable without the written authorization of the ENGINEER.

B. This Specification is part of the terms and conditions of contract engineering design at The University of Texas Southwestern Medical Center (UTSW).

C. Prior to the acceptance of project closeout drawings the responsible A/E firm shall submit an electronic copy of all drawings to the Engineering Department supervisor, who shall certify that the electronic drawing files comply with these standards.

D. Layers: The following layers shall be used for all mechanical, electrical, plumbing, and fire protection drawings. No other layer designations are permissible.

   HVAC/Mechanical:
   M-AHU     Air handler components
   M-CHILLER Chillers and refrigeration components
   M-CONTROLS Control panels, sensors, wiring, and text
   M-DEMO    Mechanical components scheduled for demolition
   M-EQUIP   Unspecified mechanical equipment
   M-EXH     Exhaust duct
   M-EXH-VAV  Exhaust VAV
   M-EXH-GRILLE Exhaust grille
   M-HVTEXT  HVAC duct size and CFM text
   M-LPDUCT  All low pressure ductwork down stream of the VAV
   M-PAD     Equipment pads
   M-PUMP    All pumps
   M-RA-DUCT Return air ducting
   M-RA-GRILLE Return air grille
   M-SA-COLD Cold deck supply air (medium pressure)
   M-SA-DIFF Supply air diffusers
   M-SA-HOT  Hot deck supply air (medium pressure)
   M-VAV     Variable air volume boxes (VAV)
   M-TEXT    General mechanical text and notes

   Electrical:
   E-120V-CKT All 120 volt circuits, panels, text, etc.
### Electrical Layers:

<table>
<thead>
<tr>
<th>Layer Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-120V-RECP</td>
<td>All 120 volt receptacles and plug mold only</td>
</tr>
<tr>
<td>E-120V-LGHT</td>
<td>All 120 volt ceiling mounted lights only</td>
</tr>
<tr>
<td>E-120V-LCKT</td>
<td>All 120 volt lighting circuits, panels, text etc.</td>
</tr>
<tr>
<td>E-120V-UCLT</td>
<td>All 120 volt under cabinet lights, circuits, and text</td>
</tr>
<tr>
<td>E-208V-RECP</td>
<td>All 208 volt receptacles only</td>
</tr>
<tr>
<td>E-208V-CKT</td>
<td>All 208 volt circuits, panels, text etc.</td>
</tr>
<tr>
<td>E-277V-CKT</td>
<td>All 277 volt circuits, panels, text etc.</td>
</tr>
<tr>
<td>E-277V-LCKT</td>
<td>All 277 lighting circuits, panels, text, etc.</td>
</tr>
<tr>
<td>E-277V-LGHT</td>
<td>All 277 volt ceiling mounted lights only</td>
</tr>
<tr>
<td>E-480V-CKT</td>
<td>All 480 volt circuits, panels, text etc.</td>
</tr>
<tr>
<td>E-480V-DISC</td>
<td>All 480 volt disconnects only</td>
</tr>
<tr>
<td>E-CTRAY</td>
<td>All cable tray</td>
</tr>
<tr>
<td>E-DEMO</td>
<td>Electrical components scheduled for demolition</td>
</tr>
<tr>
<td>E-CONDUIT</td>
<td>All conduit</td>
</tr>
<tr>
<td>E-TEXT</td>
<td>General electrical text and notes</td>
</tr>
</tbody>
</table>

### Piping:

<table>
<thead>
<tr>
<th>Layer Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>P-AIR</td>
<td>Compressed air piping and text</td>
</tr>
<tr>
<td>P-AW</td>
<td>Acid wastes and vents piping and text</td>
</tr>
<tr>
<td>P-CO2-GAS</td>
<td>Carbon dioxide gas piping and text</td>
</tr>
<tr>
<td>P-CNS</td>
<td>Condenser water supply and text</td>
</tr>
<tr>
<td>P-CNR</td>
<td>Condenser water return and text</td>
</tr>
<tr>
<td>P-CR</td>
<td>Steam condensate return and text</td>
</tr>
<tr>
<td>P-CWR</td>
<td>Chill water return piping and text</td>
</tr>
<tr>
<td>P-CWS</td>
<td>Chill water supply piping and text</td>
</tr>
<tr>
<td>P-DEMO</td>
<td>Plumbing components scheduled for demolition</td>
</tr>
<tr>
<td>P-DIR</td>
<td>De-ionized water return piping and text</td>
</tr>
<tr>
<td>P-DIS</td>
<td>De-ionized water supply piping and text</td>
</tr>
<tr>
<td>P-FUEL</td>
<td>Fuel oil system piping and text</td>
</tr>
<tr>
<td>P-HWR</td>
<td>Hot water return piping for HVAC coils and text</td>
</tr>
<tr>
<td>P-HWS</td>
<td>Hot water supply piping from HVAC coils and text</td>
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<tr>
<td>P-LAB-HW</td>
<td>Laboratory hot water piping and text</td>
</tr>
<tr>
<td>P-LAB-CW</td>
<td>Laboratory cold water piping and text</td>
</tr>
<tr>
<td>P-NGAS</td>
<td>Natural gas piping and text</td>
</tr>
<tr>
<td>P-N2-GAS</td>
<td>Nitrogen gas piping and text</td>
</tr>
<tr>
<td>P-N2-LIQ</td>
<td>Liquid nitrogen piping and text</td>
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<tr>
<td>P-SAN</td>
<td>Sanitary sewer piping, vents, and text</td>
</tr>
<tr>
<td>P-STORM</td>
<td>Storm sewer piping and text</td>
</tr>
<tr>
<td>P-STEAM</td>
<td>Steam supply piping and text</td>
</tr>
<tr>
<td>P-TEXT</td>
<td>General non-specific piping text</td>
</tr>
<tr>
<td>P-VAC</td>
<td>Vacuum piping and text</td>
</tr>
<tr>
<td>P-VALVE</td>
<td>Valves and text</td>
</tr>
</tbody>
</table>

### Fire Protection:

<table>
<thead>
<tr>
<th>Layer Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-ALARM</td>
<td>All alert devices (audible, strobe, etc.) and text</td>
</tr>
<tr>
<td>F-CO2</td>
<td>CO2 suppression system and text</td>
</tr>
<tr>
<td>F-DAMPER</td>
<td>Smoke dampers, fire dampers, and text</td>
</tr>
<tr>
<td>F-DEMO</td>
<td>Fire protection components scheduled for demolition</td>
</tr>
<tr>
<td>F-HALON</td>
<td>Halon or other type suppression system and text</td>
</tr>
<tr>
<td>F-PIPING</td>
<td>Fire protection piping and text</td>
</tr>
<tr>
<td>F-PENDANT</td>
<td>Drop ceiling sprinkler heads only</td>
</tr>
<tr>
<td>F-SPRINK</td>
<td>Sprinkler heads other than drop ceiling</td>
</tr>
<tr>
<td>F-TEXT</td>
<td>General non-specific fire protection text</td>
</tr>
<tr>
<td>F-VALVES</td>
<td>Fire protection isolation valves and text</td>
</tr>
</tbody>
</table>

### Miscellaneous Layers:

<table>
<thead>
<tr>
<th>Layer Code</th>
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<tbody>
<tr>
<td>A-TEXT</td>
<td>Paper space notes</td>
</tr>
<tr>
<td>VIEWPORT</td>
<td>View ports</td>
</tr>
<tr>
<td>XREF-BASE</td>
<td>All drawings are to be x-reffed on this layer</td>
</tr>
</tbody>
</table>

**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. Floor master drawings (if available) will be provided by e-mail or CD.

B. Master drawings follow the following alphanumeric designations as shown in the examples below:

- NA01MP  Building "NA", floor 1, mechanical floor plan
- B02PS  Building B, floor 2, plumbing sectional views
- DC01EL  Building DC, floor 1, lighting floor plan

C. Master drawings have the following classifications by discipline:

- MP  HVAC/mechanical equipment floor plan
- MS  HVAC/mechanical equipment sectional views
- EP  Electrical power floor plan
- EL  Electrical lighting floor plan
- ET  Cable tray
- ES  Electrical sectional views
- PP  Plumbing floor plan
- PS  Plumbing sectional views
- FP  Fire protection floor plan
- FS  Fire protection sectional views

Note: the EP and EL Floor Masters are eventually combined. Maintaining separate electrical master drawings is left to A/E choice.

D. 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.

E. 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. Since every A/E firm has their own project numbering scheme the use of project identifiers has not worked well.

B. Project Drawing Masters shall the following alphanumeric designations as shown in examples listed below:

- L5R262M  Bldg L, floor 5, room 262, mechanical HVAC
- NA8R410E  Bldg NA, floor 8, room 410, electrical
- B2R300P  Bldg 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 MASTERS 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". There are no exceptions.

1.5 SETTING UP PRESENTATION DRAWINGS

A. Presentation drawings shall follow the following classifications by discipline:
M1.1, 1.2... HVAC/mechanical equipment demolition floor plans
M2.1, 2.2... New HVAC/mechanical equipment floor plans
M3.1, 3.2... HVAC/mechanical equipment sectional views
M4.1, 4.2... HVAC/mechanical equipment details
M5.1, 5.2... HVAC/mechanical equipment schedules

E1.1, 1.2... Electrical demolition floor plans
E2.1, 2.2... Electrical power floor plans
E3.1, 3.2... Electrical lighting floor plans
E4.1, 4.2... Electrical power and lighting details
E5.1, 5.2... Electrical power and lighting schedules

P1.1, 1.2... Plumbing demolition floor plans
P2.1, 2.2... New plumbing floor plans
P3.1, 3.2... Utility piping plans
P4.1, 4.2... Plumbing details
P5.1, 5.2... Plumbing fixture schedules

F1.1, 1.2... Fire protection demolition floor plans
F2.1, 2.2... New fire protection floor plans
F3.1, 3.2... Fire protection sectional views
F4.1, 4.2... Fire protection details
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. UTSW deals with many A/E firms; all of who have there own choice and size of fonts. This proves to be a significant problem in drawing reconciliation.

B. Drawing presentation shall be set up on 1/4” 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 are 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. Text size on presentation drawings shall be 3/32 inch.

F. The VIEWPORT layer shall be frozen for all printed drawings.

G. All blocks shall be created and set to layer 0 prior to inserting into a drawing. The color shall be set to ‘by layer’. Do not ‘nest’ other layers or colors within the block.

PART 2 – PRODUCTS
Not Used

PART 3 – EXECUTION
Not Used

END OF SECTION
PART 1 - GENERAL

1.1 PURPOSE

A. This Specification establishes University of Texas Southwestern Medical Center (UTSW) requirements for plumbing projects on campus. This document addresses design criteria not specifically covered by the Plumbing Code (UPC), or sets requirements that may exceed the minimum requirements of the Code.

1.2 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.

1.3 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.

1.4 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, etc. 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.

1.5 PLUMBING DESIGN FOR WET LABS

A. UTSWMC 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 ½” 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” 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” 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.

1.6 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.

1.7 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” 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”. 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 the Texas Department of Health water saving performance standards. Photoelectric activated plumbing fixtures are generally not in use at the campus, and as a result of past maintenance problems their introduction is discouraged.

1.8 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’ 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.

1.9 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” wide x 14” 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
SECTION 221116
PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and pipe fittings.
B. Valves.
C. Sanitary sewer piping system.
D. Domestic water piping system.
E. Storm water piping system.
F. Natural gas piping system.
G. Wet Pipe Fire Protection piping system

1.2 REFERENCES

A. AGA - American Gas Association.
B. ANSI B31.1 - Power Piping.
C. ANSI B31.2 - Fuel Gas Piping.
D. ANSI B31.4 - Liquid Petroleum Transportation Piping Systems.
E. ANSI B31.9 - Building Service Piping.
F. ASME - Boiler and Pressure Vessel Code.
G. ASME Sec. 9 - Welding and Brazing Qualifications.
H. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.
I. ASME B16.3 - Malleable Iron Threaded Fittings.
J. ASME B16.4 - Cast Iron Threaded Fittings Class 125 and 250.
K. ASME B16.18 - Cast Bronze Solder-Joint Pressure fittings.
L. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings.
M. ASME B16.23 - Cast Copper Alloy Solder-Joint Drainage Fittings - DWV.
O. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
P. ASME B16.32 - Cast Copper Alloy Solder Joint Fittings for Solvent Drainage Systems.
Q. ASTM A47 - Ferritic Malleable Iron Castings.
R. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
S. ASTM A74 - Cast Iron Soil Pipe and Fittings.
T. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses.
U. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
V. ASTM B32 - Solder Metal.
W. ASTM B42 - Seamless Copper Pipe.
X. ASTM B43 - Seamless Red Brass Pipe.
Y. ASTM B75 - Seamless Copper Tube.
Z. ASTM B88 - Seamless Copper Water Tube.
AA. ASTM B251 - Wrought Seamless Copper and Copper-Alloy Tube.
BB. ASTM B302 - Threadless Copper Pipe (TP).
CC. ASTM B306 - Copper Drainage Tube (DWV).
DD. ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
EE. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
FF. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
HH. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).
JJ. ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing and Fittings.
KK. ASTM D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
MM. ASTM D2683 - Socket-Type Polyethylene Fillings for Outside Diameter-Controlled Polyethylene Pipe.
NN. ASTM D2729 - Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
OO. ASTM D2751 - Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
PP. ASTM D2846 - Chlorinated Polyvinyl Chloride (CPVC) Pipe, Fittings, Solvent Cements and Adhesives for Potable Hot Water Systems.
RR. ASTM D3033 - Type PSP Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
SS. ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
TT. ASTM D3309 - Polybutylene (PB) Plastic Hot Water Distribution System.
UU. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
WW. ASTM F845 - Plastic Insert Fittings for Polybutylene (PB) Pipe.
XX. AWS A5.8 - Brazing Filler Metal. BA. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
YY. AWWA C110 - Ductile - Iron and Gray - Iron Fittings 3 in. through 48 in., for Water and Other Liquids.
AAA. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
BBB. AWWA C651 - Disinfecting Water Mains.
DDD. CISPI 310 - Joints for Hubless Cast Iron Sanitary Systems.
EEE. CAN-3 B281 - Aluminum Drain, Waste, and Vent Pipe and Components.
FFF. NCPWB - Procedure Specifications for Pipe Welding.
HHH. NFPA 58 - Storage and Handling of Liquified Petroleum Gases.
III. TDH - Texas Department of Health, Water System Regulations

1.3 SUBMITTALS
A. Submit under provisions of Division 1 and Section 22 0010.
B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.5 PROJECT RECORD DOCUMENTS
A. Submit under provisions of Division 1 and Section 22 0010.
B. Record actual locations of valves, etc.

1.6 OPERATION AND MAINTENANCE DATA
A. Submit under provisions of Division 1 and Section 22 0010.
B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.7 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 Sec. 9.
D. Maintain one copy of each document on site.

1.8 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.

1.9 REGULATORY REQUIREMENTS

A. Perform Work in accordance with International Plumbing Code.
B. Conform to applicable code for installation of backflow prevention devices.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 1 and Section 22 0010.
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 are wet or frozen.

1.12 EXTRA MATERIALS

A. Furnish under provisions of Division 1 and Section 22 0010.
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. 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. Plates will not be required for piping where pipe sleeves extend 3/4" above finished floor. 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: 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. All penetrations must pass through sleeves except soil pipe installed under concrete slabs on fill. 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. 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”, except that the minimum clearance shall accommodate a Thunderline Link-seal closure where piping exits the building, or penetrates a wall below ground level. Contractor shall be responsible for the accurate location of penetrations in the slab for his pipe, duct, etc. All penetrations shall be of ample size to accommodate the pipe, duct, etc. plus any specified insulation. 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. Refer to the details on the project drawings. 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: 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.

F. Fasteners: 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.

Note: Under no circumstances will the use of plastic anchors or plastic expansion shields be permitted for any purpose whatsoever.

G. Ratproofing: The open space around all ductwork, piping, etc., passing through the ground floor and/or exterior walls shall be ratproofed 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: 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, vermintight barrier that is capable of containing smoke and fire up to 2000 degrees F for two hours. Sealing of cable trays, and conduits that extend through rated walls from ends of cable tray shall be done after conductors have been installed. For wet locations, the foam material shall be a silicone RTV foam or an approved equal. For dry locations a premixed putty equal to Nelson Flameseal Firestop putty may be used.

2.3 VALVES

A. 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. All valves must be of threaded or flanged type. No solder connected or grooved fitting valves shall be used on this project. 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.

B. All valves used in circulating systems, plumbing and steam systems (low and medium pressure) shall be Class 150 SWP. Class 300 valves shall be constructed of all ASTM B-61 composition. 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.

C. 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. 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.

D. All cast steel body valves shall have the pressure containing parts constructed of ASTM designation A-216-GR-WCB carbon steel. 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. 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”. Sizes 8” 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% chromium A-182-F6 stainless. Handwheels shall be A47 Grade 35018 malleable iron or Ductile Iron ASTM A536.

E. 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.

F. 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” and larger which may have either malleable iron or ASTM A-126 Class B, gray iron hand wheels.

G. 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.

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. Balancing and/or Shutoff Valves for Water Systems: 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. Valves 2-1/2” 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" (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. Butterfly valves 8” 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. Valves 2-1/2” through 6” 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.

J. Gate Valves for Fire Protection Service: 2” and smaller, bronze body, outside screw and yoke, rising stem, solid wedge, Underwriters’ Laboratories Listed and Factory Mutual Approved, screw pattern. Iron body, 2-1/2” and larger wedge, flanged pattern, OS&Y rising stem. Underwriters Laboratories Listed and Factory Mutual Approved. Butterfly valves U. L. listed with tapped full lug body and gear operated with malleable mop hand-wheel and position indicator may also be used.
K. Check Valves: Bronze body, 2" and smaller, bronze body regrinding disc and seat with screw-in cap. Iron body, 2-1/2" 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" and smaller shall be bolted cap and body, screwed end connections and conform to ANSI B16.34 and pressure temperature rating.

L. Check Valves Fire Protection System: Iron body, swing-check, bronze disc, seat ring and hinge pin, 175 psi rated working pressure, Underwriters' Laboratories and Factory Mutual approved. Complete with ball drip assembly.

M. Standards of Quality for Valves:

**Standard of Quality for Valves:**

<table>
<thead>
<tr>
<th>2&quot; &amp; smaller</th>
<th>Gate Valve</th>
<th>L.P. Steam</th>
<th>Milwaukee</th>
<th>Milwaukee</th>
<th>Nibco</th>
<th>Nibco</th>
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<tbody>
<tr>
<td>2-1/2&quot; &amp; larger</td>
<td>Gate Valve</td>
<td>L.P. Steam</td>
<td>F-2885</td>
<td>F-617-0</td>
<td>G-623</td>
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### Chilled, Water, Plumbing

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<thead>
<tr>
<th>2&quot; &amp; smaller</th>
<th>Ball Valve</th>
<th>Domestic Hot &amp; Cold Water Plbg. Systems Recirculating Chilled and Heating Water</th>
<th>Any Appollo Series 70</th>
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<tbody>
<tr>
<td></td>
<td>Globe, Angle &amp; Balancing Valve</td>
<td>Chilled Water, L.P. Steam</td>
<td>590T</td>
</tr>
<tr>
<td>2-1/2&quot; &amp; larger</td>
<td>Globe, Angle &amp; Balancing Valve</td>
<td>Plumbing, Chilled Water, L.P. Steam</td>
<td>F-2981</td>
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<tr>
<td>2-1/2&quot; &amp; larger</td>
<td>Butterfly Valve for shutoff</td>
<td>Domestic Hot &amp; Cold Water Plbg. Systems Recirculating Chilled and Heating Water</td>
<td>ML-123B</td>
</tr>
<tr>
<td>2&quot; &amp; smaller</td>
<td>Gate Valve</td>
<td>Fire Protection</td>
<td>--</td>
</tr>
<tr>
<td>2-1/2&quot; &amp; larger</td>
<td>Gate Valve</td>
<td>Fire Protection</td>
<td>--</td>
</tr>
<tr>
<td>Size &amp; Type</td>
<td>Valve</td>
<td>Material</td>
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<tr>
<td>------------</td>
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</tr>
<tr>
<td>2-1/2&quot; &amp; Larger</td>
<td>Check Valve</td>
<td>***Fire Protection</td>
<td>--</td>
</tr>
<tr>
<td>2&quot; &amp; Smaller</td>
<td>Check Valve</td>
<td>All Water Systems</td>
<td>510</td>
</tr>
<tr>
<td>2-1/2&quot; &amp; Larger</td>
<td>Check Valve</td>
<td>All Water Systems</td>
<td>1400 Series</td>
</tr>
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<td>Primary Hot Water</td>
<td>276AP</td>
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<tr>
<td>2-1/2&quot; &amp; Larger</td>
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<td>Primary Hot Water</td>
<td>F-2983 F-768-B</td>
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<tr>
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<td>Gate Valve</td>
<td>High Pressure Steam</td>
<td>--</td>
</tr>
<tr>
<td>2&quot; &amp; Larger</td>
<td>Gate Valve</td>
<td>High Pressure Steam</td>
<td>--</td>
</tr>
<tr>
<td>2&quot; to 12&quot;</td>
<td>Hub End</td>
<td>(AWWA)</td>
<td>--</td>
</tr>
<tr>
<td>1-1/2&quot; &amp; Smaller</td>
<td>Lubricated Gas Cock</td>
<td>Medical &amp; Lab gases</td>
<td>BB2-100</td>
</tr>
<tr>
<td>2&quot; &amp; Larger</td>
<td>Lubricated Gas Cock</td>
<td>Medical &amp; Lab gases</td>
<td>--</td>
</tr>
<tr>
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<td>Isolation Ball Valve</td>
<td>Medical &amp; Lab gases</td>
<td>Spirax Sarco Model 60</td>
</tr>
</tbody>
</table>

*Requires extended stem in insulated lines.

**Valves 8" and larger, and valves used for balancing service regardless of size, shall have heavy duty weather proof encased gear operators.

***Requires ball drip assembly.

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. 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. Unions in 2" and smaller in ferrous lines shall be Class 300 AAR malleable iron unions with iron to brass seats, and 2-1/2" 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 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: This 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, steam, steam condensate, and fire protection systems.

B. MATERIALS: All 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. 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. Only one manufacturer of weld fittings will be approved for the project. Fittings that have been machined, remarked, printed or otherwise produced domestically from non-domestic forgings or materials will not be acceptable. Each 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.

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. 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. 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. The owner will, at the owners 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. The contractor shall be responsible for all labor, material and travel expenses involved in the reinspection 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/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. 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. Complete test reports may be required for any fittings selected at random. Only one manufacturer of weld fittings will be approved for each project. Fittings which have been machined, remarked, printed or otherwise produced domestically from imported forgings or materials will not be acceptable. Each fitting shall have the manufacturer's trademark permanently identified 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.

2.6 FLANGES

A. All 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. 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. 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 forgings 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. All thread rods will not be an acceptable for flange bolts. Bolts shall have a tensile strength of 60,000 psi and an elastic limit of 30,000 psi. Flat faced flanges shall be furnished where required to match flanges on pumps, check valves, strainers, etc. Only one manufacturer of weld flanges will be approved for each project.

B. All flanges shall be gasketed. Contractor shall place gasket between flanges of flanged joints. Gaskets shall fit within the bolt circle on raised face flanges and shall be full face on flat face flanges. 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.

2.7 STORM WATER SYSTEM

A. A complete system of storm water drainage piping shall be installed as indicated on the Drawings. Storm water systems shall be installed with the materials and methods as specified in the following paragraphs.

B. PIPE & FITTINGS:

1. All interior downspouts and interior storm drainage piping, and all such piping up to a point five feet (5') outside the building walls, or to any other point indicated on the Drawings, shall be service weight cast iron soil pipe conforming to ASTM Specification A-74 and CISPI Standard 301, hub and spigot for pipe ten inch (10") and larger and hubless for eight inch (8") and smaller. 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. Piping shall be Type DWV copper pipe with wrought copper sweat joints where indicated on the Drawings. 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. INSTALLATION OF PIPING:
1. All piping shall be run in the most direct manner. Piping cannot interfere with other maintenance items, e.g., VAV boxes, EMS control boxes. Horizontal pipes shall have a grade of one-quarter inch (1/4") per foot, wherever possible, and not less in any case than one-eighth inch (1/8") per foot, unless otherwise noted on Drawings.

2. All 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. 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. Each clamp shall consist of a neoprene gasket with a stainless steel outer band which effectively captures the gasket material. Each clamp shall bear the FM and UPC stamp, shall be approved to Class I of Factory Mutual Standard #1680, and shall be Clamp-All or approved equal. All elbows and tees shall be braced against thrust loads which might result in joint separation due to dynamic forces caused by sudden, heavy impulse loading (water hammer) conditions.

3. Cleanouts shall be provided at the bottom of each downspout, at each change of direction and at intervals not exceeding 95 feet in horizontal runs. 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. All interior cleanouts shall be of the same size at the pipe served up to four inch (4") size and four inches (4") for all larger lines.

4. 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. 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. A removable concrete stopper shall be set in the open top of the cleanout pipe.

5. All horizontal runs of storm drainage piping within the building, except in crawl space shall be insulated as described in the insulation specifications.

6. All 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.

D. ROOF AND AREA DRAINS: All roof and area drains will be furnished and installed by the Mechanical Contractor with all accessories required for the particular construction in which they are to be mounted. Area drains shall be as specified in other sections.

E. TREE WELL DRAINS AND CATCH BASINS: All tree well drains and catch basins shall be furnished and installed by the Mechanical Contractor with all accessories as indicated on the Drawings and as specified in other sections.

F. SUB-SOIL DRAINAGE:
   1. Excavation to bottom of grade beam is by General Contractor. Final fine grading for sub-soil pipe is by Mechanical Contractor.
   2. Material for backfill, twelve inch (12") both sides of pipe and twenty-four (24") above pipe bottom of excavation, shall be furnished by General Contractor and installed by Mechanical Contractor. Additional backfill is furnished and installed by General Contractor.
   3. Where shown on Drawings and as detailed, furnish and install Perforated PVC Drain Pipe of the size as indicated on the Drawings.

G. TESTS: All storm drains shall be tested in vertical sections of approximately 50 feet each by filling leader with water and allowing to stand twenty-four (24) hours. Any leaks discovered shall be repaired and the test repeated. All tests shall be observed by a representative of the Architect before tests are removed.

2.8 SANITARY DRAINAGE SYSTEM
A. The sanitary drainage system shall be installed as indicated on the Drawings complete with all fixtures, drains, traps and required connections. All fixtures and drains shall be properly vented and trapped. 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.

B. Materials and installation of the system shall be as specified in the following paragraphs.

C. PIPE AND FITTINGS:
1. All 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 Specifications A-74 and CISPI standard 301, hub and spigot for ten inch (10") and larger and hubless for eight inch (8") and smaller, each piece of pipe and each fitting shall have the manufacturer's mark or name cast on it.
2. All 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" of 5'-0" 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.)
4. All 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.

D. INSTALLATION OF PIPING:
1. All piping shall be run in the most direct manner. Horizontal pipes shall have a grade of one-quarter inch (1/4") per foot, wherever possible, and not less in any case than one-eighth inch (1/8") per foot, unless otherwise noted on Drawings.
2. All 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. 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. Each clamp shall consist of a neoprene gasket with a stainless steel outer band which effectively captures the gasket material. Each clamp shall bear the FM and UPC stamp, and shall be approved to Class I of Factory Mutual Standard #1680, and be equal to Clamp-All. All materials used in the clamp shall be stainless steel. All 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. 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.
3. Cleanouts shall be provided at the bottom of each downspout, at each change of direction and at intervals not exceeding 95 feet in horizontal runs. 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. All interior cleanouts shall be of the same size at the pipe served up to four inch (4") size and four inches (4") for all larger lines.
4. 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. 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. A removable concrete stopper shall be set in the open top of the cleanout pipe.
5. All horizontal runs of storm drainage piping within the building, except in crawl space shall be insulated as specified.

E. FLASHINGS: All 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 ten inches (10") on each side of the pipe. The vertical portion of the flashing shall extend upward the entire length of the pipe and be turned inside the pipe at least two inches (2"). Lead flashings shall be fabricated and furnished by Mechanical Contractor and turned over to Roofing Contractor who will install them.

F. TESTING:
1. 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. One floor level of the building shall be tested at a time. 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. 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. 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.

2. 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. 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.

3. 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.

G. FABRICATION METHODS FOR SEWAGE AND DRAINAGE PIPE LINES:

1. Install promptly all sewer, drains and piping after excavating, chasing or cutting for same has been done so as to keep the openings for such piping open as short a time as possible. No piping shall, however, be permanently closed up, furred in or covered before the examination of same by the authorities having jurisdiction.

2. Waste pipes shall be sized to conform to the sizes indicated on the Drawings. Under no circumstances shall any drain line be smaller than two inches. The waste pipes from water closets shall not be smaller than four inches.

3. The drilling and tapping of soil or waste lines or the use of saddle joints or the welding or brazing of hubs or pipe to any soil, waste or vent lines is prohibited.

4. Wastes must be brought up directly in back of each fixture as not horizontal branch arms of lead or brass will not be allowed.

5. No waste or soil lines shall enter the vertical part or heel of a lead or cast iron closet bend. Waste lines may enter the horizontal part of the lead or cast iron closet bend. No sink or lavatory waste line shall enter any other waste line of two inch (2") size.

6. All waste connections shall be made of heavy brass threaded nipples or with copper tube with appropriate screw to sweat adapters for connecting to sanitary tee. All fixtures used in connection with the conveying of any waste substance to the sanitary sewer, shall be connected by means of a trap, waste and overflow. Slip joints will be permitted only on the house side of the trap, waste and overflow, or appliance which have such slip joints embodied in their original manufacture. Fixtures which have waste opening connected to the soil or waste lines by the use of bolts or screws shall have such connections made by the use of the exact number of bolts or screws as provided for in their original manufacture.

7. Where waste and vents are exposed at fixtures, pipes shall be chrome plated brass or brass W.C.P. cover (iron pipe size) and shall have chrome plated escutcheons where they pass through floors, walls, or ceilings.

H. VENTS:

1. Vent pipes shall be carried up adjoining soil and waste pipes, and they shall be connected into the main stack at top and bottom as indicated on the plumbing riser diagrams on the Drawings.

2. Vent pipes shall be of hubless cast iron pipe.

3. All vent lines shall be so constructed that they cannot be used for waste or soil lines. No fixture shall be double trapped.
I. CONNECTIONS FOR FLOOR MOUNTED WATER CLOSETS: All connections for floor mounted water closets and waste piping shall be made with an appropriate cast iron closet flange and wax gaskets.

2.9 WATER SUPPLY SYSTEM

A. A complete system of hot and cold water supply to all plumbing fixtures and mechanical equipment shall be supplied and installed as shown on the Drawings. The water supply system shall be installed using the materials and methods as specified in the following paragraphs.

B. BUILDING ENTRANCE:
1. A metallic sleeve shall be inserted in the forms of the building wall through which the water service enters the building. The interior diameter of such sleeve shall be four inches (4") greater than the exterior diameter of the water service.
2. The water service pipe from within the building shall be extended to a point three feet outside the building wall through this sleeve. The position of the water service in this sleeve shall be concentric and the intervening space shall be packed in a flexible manner to avert the flow of water from outside of the building into the basement.
3. The pipe extended outside the building shall be provided with a protective wrapping of "Tape Coat" SP warmed with hand torch. This protective tape shall be applied with "half-lap" coverage in strict accordance with the manufacturer's published instructions. The cast iron pipe connected to the pipe extending from the building wall shall contain two caulked joints within four feet of the union of the cast iron pipe and the pipe from building.

2.10 INTERIOR DOMESTIC WATER PIPING SYSTEMS

A. ALL piping within confines of building walls shall be a part of the interior water piping system. Interior domestic water piping material and installation shall be as specified in the following paragraphs.

B. PIPE:
1. Interior domestic water piping larger than six inches (6") shall be Schedule 40 galvanized steel pipe. 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 A.S.T.M. Designation A-53, latest revision, Type E or S. This threaded pipe shall be supplied with thread protectors on each end. All steel water pipe shall be hot-dipped galvanized pipe zinc coated both inside and outside.
2. Unless otherwise shown on the Drawings, all interior domestic water piping four inches (4") and smaller shall be fabricated of Type K, hard drawn, copper pipe made of deoxidized copper (99.9% pure). No pipe smaller than three-fourths inches (3/4") shall be used in this project except at local connections or as detailed for laboratory areas. This Type K copper pipe shall conform in every detail to A.S.T.M. Standard Specifications for COPPER WATER TUBE, Serial Designation B-88-66, and it shall be provided in 20 foot straight lengths. Copper pipe may only be joined using non-lead-bearing solder, such as 95-5 silver or antimony solder (95 percent tin, and 5 percent silver or antimony).

C. FITTINGS:
1. All fittings for six inch (6") 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.
2. All fittings for four inch (4") and smaller water lines shall be Streamline Solder Fittings manufactured by Streamline Pipe and Fittings Division, Mueller Brass Company, or approved equal. These wrought copper fittings shall be rigid and strong with openings machined to accurate capillary fit for the pipe.
3. Fittings for piping systems involving the use of copper pipe shall 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. Silver solder consisting of 95 percent tin and 5 percent silver is the only acceptable substitution.
D. HEADERS:
1. Suitable headers of the nature detailed on the accompanying Drawings shall be provided for the
distribution of the cold water and hot water systems. These headers shall be fabricated by a fusion
welding process by the use of extra strong black steel pipe and pipe supplies of the same character.
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-1939).
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”.
2. Upon being completed, 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 rewelding. After repairs have been made, the
headers shall be retested as described above.
3. After the headers have been tested and found to be tight, they shall be galvanized by a "double-dip"
process. The manufacturer shall be required to provide certificates assuring the fact that the headers
were so "double-dipped". Both exterior and interior surfaces shall receive a heavy zinc coating by a hot
dipping process. 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. 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. At a
point just beyond these gate valves, a three-fourths inch (3/4") valved drain line shall be installed in the
case of each outgoing branch leaving the header. 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.
These three-fourths inch (3/4") drain line valves from the various branches leaving the headers shall be
likewise lined up in a straight horizontal line. These three-fourths inch (3/4") drain lines shall terminate
in a common "drain line". That one inch (1") drain line shall be the header drain line. Headers
fabricated from copper pipe and fittings may be substituted only with the written approval of the owner.

E. 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. Valves shall be provided on all inlet (and
outlet where applicable) connections to all kinds of apparatuses, all risers and all groups of fixtures.
Groups of fixtures shall be arranged to have their group valves in one location. Access shall be
provided to all concealed valves by means of an access door. 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.
2. 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.

F. 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.

G. 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.
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 and Section 15010 for other information concerning installation of piping.

H. 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. 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 200 pounds per square inch gauge for a period of no less than twenty-four hours. During this test period, all pipe, fittings and accessories in the particular piping system which is being tested shall be carefully inspected. 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. 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. 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. 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. 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 O-C-114. 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. 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 of Dallas, Texas, and the specifications above, and upon completion of the process, the Health Department shall test and certify the cleanliness of the water piping system. The Mechanical Subcontractor shall pay all costs and charges incidental to this test and certification.

2.11 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. This Contractor shall, moreover, pay all fees and deposits which are required to have the meter "set" by the Gas Company. This Contractor shall then extend the gas service into the buildings. This Contractor shall make all arrangements and pay all fees which are required for odorizing the entire gas distribution system. 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. 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. The natural gas system shall be installed using the materials and methods as specified herein and in the following paragraphs.

E. VALVES: 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.
A. GAS CUTOFFS: On the inlet and discharge side of the meter and pressure regulators, install a wrench operated plug cock valve. 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 (B16.1-1948). Install zone valves on each floor accessible to occupants for shutting off areas of the building under emergency conditions. Gas piping shall be welded up to these zone valves.

B. 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, A.S.T.M. Designation A53, 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” and larger of 3/4” and larger if before the emergency shut off valve. No pipe smaller than 3/4”, 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.
3. All gas piping within the building shall be installed exposed to view.

C. FITTINGS: 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. These fittings shall be fittings as specified in other sections. 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 joined. 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).

D. FLANGES: 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. These flanges shall be dimensioned, faced drilled and spot faced to conform to the Class 150 American Standard for Steel Pipe Flanges and Flanged Fittings (B16.9-1964). See piping section for additional requirements for flanges.

E. 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, A.S.T.M. Designation A53-Grade B, Type E or S, latest revision. 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.
2. 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. 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. These leaks shall not be repaired by any peening operations. Such leaks shall be remedied by chipping and rewelding until the header is devoid of leaks at that pressure. The header shall then be subjected to a hydrostatic test pressure of 200 pounds per square inch. Under these circumstances, the test pressure of the water confined in the header shall not decrease in a four hour period of observation. If leaks are encountered, they shall be eliminated in the manner prescribed by the Owner's duly authorized representative.
3. The header shall be provided with a one-half inch (1/2”) drain connection "taken off" the bottom of the header and terminated in a suitable stop cock. This one-half inch (1/2”) drain connection shall have its origin in a 2” x 1/2” welding reducer having its two inch (2”) 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.

F. COCKS: 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. Cocks of the same type shall, moreover, be installed at each other point indicated on the Drawings.

G. DRIP PIPES:
1. Drip pipes shall be provided throughout the gas piping systems for the purpose of accumulating moisture and condensate. They shall be sized no smaller than the gas piping to which they are
connected in each instance. These drip pipes shall be U-shaped providing an effective water seal of no less than twelve inches (12") of water. 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.

2. 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.

M. FABRICATION METHODS:

1. All interior gas piping shall, wherever possible, be installed so as to grade back toward the gas header in the basement. 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. 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. 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.

2. All house piping must be securely fastened in place in such a manner as to maintain its grading. Under no circumstances shall extension bars be used for supporting gas piping. Under no circumstances shall any gas piping be used to support any weight other than its own weight.

3. All branch outlet pipes shall be taken from the top or sides of running horizontal lines and not from the bottom. No crosses shall be installed in any horizontal gas line. No unions, gas cocks, or valves shall be used in any concealed location. Every gas cock and valve shall be accessible for inspection and repair.

4. The general arrangement of all gas piping shall be such that the number of threaded joints involved is reduced to an absolute minimum. 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. Wherever gas pipes run through outside brick, stone, or other walls, the opening around the pipe shall be securely and rigidly sealed. Gas pipe sizes shall be at least one pipe size larger than the inlet of the gas appliance which they supply. No bushings shall be used in conjunction with any gas piping.

5. Refer to Section 15010 for other information concerning installation of piping.

N. PROTECTIVE COATING:

1. Gas piping systems installed underground shall utilize pipe which has been factory coated with Scotchkote protective resin No. 212. All materials, surface preparation, application and testing shall conform to Federal Specification L-C-530 B-Type 2, dated June 4, 1970. This coating shall be applied by A&A Coating Company, Lone Star, Texas.

2. Underground welded joints and fittings shall be coated with Scotchkote No. 306 epoxy resin and taped with vinyl Scotchwrap-50 brand tape. Flanged joints shall be given two coats of Koppers Company No. 300M Catalyzed Coal Tar Epoxy.

3. Under no circumstances shall any backfilling operations be begun until these pipe protection operations have been completed.

O. TESTING:

1. All gas piping systems shall be very carefully tested by the Contractor. These piping systems shall first be subjected to a pneumatic test pressure of 100 pounds per square inch. All hydro and pneumatic tests shall be dead weighted, recorded, and countersigned by the project inspector. 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. A final test shall be performed after casework and lab hook up are completed at 15 psi for a minimum of 4 hours. If leaks are found, they shall be repaired by chipping and rewelding operations. Alternate testing and rewelding operations shall be repeated until gas piping systems are absolutely tight at the pneumatic test pressure indicated above. 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. Leaking flanged joints shall have flange bolts appropriately tightened or have gaskets causing leaks replaced.
2. Then the 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. In all instances in which leaks are then found, they shall be eliminated in the manner designated by the Owner's duly authorized representative. A one-half inch (1/2") test connection and cap shall be provided in each branch of the gas piping system.

3. 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. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify excavations under provisions of Section 15010.
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. Provide access where valves and fittings are not exposed. Coordinate access door location with architectural features.
H. Establish elevations of buried piping outside the building to ensure a minimum of cover.
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 prefinished, ready for finish painting.
L. Excavate in accordance with Section 22 0010 for work of this Section.
M. Backfill in accordance with Section 22 0010 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.
P. 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.
Q. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.

3.4 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.

3.5 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.

3.6 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.

3.7 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. Provide suitable shutoff valves, check valves, and, if required by the drawings, bypass valves at each and every such point of connection.

3.8 CONNECTIONS FOR GENERAL CONTRACTOR FURNISHED EQUIPMENT

A. Route lines as indicated on the Drawings to serve various items of equipment specified under General Specification. Rough-in in accordance with detailed drawings furnished by the equipment supplier, and make final connections to the equipment when it is installed. Rough-in shall terminate where noted on Drawings. All pressure lines shall be provided with shutoff valves or cocks. Drain lines shall be provided where required. 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. Trim, sink strainers and tail pieces shall be furnished to Mechanical Contractor who shall receive, store and install them. In addition, Mechanical Contractor shall furnish the sink P-traps and all materials and labor to rough-in and final connect as shown on the Drawings.

3.9 CONNECTIONS FOR OWNER FURNISHED EQUIPMENT

A. The Owner will be furnishing various pieces of equipment. The Contractor shall provide the rough-in indicated on the Drawings. Final connections are also included as part of this contract.

END OF SECTION
SECTION 221119
PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Roof Drains.
B. Cleanouts.
C. Backflow preventers.
D. Water hammer arrestors.
E. Trap Primers

1.2 RELATED SECTIONS

A. Section 01100 - Summary of Work.
B. Section 22 0010 - Basic Mechanical Requirements.
C. Section 22 1116 – Domestic Water Piping.
D. Section 22 3350 – Domestic Water Heaters.

1.3 REFERENCES

A. ANSI/ASSE 1011 - Hose Connection Vacuum Breakers.
B. ANSI/ASSE 1012 - Backflow Preventers with Immediate Atmospheric Vent.
C. ANSI/ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.
E. ANSI A112.21.1 - Floor Drains.
F. ANSI A112.21.2 - Roof Drains.
H. ASTM C478 - Precast Reinforced Concrete Manhole Sections.
I. AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.
J. PDI WH-201 Water Hammer Arresters.

1.4 SUBMITTALS

A. Submit under provisions of Section 22 0010.
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.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 22 0010.
B. Record actual locations of equipment, cleanouts, backflow preventers, etc.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 22 010.
B. Operation Data: Indicate frequency of treatment required for interceptors.
C. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 22 010.
B. Accept specialties on site in original factory packaging. Inspect for damage.

1.8 EXTRA MATERIALS

A. Furnish under provisions of Section 22 0010.
B. Provide two loose keys for each type of manhole cover and valve box.

PART 2 - PRODUCTS

2.1 ROOF AND AREA DRAINS

A. All roof and area drains will be furnished and installed by the Mechanical Contractor with all accessories required for the particular construction in which they are to be mounted. Area drains shall be as manufactured by Wade, Josam, Zum, or approved equal.
B. Roof Drain (RD): Wade Series W-3000, cast iron, flashing clamp, mushroom cast iron dome strainer and large sump.
C. Area Drain (AD): Wade No. 1100, cast iron drain body with clamping collar, 8" x 8" Type "J" polished bronze strainer, three inch (3") Type "EA" extension adapter.
D. Overflow Drain (OFD): To match the Roof Drain.

2.2 TREE WELL DRAINS AND CATCH BASINS – NOT USED

2.3 SUMP PUMP

A. Mechanical Contractor shall furnish and install sump pumps as scheduled complete with a cast iron mounting cover and curb ring which will mount on the floor over the sump. Sump will be constructed by the General Contractor but this Contractor shall coordinate his work so that mounting cover will set properly on the floor opening provided.
B. Sump pumps as scheduled on Drawings or approved equal. Each motor shall be provided with an across the line magnetic starter having three pole protection. Each pump shall be equipped with copper float and float switch for automatic operation. Provide mechanical or electrical alternator to switch the starting of the pumps from one to the other. Mechanical alternator is preferred, but if electrical alternator is used, it shall be Allen Bradley.
C. Provide high level alarm switch complete with transformer, bell and one set of 120 volt A.C. rated normally open contact for connection to owners FCMS system.
D. Provide a complete wiring diagram for this installation with submittal data.

2.4 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.

C. Floor Drain (or Shower Drain) Type A (FD "A"): Wade W-1100, cast iron floor drain with integral reversible clamp device, caulk device, caulk outlet and square adjustable nickel brass strainer.

D. Floor Drain (FD "B"): Wade W-1100-TS cast iron floor drain with integral reversible clamp device, caulk device, caulk outlet and 8-1/2" x 8-1/2" square adjustable cast iron strainer with 1/2 grate.

E. Floor Sink (FS) Josam 49000 Series square cast iron 6-1/4" deep SUPER-FLO-SEPTOR Floor Sink with acid-resisting interior, double drainage flange with weepholes, bottom outlet, aluminum internal dome strainer, Nikaloy sanitary sloped rim, and Nikaloy anti-tilting SUPER-FLO half Grate

2.5 HUB DRAINS (HD)

A. Hub drains (HD) located at, or near, Owner furnished equipment shall be cast iron soil pipe hubs or hub adaptors set flush with finished floor. Install in all such hubs or hub adaptors a Wade WL-8450-R cast iron cleanout ferrule with slotted head plug and round stainless steel access cover. Each hub drain shall be provided with a P-trap.

B. Hub drains for other services shall be cast iron soil pipe hubs or hub adaptors set with top of hub one-half inch (1/2") above finished floor. Each hub drain shall be provided with a P-trap.

2.6 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' intervals in long horizontal runs, of lines of four inch (4") size and smaller, and not more than 95' intervals for larger lines, cleanouts shall be placed in soil and waste lines. The size of the cleanouts shall be identical with the size of the soil or waste line in which they are placed for four inch (4") and smaller lines. The size of cleanouts in lines larger than four inches (4") shall be six inches (6") in all cases. All cleanouts shall be placed to be easily accessible for servicing. 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. All horizontal soil and waste lines shall have a cleanout placed in the end of the line by the use of a tee and a 1/8 bend, or by a combination tee-tee and made easily accessible by extending the cleanout through the wall and be covered as described above. The screw plug of all cleanouts shall be of cast brass.

B. The bodies of floor cleanouts shall be tapped for iron pipe threads. The brass tap screws shall have flange caps with raised nuts. 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 eight inch (8") round screwed brass access cover with three-eighths inches (3/8") diameter Allen Head Screw.

C. Floor Cleanouts (All Areas): Wade W-8190-UT or Zurn ZN 1455-4-75-UT as described above.

D. Final mounting of cleanout or cover shall be set flush with the finished surface the device is mounted in.

2.7 STRAINERS

A. Strainers, 2" 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 1/2" 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). Special Note: All strainers 6" and larger shall have studs mounted in the body flange in lieu of bolts for removal of cap. Baskets for strainers 6" 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.

2.8 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.)

2.9 OVERFLOW DRAIN DOWNSPOUT NOZZLE

A. Josam 25010 Cast Bronze Downspout nozzle, loose wall flange and inlet threaded connection, Satin Finish Bronze.

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 graphite and linseed oil. 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
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Lavatories.
B. Water closets.
C. Urinals.
D. Faucets.
E. Hose bibbs.
F. Vacuum Breakers
G. Electric Water Coolers
H. Trap Primers

1.2 RELATED SECTIONS

A. Section 07901- Joint Sealers: Seal fixtures to walls and floors.
B. Section 22 0010 - Basic Mechanical Requirements.
C. Section 23 0529 - Supports and Anchors.
D. Section 22 1116 – Domestic Water Piping.
E. Section 22 1119 - Plumbing Specialties.
F. Section 22 3350 – Domestic Water Heaters.

1.3 ALLOWANCES

A. Cash Allowance: Include under provisions of Section 22 0010.
B. Allowance includes purchase and delivery of owner selected fixtures. Installation is included in this section and is part of the Contract Sum/Price.

1.4 REFERENCES

A. ANSI/ASME A112.6.1 - Supports for Off-the-Floor Plumbing Fixtures for Public Use.
B. ASME A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.
D. ANSI/ASME A112.19.2 - Vitreous China Plumbing Fixtures.
E. ANSI/ASME A112.19.4 - Porcelain Enamelled Formed Steel Plumbing Fixtures.
F. ANSI/ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals (Dimensional Standards).

1.5 SUBMITTALS

A. Submit under provisions of Section 22 0010.
B. Product Data: Provide catalogue illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
C. Manufacturer's Installation Instructions.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 22 0010.
B. Maintenance Data: Include fixture trim exploded view and replacement parts lists.
1.7 DELIVERY, STORAGE, AND HANDLING
A. Deliver, store, protect and handle products to site under provisions of Section 22 0010.
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.

1.8 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.

1.9 WARRANTY
A. Provide five year warranty under provisions of Section 22 0010.

1.10 EXTRA MATERIALS
A. Furnish under provisions of Section 22 0010.

PART 2 - PRODUCTS

2.1 GENERAL
A. The Contractor shall provide plumbing fixtures where indicated on the Drawings. These plumbing fixtures shall be standard products as manufactured by American Standard, Kohler, Crane, Halsey-Taylor or Eljer or as otherwise noted. The 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. The space between fixtures and masonry walls shall be grouted with White General Electric Silicone flexible grout. The 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” gap.
B. All faucets, fittings, supply stops and similar devices shall be of one manufacturer unless otherwise specified. All water faucets and valve bodies shall be cast brass with a minimum copper content of 85%. They shall contain standardized interchangeable operating units constructed of a removable and replaceable unit containing all parts subject to wear. All water faucets shall contain an adjustable internal volume control unit. All exposed parts shall be chromium plated.
C. All fixtures shall meet the requirements of ADA, ANSI A117.1, ANSI Z124.2 and the State of Texas Accessibility Standards (TAS).

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” I.P.S. female inlets and shall include wall flanges, and 1/2” O.D. flexible risers with bull-nose or flared end outlets. All components to be chrome plated. 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. Fittings requiring a friction fit using slip-on or gasketed connections are not acceptable.
2.3 LA VATORIES - General Toilet Rooms - Lavatory Type "A":

A. American Standard "Aqualyn" 0475.020 self-rimming 20" x 17" oval counter lavatory punched for 8" center faucets. Equal lavatories by Eljer, Crane and Kohler will be acceptable. Lavatory shall be mounted in counter with top surface 36" (91 cm) above finished floor and with 29-1/2" (75 cm) clear underneath.

B. Chicago Faucet 785-E3-245/T&S Brass B2867-4-119-ADA-LF ADA compliant, 8-inch center spread, concealed fitting lavatory faucet with No. GN1A/119X-ADA 3-1/2 inch gooseneck spout, No. 317/BWH 4-inch blade handles, E3/B119-2 aerator and No. 245/LF integral flow control cartridges with monel seats. The force required to activate the faucet controls shall be no greater than 5 lb. Faucet shall meet the requirements of ADA, ANSI A117.1 and the State of Texas Accessibility Standards (TAS). Acceptable alternative manufacturers: Water Saver, by approval only. Manufacturer must equal specification.

C. McGuire No. 155WC, or approved equal, ADA compliant, chrome plated offset lavatory strainer, with heavy cast brass grid drain strainer, heavy cast base elbow and 1-1/4 inch 17-gauge tubular brass offset tailpiece. Acceptable alternative manufacturers: Water Saver, by approval only. Manufacturer must equal specification.

D. Chicago Faucet 1006/T&S Brass B1342M supplies, with loose key angle stops, lock shield caps, 1/2" I.P. female inlets 12" long, 1/2" O.D. flexible risers, wall flanges, and 1/2" O.D. flexible tube risers with bull-nose outlets. Acceptable alternative manufacturers: Water Saver, by approval only. Manufacturer must equal specification.

E. American Standard 7723.018/McGuire 8088 with 1127 nipple grid drain, (or equal as manufactured by Crane, Kohler or Eljer) 1-1/4" inlet and 1-1/4" outlet adjustable cast brass P-traps with cleanout plug, brass threaded nipple from trap to tapered sanitary tee behind wall, chrome-plated cover tubing to wall and chrome plated wall escutcheon.

F. Insulate all exposed drain and supply piping with Plumberex Specialty Products "HANDY SHIELD", or approved equal, drain line and supply line safety covers.

2.4 LA VATORIES – General Toilet Rooms - Lavatory Type "B":

A. American Standard "Lucerne" No. 0356.028(or equal as manufactured by Crane, Kohler or Eljer). ADA compliant, white vitreous china, wall-hung, lavatory. Lavatory fixture shall measure 20-1/2 inches wide by 18-1/4 inches deep, shall have faucet holes on 8-inch centers and shall be equipped with integral front-overflow ports.

B. Chicago Faucet 785-E3-245/T&S Brass B2867-4-119-ADA-LF ADA compliant, 8-inch center spread, concealed fitting lavatory faucet with No. GN1A/119X-ADA 3-1/2 inch gooseneck spout, No. 317/BWH 4-inch blade handles, E3/B119-2 aerator and No. 245/LF integral flow control cartridges with monel seats. The force required to activate the faucet controls shall be no greater than 5 lb. Faucet shall meet the requirements of ADA, ANSI A117.1 and the State of Texas Accessibility Standards (TAS). Acceptable alternative manufacturers: Water Saver, by approval only. Manufacturer must equal specification.

C. McGuire No. 155WC, or approved equal, ADA compliant, chrome plated offset lavatory strainer, with heavy cast brass grid drain strainer, heavy cast base elbow and 1-1/4 inch 17-gauge tubular brass offset tailpiece. Acceptable alternative manufacturers: Water Saver, by approval only. Manufacturer must equal specification.

D. Chicago Faucet 1006/T&S Brass B1342M supplies, with loose key angle stops, lock shield caps, 1/2" I.P. female inlets 12" long, 1/2" O.D. flexible risers, wall flanges, and 1/2" O.D. flexible tube risers with bull-nose outlets. Acceptable alternative manufacturers: Water Saver, by approval only. Manufacturer must equal specification.

E. American Standard 7723.018/McGuire 8088 with 1127 nipple grid drain, (or equal as manufactured by Crane, Kohler or Eljer) 1-1/4" inlet and 1-1/4" outlet adjustable cast brass P-traps with cleanout plug, brass threaded nipple from trap to tapered sanitary tee behind wall, chrome-plated cover tubing to wall and chrome plated wall escutcheon.

F. Insulate all exposed drain and supply piping with Plumberex Specialty Products "HANDY SHIELD", or approved equal, drain line and supply line safety covers.

2.5 WA TERCLOSETS – Type 'A' and Type 'B' (Note: All water closets Type 'B' shall be installed 17" from finished floor to the top of the china rim.)
**PLUMBING FIXTURES**

**2.6 URINALS - General Toilet Rooms – UR:**

A. All urinals shall be mounted with rim at 24” above finished floor. In toilet rooms designated to be accessible to the handicapped, only one (1) urinal shall be installed with rim at 17” above finished floor. Submittal data shall show height of basin opening and rough-in height. Fixture size, design and mounting height shall meet the requirements of ADA, ANSI A117.1 and the State of Texas Accessibility Standards (TAS). Fixture-to-wall sealing rings shall be resilient rubber. Wax sealing rings will not be acceptable.

B. American Standard "ALLBROOK" No. 6541.132, Crane, Eljer or Kohler ADA compliant, 1-gallon per flush, white vitreous china, siphon jet flushing action, compact, space-saving, wall-hung, flush valve urinal fixture with 3/4 inch top spud. Provide a urinal fixture measuring a minimum of 14-inches from finished wall to front of flare. Fixture shall meet the requirements of ADA, ANSI A117.1 and the State of Texas Accessibility Standards (TAS). Urinal fixture shall be designed to flush efficiently with a maximum 1-gallon of water total per flush. Fixture shall be listed in the State of Texas Water Commission List of Approved Plumbing Fixtures.

C. Zurn AQUA VANTAGE Z-6003-WSi-YK-ADA or Sloan ROYAL 186-1-YK ADA compliant, diaphragm operated, quiet flush, exposed water closet flush valve made of brass with metal oscillating non-hold-open type handle, 1-inch IPS screw driver operated back check angle stop with protective cap, renewable main valve seat, adjustable threaded union tailpiece, vacuum breaker, 3/4-inch by 11-1/2 inch flush tube and connection with spud coupling for 3/4-inch top spud, spud securing nut, wall and spud flanges, 1-gallon flush regulator, solid ring pipe support all with polished chrome finish. The force required to activate the control shall be no greater than 5 lbf. Flush valve assembly shall meet the requirements of ADA, ANSI A117.1 and the State of Texas Accessibility Standards (TAS). Flush valve shall be designed to flush efficiently with a maximum 1-gallon of water total per flush. Flush valve shall be listed in the State of Texas Water Commission List of Approved Plumbing Fixtures.

D. Wade W-451, Zurn, J.R. Smith or Josam concealed carrier with bearing plate. Equip each carrier with a flush valve supply support for exposed flush valves, J.R. Smith Suffix-M12, Wade number AM1 or Josam Suffix-6.

**2.7 SINKS**

A. **Sink Type A (S"A")**:  
1. Elkay LRAD-2222, 22" x 22" (19" x 16" x 6-1/2") 18 gauge Type 302 stainless steel self-rimming
sink.
2. Faucet: Chicago No. 786-E3 concealed fitting for 8" centers, 317 4" wrist handles, GN2A gooseneck with 2.0 gpm flow control spout.
4. Trap: McGuire No. 8912 1-1/2" x 1-1/2" cast brass p-trap with cleanout and waste to wall.
5. Supplies: McGuire No. 167 3/8" x 1/2" wheel handle stop with 1/2" x 12" flexible riser.

2.8 MOP SERVICE BASIN (MS):
A. Fiat TSBC-1611 32" x 32" x 12" "Precast Terrazzo" floor mounted basin with stainless steel threshold.
B. Faucet: No. 830-AA chrome plated service sink with vacuum breaker and integral stops.
C. Drain: 3" drain with #1453-BB strainer.
D. Accessories: #832-AA 5/8" x 30" long rubber hose with hose bracket; #889-CC stainless steel mop hanger.

2.9 EMERGENCY SHOWER/EYEWASH (ES/EW):
A. Shower/eyewash shall be equal to Encon #0112471-SS stainless steel recessed wall mounted unit.
B. Shower Head: 10" diameter stainless steel extended shower head with stainless steel vertical supply pipe and ceiling escutcheon for mounting shower head below ceiling. Self-adjusting regulator to flow at 30 gpm.
C. Shower Valve: 1" CP bronze stay-open shower valve with CP ball, stainless steel stem, push-plate at half-actuated position with application decal.
D. Eyewash: Eyewash spray head assembly to be two spray heads mounted on supply arms. Each spray head to have internal flow control and filter; cover/drain pan to be stainless steel; have a recessed horizontal grab bar pull handle with application decal; 19" extension for wheelchair access.
E. Eyewash Valve: 1/2" CP bronze stay-open eyewash valve integral to swing down arm in wall cabinet, valve to be activated by pulling eyewash handle starting at 15°, full open at 90°, and return to cabinet to shut off. Self-adjusting regulator to flow at 2.4 gpm.
F. Eyewash Drain: 1-1/2" slip joint tailpiece.
G. Supply: 1-1/4" NPT connection.
H. Thermostatic Mixing Valve: Mixing valve precisely blends hot and cold water to deliver warm (tepid) water to shower and eyewash. Mixing valve to be recessed into wall with flush mounted access panel where chase space is provided or mounted above ceiling with access.
I. Sign: Furnished with ANSI-compliant identification sign.

2.10 HOSE BIBBS (HB)

2.11 WALL HYDRANTS (WH) (alternate for Frost Proof Hose Bibb with Vacuum Breaker)
A. Non-freeze type with integral vacuum breaker; Wade W-8625 or Zurn Z-1300.

2.12 VACUUM BREAKERS
A. All outlets with hose threads shall be provided with vacuum breakers. 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" hose thread vacuum breakers attached to the hose outlet threads with tamper proof set screw. Vacuum breaker shall be as manufactured by Chicago Faucet (E-27 or E-22), or by Watts.
2.13 ELECTRIC WATER COOLERS (EWC)

B. Provide p-traps and cut-off valve.

2.14 TRAP PRIMER

A. Pressure principal activated, Multi-fixture device. Precision Plumbing Products or approved equal.
B. Provide trap primers for all floor and hub drains in mechanical rooms even if not shown on drawings.

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 0010.
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 0010.
B. At completion clean plumbing fixtures and equipment.
3.7 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Section 22 0010.
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, ANSI A117.1 and the State of Texas Accessibility Standards (TAS).
B. Install fixtures to heights above finished floor as indicated.
C. Water-Closet
   1. Standard 15 inches to top of bowl rim.
   2. Handicapped 17 inches to top of bowl rim.
D. Urinal
   1. Standard 24 inches to top of bowl rim.
   2. Handicapped 17 inches to top of bowl rim (one and only one urinal shall be installed at this height in each location where urinals are installed).
E. Lavatory (wall hung)
   1. Standard 32 inches to top of basin rim.
F. Water Closet Flush Valves
   1. Standard 10 inches min. above bowl rim.

3.9 FIXTURE ROUGH-IN SCHEDULE

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END OF SECTION
SECTION 230000
UTSW MECHANICAL DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This specification includes University of Texas Southwestern Medical Center (UTSW) requirements for Heating, Ventilation, and Air conditioning (HVAC) projects on UTSW campus.

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.

C. Basic Mechanical Requirements specifically applicable to Division 23 Sections, in addition to Division 1 - General Requirements

1.2 APPLICABILITY

A. This Specification applies to all HVAC projects designed and constructed by physical plant personnel, outside Architect/Engineering (A/E) firms, and all construction contractors. No deviations to the standard are acceptable without the authorization of the Owner or Owner’s Representative.

B. THE UNIFORM GENERAL CONDITIONS, SUPPLEMENTARY GENERAL CONDITIONS, and DIVISION 1 of the Specifications apply to the work specified in this Section.

C. All 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.

1.3 GENERAL

A. The Contractor shall execute all work hereinafter specified or indicated on accompanying Drawings. 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.

B. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation and thereby to provide an integrated satisfactory operating installation.

C. 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.

D. 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. 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. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

E. 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.

F. 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. The contractor shall not start work until this drawing has been provided.
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. The drawings do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas.

1.4 TERMS AND DEFINITIONS: (Note: These definitions are included here to clarify the direction and intention of this specification. The list given here is not by any means complete. For further clarification as required, contractor shall contact the designated owner’s representative.)

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, Owner, or Owner’s designated representative

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.

F. 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 rooms.

1.5 PERMITS, UTILITY CONNECTIONS AND INSPECTIONS

A. General: Refer to DIVISION 1 for construction phasing and time increments.

B. Fees and Costs: If, during the course of the construction, a need arises to buy utilities, the Contractor shall pay all fees attendant thereto. 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. 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: The Contractor shall comply in every respect with all requirements of National Fire Protection Association, local Fire Department regulations, and utility company requirements. 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. 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.

1.6 CONTRACT DOCUMENTS

A. All dimensional information related to new structures shall be taken from the appropriate Drawings. 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: The Specifications determine the nature and setting of the several materials, the Drawings establish the quantities, dimensions and details, and the schedules give the performance characteristics. If the Contractor requires additional clarification, he shall request it in writing, following 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.

1.7 OWNER FURNISHED PRODUCTS
A. Products furnished to the site and paid for by Owner will be noted on the drawings.

1.8 FUTURE WORK
A. Future work will be noted on the Drawings.

1.9 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 1 of the Specifications. 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.

1.10 SUBMITTALS
A. Refer to the enclosed Specifications.
B. Submit shop drawings and product data grouped to include complete submittals of related systems, products,
and accessories in a single submittal.
C. Mark dimensions and values in units to match those specified.
D. Submit Fabrication Drawings whenever (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; or (4) where specifically requested by the Architect/Engineer. 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"
= 1'-0". Fabrication Drawings for ductwork, air handling units, and sections in Mechanical Rooms shall be
drawn at a minimum scale of 3/8" = 1'-0". Submit Fabrication Drawing to the Architect/Engineer for review in
the quantity and format as specified in Division 1. Reproduction and submittal of the Construction Documents
is not acceptable. The Architect/Engineer will review the drawing and return with comments.

1.11 SUBSTITUTION OF MATERIALS AND EQUIPMENT
A. Refer to General Conditions for substitution of materials and equipment.
B. General: 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. The list shall be arranged in accordance with the organization of the
Specifications. 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. 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.
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. 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.

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. Some proprietary products are mentioned to set a definite standard for acceptance and to serve as a reference in comparison with other products. 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. The successful manufacturer or supplier shall meet all of the provisions of the appropriate specification(s).

D. 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. The burden of proof of equality rests with the Contractor. 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: The burden of timeliness in the complete cycle of submittal data, shop Drawings, and sample processing is on the Contractor. 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. 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. 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 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. 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. 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 and found to be correct with respect to dimensions and available space and that the equipment complies with all requirements of the Specifications and 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: 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 1. The lists shall be accompanied by pictorial and descriptive data derived from the manufacturers' catalogs, sales literature, or incorporated in the Shop Drawings. 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.

1.12 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. Materials and equipment shall be installed in accordance with the
manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by mechanics skilled in their respective trades, and the installations shall provide a neat, precise appearance. 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.

1.13 FLAME SPREAD PROPERTIES OF MATERIALS

A. Materials and adhesives incorporated in this project shall conform to NFPA Standard 255 (1984), "Method of Test of Surface Burning Characteristics of Building Materials". 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.

1.14 REGULATORY REQUIREMENTS

A. The "Authority Having Jurisdiction" over the project described by these documents is the Owner, as an Agency of the State of Texas. As such, it is required that the installation shall meet the minimum standards prescribed in the latest editions of the following listed codes and standards in effect as of January 1, 2010 (current edition) unless otherwise noted, which are made a part of these Specifications.

B. National Fire Protection Association Standards (NFPA):

1. NFPA No. 13, Sprinkler System, Installation
2. NFPA No. 14, Standpipes and Hose Systems
3. NFPA No. 20, Centrifugal Fire Pumps
4. NFPA No. 37, Stationary Combustion Engines & Gas Turbines
5. NFPA No. 45, Fire Protection for Laboratories Using Chemicals
6. NFPA No. 51, Welding & Cutting, Oxygen Fuel Gas Systems
7. NFPA No. 54, Gas Appliances, Piping, National Fuel Gas Code
8. NFPA No. 70, National Electrical Code
9. NFPA No. 72D, Proprietary Signaling Systems
10. NFPA No. 78, Lightning Protection Code
11. NFPA No. 88A, Standard for Parking Structures
12. NFPA No. 90A, Air Conditioning Systems
13. NFPA No. 91, Blower & Exhaust Systems
14. NFPA No. 99, Health Care Facilities
16. NFPA No. 200, Series, Building Construction
17. NFPA No. 211, Chimneys, Fireplaces, Vent Systems
19. NFPA No. 255, Method of Test of Surface Burning Characteristics of Building Materials
21. ASHRAE 90.1, 2007
C. American National Standards Institute (ANSI):
   1. A40.8, National Plumbing Code
   2. B31.1, Power Piping
D. American Gas Association Publications (AGA): Directory of Approved Gas Appliances and Tested Accessories
E. American Society of Mechanical Engineers (ASME): Boiler and Pressure Vessel Codes
F. Air Conditioning and Refrigeration Institute Standards (ARI): All standards related to refrigeration and air conditioning equipment and piping furnished under these Specifications.
G. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA): All current editions of applicable manuals and standards (See Sections 233100 and 233300).
H. Air Moving and Conditioning Association (AMCA): All current editions of applicable manuals and standards.
J. American Water Works Association (AWWA): All current editions of applicable manuals and standards.
K. National Electrical Manufacturers' Association (NEMA): All current editions of applicable manuals and standards.
L. International Codes, current edition or as listed elsewhere in the contract.
M. Texas Occupational Safety Act: All applicable safety standards.
N. Occupational Safety and Health Act (OSHA).
O. 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.
P. Refer to Specification Sections hereinafter bound for additional Codes and Standards.
Q. All materials and workmanship shall comply with all applicable state and national codes, Specifications, and industry standards. In all cases where Underwriters' Laboratories, Inc. has established standards for a particular type material, such material shall comply with these standards. Evidence of compliance shall be the UL "label" or "listing" under Reexamination Service.
R. The Contract Documents are intended to comply with the aforementioned rules and regulations; however, some discrepancies may occur. Where such discrepancies occur, the Contractor shall immediately notify the Architect/Engineer in writing of said discrepancies and apply for an interpretation. 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. 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.

1.15 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, drip, humidity, and dust damage.
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: 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. The label of the Underwriters Laboratories, Inc., applied to the item will be acceptable as sufficient evidence that the items conform to such requirements. The ASME stamp or the AMCA label will be acceptable as sufficient evidence that the items conform to the respective requirements.

D. Nameplates: 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. All data on nameplates shall be legible at the time of Final Inspection.

E. Prevention of Rust: Standard factory finish will be acceptable on equipment specified by model number; otherwise, surfaces of ferrous metal shall be given a rust inhibiting coating. The treatment shall withstand 200 hours in salt spray fog test, in accordance with Method 6061 of Federal Standard No. 141. 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" on either side of the scratch mark. 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. 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: Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts shall be fully enclosed or properly guarded for personnel protection. Guards shall be compliant with OSHA requirements.

G. Verification of Dimensions: 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. 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. 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.

1.16 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. 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. Plates will not be required for piping where pipe sleeves extend 3/4" above finished floor. 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.

1.17 SLEEVES, INSERTS, AND FASTENINGS

A. General: 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. All penetrations must pass through sleeves except soil pipe installed under concrete slabs on fill. 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. If a penetration is cored into an existing solid concrete or stone structure, then the installation of a sleeve will not be necessary. (This does not apply to cases in which a sleeve was not placed in a timely fashion before the concrete was poured. In such cases, direction shall be requested from the Architect/Engineer.) Sleeves set in floors shall extend 4" 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", except that the minimum clearance shall accommodate a Thunderline Link-seal (or approved equal) closure where piping exits the building, or penetrates a wall below ground level. Contractor shall be
responsible for the accurate location of penetrations in the slab for his pipe, duct, etc. All penetrations shall be of ample size to accommodate the pipe, duct, etc. plus any specified insulation. 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. Refer to the details on the project drawings. 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: 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. 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. 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: 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 with torque nuts and washers shall be used.

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: 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 2000 degrees F for two hours. For wet locations, the foam material shall be silicone RTV foam or an approved equal. For dry locations, premixed putty equal to Nelson Flameseal Firestop putty may be used.

1.18 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. Obtain permission of Architect/Engineer before proceeding.

1.19 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. 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. Should the Contractor
perform any such work that does not comply with the manufacturers’ directions or such instructions from the Architect/Engineer, he shall bear all costs arising in connection with the deficiencies.

1.20 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. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment he proposes to furnish will fit in the space. 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. 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.

1.21 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. Following placement in the space, such apparatus shall be thoroughly, completely protected from damage as hereinafter specified.

1.22 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. 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. 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. 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. 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. All pumps, fans and motors shall be rotated by hand when received and when stored to maintain bearing lubrication.

1.23 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. Each trade, subcontractor, and/or Contractor must pursue its work promptly and carefully so as not to delay the general progress of the job. This Contractor shall work in harmony with Contractors working under other contracts on the premises.

1.24 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. The Electrical Trades shall provide all disconnect switches as required for proper operation, as indicated on the Drawings or required by applicable code. 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.

C. The Mechanical Trades shall provide complete wiring diagrams indicating power wiring and interlock wiring. Diagrams shall be submitted for review within thirty (30) days after the submittals for equipment have been reviewed. 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. After these diagrams have been reviewed, copies shall be transmitted to the Electrical Trades by the Contractor. They shall be followed in detail. See Section 230923, ENERGY MANAGEMENT SYSTEM (EMS), for additional clarification.

1.25 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 himself with the work to be done by other trades. He shall coordinate his work with other trades and before material is fabricated or installed, make sure that his work will not cause an interference with another trade. Where interferences are encountered, they shall be resolved at the job site by the superintendents involved. Where interferences cannot be resolved without major changes to the design, the matter shall be referred to the A/E for ruling.

1.26 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.

1.27 PRECEDENCE OF MATERIALS

A. The specifications determine the nature and setting of materials and equipment. The drawings establish quantities, dimensions and details.

B. The installation precedence of materials shall generally be as follows. 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.

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

1.28 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. 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.

D. 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.

E. Provide all sheet metal ductwork, transition pieces, etc., required for a complete installation of vent hoods, fume hoods, etc., provided by others.

1.29 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: 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. 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: 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. Sleeves shall be as herein specified. 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.

E. All pipe, conduits, etc., shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. 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. 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.

1. All piping not directly buried in the ground shall be considered as "interior piping".

2. 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. The Contractor shall give as much advance notice as possible but no less than 10 working days.

3. All above ceiling areas will be subject to a formal inspection before ceiling panels are installed, or installation is otherwise concealed from view. 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. The inspection will include representatives of the following: General Contractor and each Subcontractor having work above the ceiling, Physical Plant, and the Resident Construction Manager's Construction Inspector Areas to be included and time of inspection shall be coordinated with the Construction Inspector.

4. 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. The ceiling supports (tee bar or
lath) shall be in place so that access panel and light fixture locations are identifiable and so that clearances and access provisions may be evaluated.

5. No ceiling materials may be installed until the resulting deficiency list from this inspection is worked off and the Construction Inspector has given approval.

6. Proper accessibility to equipment may be required to be demonstrated by the commissioning agent or inspector.

1.30 RECORDS FOR OWNER

A. The Contractor shall maintain a set of prints in the Field Office for the sole purpose of recording "installed" conditions. 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 in electronic format (PDF). The contractor shall transfer the information from the prints maintained as described above, and turn over this neatly marked set of reproducible Drawings representing the "as installed" work to the Architect/Engineers for verification and subsequent transmittal to the Owner. The Contractor shall refer to Division 1 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.

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 1.
1.31 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: 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. 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: Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. 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: All mechanical work in areas containing plaster shall be completed prior to the application of the finish plaster coat. 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. Rebar placement shall be determined prior to floor coring operations. Any rebar, which has been cut, shall be submitted in writing to the Architect/Engineer for evaluation.

1.32 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. This shall be the responsibility of the General Contractor.

1.33 EXCAVATION, TRENCHING AND BACKFILL

A. Excavation (See Divisions 0 and 1 for special requirements related to excavation and trenching.):

1. The contractor 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. All exterior lines shall be installed with a minimum cover of 24", unless otherwise indicated. Generally, more cover shall be provided if grade will permit. All excavation materials not required for backfill or fill shall be removed and wasted as acceptable to the Construction Inspector. All excavations shall be made only by open cut. The banks of trenches shall be kept as nearly vertical as possible and where required, shall be properly sheeted and braced. Trenches shall be not less than 12" wider nor more than 16" 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" nor more than 8" in width is provided on each side of the pipe. 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.

2. 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" 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. Bell holes shall be dug after the trench bottom has been graded. Where inverts are not shown, grading shall be determined by the Plumbing Code for the service intended and the size used. Bell holes for lead pipe joints shall be 12" in depth below the trench bottom and shall extend from a point 6" back of the face of the bell. Such bell holes shall be of sufficient width to provide ample room for caulk ing. 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. 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. In general, grading for electrical duct banks and
Conduits shall be from building to manhole, and from a high point between manholes to each manhole. Special pipe beds shall be provided as specified hereinafter.

3. The lower 4" 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 men especially skilled in this type of work. Where damage is likely to result from withdrawing sheeting, the sheeting shall be left in place. 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. Where rock excavation is required, the rock shall be excavated to a minimum over depth of 6" below the trench depths specified. The over depth rock excavation and all excess trench excavation shall be backfilled with sand. 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.

4. All grading in the vicinity of excavation shall be controlled to prevent surface ground water from flowing into the excavations. Any water accumulated in the excavations shall be removed by pumping or other acceptable method. 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. Material unsuitable for backfilling shall be wasted and removed from the job site as directed by the Construction Inspector.

5. All shoring and sheeting required to perform and protect the excavations and to safeguard employees and/or adjacent structures shall be provided.

6. Excavate as required under the building in order that all piping, ductwork, etc., shall clear the ground a minimum of 12" for a distance of 24" on either side. Edges of such excavations shall slope at an angle of not over 45 degrees with the horizontal unless otherwise approved by the Construction Inspector. The bottom of such excavation shall be graded to drain in a manner acceptable to the Construction Inspector.

7. Trenches for cast iron drain, storm water and sewer lines inside the building shall be properly excavated, following, in general, the procedures set out for exterior lines. Where floors are to be poured over these lines, they shall be backfilled, tamped and settled with water. Where no flooring is to cover the lines, they shall be backfilled to form a level grade.

8. 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. The trenches shall be carefully backfilled with sand to a depth of 12 inches above the top of the pipe. 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" in diameter, flooded until the pipe has cover of not less than one foot. The remainder of the backfill material shall then be thrown into the trenches, moistened, and tamped or flooded in one foot layers. Blasted rock, broken concrete or pavement, and large boulders shall not be used as backfill material. 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.

2. 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 Reclosing Pavement and Lawns: 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. The sizes of the cut shall be held to a minimum, consistent with the work to be accomplished. 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. 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: All trees including low hanging limbs within the immediate area of construction shall be adequately protected to a height of at least 5 ft. to prevent damage from the construction operations and/or equipment. All excavation within the outermost limb radius of all trees shall be accomplished with extreme care. 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. The Construction Inspector will give immediate instructions for the disposition of same. 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" from the outside of any concrete structure or pipeline. No chips, parts of stumps, or loose rock shall be left in the excavation. Where stumps and roots have been cut out of the excavation, clean compacted dry bank sand shall be backfilled and tamped.

1.34 ACCESS DOORS

A. General: Contractor shall provide wall or ceiling access doors for unrestricted access to all concealed items of mechanical equipment or devices.

B. Doors: Access doors mounted in painted surfaces shall be of Milcor (Inland-Ryerson Construction Products Company) manufacture, Style K for plastered surfaces and Style M or DW for non plastered surfaces. The Style K doors shall be set so that the finished surface of the door is even with the finished surface of the adjacent finishes. Access doors mounted on tile surfaces shall be of similar construction as noted above, except they shall be of stainless steel materials. Access doors shall be a minimum of 12" x 12" in size.

1.35 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, he may do so, providing that he properly supervises the operation, and has the Construction Inspector's written permission to do so. 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.

B. 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. The date of acceptance and performance certification will be the same date.

C. 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.

D. Additional requirements for operation of equipment prior to completion found in the commissioning sections of Division 1 and Division 23 shall be followed.

1.36 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. 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. The decision of the owner concerning the appropriateness of the representative shall be final. 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: "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 23 for additional start-up, testing, and acceptance requirements.

1.37 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. The Contractor shall provide all equipment, materials, and labor for making such tests. Reasonable amounts of fuel and electrical energy costs for system tests will be paid by the Owner. 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. 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 hereinafter for additional tests and requirements.

1.38 LOG OF TESTS

A. All tests shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel, description, and extent of system tested, test conditions, test results, specified results, and other pertinent data. Data shall be delivered to the Architect/Engineer as specified under “Requirements for Final Acceptance”. All Test Log entries shall be legibly signed by the Project Contractor or his authorized job superintendent.

1.39 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 of his 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.

1.40 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. Natural gas piping shall be painted in its entirety. In the event of a conflict between the specifications referenced, the provisions of this specification shall prevail only for Division 23 work.

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. The following materials shall not be painted: copper, galvanized metal, stainless steel, fiberglass, PVC, and PVDF.

C. 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. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Exposed metal work shall be carefully brushed down with the steel brushes to remove rust and other spots and left smooth and clean.

D. Color of finish painting in Mechanical Rooms shall be painted in accordance with The University of Texas Standard Color Schedule for machinery spaces using Kelly Moore or Pratt and Lambert enamel, or approved...
equal. 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. Two coats shall be applied with a light tint first coat and deep color for final coat. Colors shall be as follows:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>COLOR</th>
<th>PAINT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIRE SPRINKLER LINE</td>
<td>RED</td>
<td>SIREN RED 1700-62</td>
</tr>
<tr>
<td>STEAM</td>
<td>WHITE</td>
<td>WHITE 5392</td>
</tr>
<tr>
<td>STEAM</td>
<td>WHITE</td>
<td>WHITE 5301 Activator</td>
</tr>
<tr>
<td>CONDENSATE RETURN</td>
<td>WHITE</td>
<td>WHITE 1700-61</td>
</tr>
<tr>
<td>SOFTWATER</td>
<td>MEDIUM BLUE</td>
<td>IRIS QUEEN 1700-222-V-23-2</td>
</tr>
<tr>
<td>NATURAL GAS</td>
<td>YELLOW</td>
<td>DAISY YELLOW Y361M</td>
</tr>
<tr>
<td>FUEL OIL</td>
<td>YELLOW</td>
<td>SUNBURST YELLOW 1700-63</td>
</tr>
<tr>
<td>LUBE OIL</td>
<td>BROWN</td>
<td>PIGSKIN 1275-555-AC-13-N</td>
</tr>
<tr>
<td>CITY WATER</td>
<td>LIGHT BLUE</td>
<td>CASANOVA 1700-111-W-2-1</td>
</tr>
<tr>
<td>CHILLED WATER</td>
<td>DARK BLUE</td>
<td>INDIGO BLUE 1700-64</td>
</tr>
<tr>
<td>CONDENSING WATER</td>
<td>DARK GREEN</td>
<td>FOREST GREEN 1700-51</td>
</tr>
<tr>
<td>COMPRESSED AIR</td>
<td>LIGHT GREEN</td>
<td>SHAMROCK1700-333-M-25-3</td>
</tr>
<tr>
<td>REFRIGERANT RECOVERY</td>
<td>PURPLE</td>
<td>PLUM 1700-333-Z-10-3</td>
</tr>
<tr>
<td>HEATING HOT WATER</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>HANGER RODS</td>
<td>SAME AS &quot;PIPING&quot; ABOVE</td>
<td></td>
</tr>
<tr>
<td>STEAM TRAPS AND</td>
<td>SAME AS &quot;PIPING&quot; ABOVE</td>
<td></td>
</tr>
<tr>
<td>METAL EXPOSED TO</td>
<td>HIGH TEMP RATED</td>
<td></td>
</tr>
<tr>
<td>HIGH TEMPERATURES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATMOSPHERIC</td>
<td>SAME AS &quot;PIPING&quot; ABOVE</td>
<td></td>
</tr>
<tr>
<td>RELIEF LINES</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

E. Aluminum jacketing on insulation shall not be painted.

F. No nameplates on equipment shall be painted, and suitable protection shall be afforded to the plates to prevent their being rendered illegible due to the painting operation.

G. Scope of painting for Division 23 work in areas other than those defined as "exposed" is as follows:

1. All uncovered steel pipe, supports, exposed pipe and hanger rod threads, and hangers in under floor spaces shall be cleaned and painted with two coats of Tropical Paint Co. No. 77-black asphaltic emulsion. Galvanized steel and copper lines in these spaces shall not be painted.

2. All canvas finishes including those under floor and in concealed spaces shall be painted with one sizing coat if not already sized, containing mildew resistant additive and Arabol adhesive prior to any other specified finish paint.

3. All fuel piping shall be painted whether concealed or exposed, in all areas of the project without exception. Fuel piping shall be painted safety yellow, and fire protection piping shall be painted safety red. These "safety" colors shall be as defined by OSHA.
4. 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.

H. 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 of Kelly Moore or Pratt and Lambert, Inc.'s "Effector" enamel of color selected by the Architect/Engineer.

I. Additional areas to be defined as "exposed" for purposes of painting, are defined on the Drawings.

J. The surfaces to be finish painted shall first be prepared as follows:
   1. On canvas finishes pretreated as specified above. Insulated surfaces having vapor barrier jacket exposed to view shall first be painted with one (1) coat of sealer.
   2. 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.
   3. Aluminum surfaces shall first be painted with one (1) coat of P&L zinc chromate primer.
   4. Cast iron pipe shall first be primed with a "non bleed" primer.
   5. The underside of all cast iron sinks not recessed in a cabinet are included as items to be painted in exposed areas.

K. 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 two (2) coats of P&L zinc chromate primer as the construction progresses to protect against deterioration.

1.41 WARRANTY
A. Refer to Division 1 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.

1.4 HVAC DESIGN CONDITIONS FOR VARIOUS OCCUPANCIES
A. Listed below are the general design conditions that shall be used for occupancies at UTSWMC:

<table>
<thead>
<tr>
<th>Room Type</th>
<th>Temperature</th>
<th>Humidity</th>
<th>Air Changes</th>
<th>Room Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office</td>
<td>72 +/- 3°F</td>
<td>10%-60%</td>
<td>6-10 per hour</td>
<td>neutral</td>
</tr>
<tr>
<td>Wet Lab</td>
<td>72 +/- 3°F</td>
<td>10%-60%</td>
<td>10-15 per hour</td>
<td>15% negative</td>
</tr>
<tr>
<td>Dry Lab</td>
<td>72 +/- 3°F</td>
<td>10%-60%</td>
<td>6-10 per hour</td>
<td>neutral</td>
</tr>
<tr>
<td>Equipment Galley</td>
<td>72 +/- 3°F</td>
<td>10%-60%</td>
<td>6-10 per hour</td>
<td>neutral</td>
</tr>
<tr>
<td>Animal Room</td>
<td>72 +/- 3°F</td>
<td>10%-60%</td>
<td>10-15 per hour</td>
<td>15% negative</td>
</tr>
<tr>
<td>Fly room</td>
<td>63 +/- 3°F</td>
<td>per client</td>
<td>1-5 per hour</td>
<td>5% negative</td>
</tr>
<tr>
<td>Tissue culture</td>
<td>72 +/- 3°F</td>
<td>10%-60%</td>
<td>6-10 per hour</td>
<td>See below</td>
</tr>
</tbody>
</table>

B. The majority of buildings on the UTSW campus are designed for 100% outside air.

C. Air from wet labs, animal rooms, fly rooms, and tissue culture labs shall be 100% exhausted

D. Environmental Health and Safety requires that Tissue culture rooms be negative pressure with respect to the corridor in order to prevent contamination of adjacent labs. Tissue culture labs require that the room be positive with respect to the hood in order to prevent migration of contamination into the experiment.

E. Standard practice has been to locate the exhaust grill between the hood(s) and the room exit to provide a relative negative pressure zone with respect to the hood and the adjacent laboratories. Where cleanliness requirements are needed, an air shower should be used.
F. Special consideration must be used in the location of supply air diffusers in a tissue culture room. As a rule diffusers are not located within six feet of a hood, and the airflow is directed away from the hood face. In lieu of location, directional diffusers must be used. The velocity of the supply air discharge shall not exceed 50 FPM for any diffuser within six feet of a tissue culture hood.

G. Outside Air Design Considerations

H. Outside Air Temperature 98 dry bulb 77 coincident wet bulb

I. Dehumidification process: > 40% RH – Refrigeration or chilled water and for < 40% RH – Refrigeration or chilled water supplemented by desiccant wheel type dehumidification.

1.43 SINGLE AND DUAL DUCT (VAV) MIXING BOXES

A. Mixing Box Vendors:

1. UTSWMC has developed a specification for medical grade mixing boxes, and has qualified the following suppliers through testing of the box:

   a. Titus
   b. Metalaire

2. Meeting UT specifications should be clearly annotated on the drawing for all dual and single duct boxes used in laboratories or medical service.

3. Refer to UT Specification 15930 for mixing box construction.

B. VAV Mixing Box Controls:

1. UTSWMC dual duct mixing boxes are normally set to constant volume with the mixed air temperature varied to maintain space temperature.

2. This part of the project utilizes all variable air volume mixing boxes. When a constant volume double duct box is required, it will be specifically called out on the schedules.

3. All dual or single duct boxes that are to be re-used shall be retrofitted with DDC controls.

4. Dual duct boxes require factory installed flow crosses on the hot and cold inlets and no flow cross on the discharge. UTSWMC personnel normally install the mixing box controls in the field. Therefore, factory controls are not normally specified. For this project the controls will be provided as specified in the appropriate section of these specifications.

5. In order to maintain acceptable work access to the controls, VAV dual duct boxes shall be centered over the lab peninsulas with the control box readily accessible without having to move lab equipment off the counter top.

6. Mixing boxes shall be situated in offices so that they are readily accessible without having to move heavy furniture. Corridors and doorways are preferred locations.

7. A minimum of 24 inches of clear space is needed in order to access the controls. For dual duct boxes 24 inches is needed on both sides. The design engineer shall coordinate the HVAC, plumbing, electrical, and fire protection drawings to ensure that the control access to the VAV box is not hampered.

1.44 VAV BOX SIZING

A. UTSWMC does a considerable amount of renovation and subsequent relocation of VAV boxes and diffusers. This requires us to implement a standardized VAV sizing system, which has the benefits of capacity, flexibility, controllability, and simplified installation.

B. UTSWMC uses 8", 10", and 12" single and dual duct boxes for all new construction and renovation work. Any larger capacity requirements shall use two boxes slaved together or independent zone control. A 6" box is used in some circumstances but is generally not desired.
C. VAV mixing boxes in sizes 14 or 16 are acceptable only under special circumstances and must be submitted to the ENGINEER for approval PRIOR TO incorporation in the design. This project includes MRI bays which are special circumstances. The following minimum CFM guidelines shall be used for selection of mixing box size:

- 6" 120 CFM
- 8" 200 CFM
- 10" 310 CFM
- 12" 445 CFM

D. A single VAV mixing box normally controls a maximum of three offices. Interior zones shall not be combined with exterior zones. Director’s offices, corner rooms, conference rooms, and other special purpose rooms should be on an individual zone. Note that a small corridor area or storeroom may be added to almost any small zone. Zones requiring large amounts of air (such as auditoriums or laboratories) may require more than one terminal unit, and may be controlled by a single thermostat.

E. Each lab (wet, dry, or tissue culture) shall have dedicated VAV mixing box(s).

1.45 DIFFUSERS AND DAMPERS

A. Standard diffuser throat sizes are 8, 10, 12, and 14-inch diameter. Diffuser throat sizes smaller than 8 inches are unacceptable. Only under special circumstances will diffusers with inlets larger than 14 inches in diameter be accepted. Diffusers shall be selected based on a Noise Criteria (NC) level less than 25.

B. Balancing dampers shall be located in each branch duct and located no closer than 3 feet from the diffuser throat. All dampers shall be shown in the plans.

C. Power-actuated dampers (including smoke dampers) are normally equipped with a 24-volt electric actuator. However, damper actuators for make-up air and/or exhaust (general and hood) serving variable volume labs should be pneumatic for acceptable room pressure control recovery time with volume change.

1.46 DUCTWORK

A. All ductwork shown on plans shall be indicated as clear air stream size. Ducts shall be shown in two dimensions to scale with fittings, dampers, outlets and offsets clearly illustrated. Include details of duct fabrication where necessary to show construction methods.

B. Internal insulation of ductwork is not permitted, unless written permission is obtained from the ENGINEER.

C. Ductwork taps to supply diffusers shall be made using bell-mouth or shoe-tap connections. Connections shall be from the side of the duct, not the bottom. This will allow for a better location for the volume dampers. Also, flexible duct shall be limited to 48-inch lengths or less. All other ducts shall be rigid. On this project there are several areas with space limitations and connections on the bottom are allowed.

D. Use short radius vane elbows in lieu of square 90° fittings with turning vanes. It is preferred that long radius sweeps be employed where space permits.

E. Show all supply and exhaust ductwork on the same plan for each floor.

1.47 TESTING AND BALANCE

A. The owner will contract for TAB (HVAC Testing and Balancing) services separately from the construction contract. Representatives of the TAB agency will participate in the progress reviews and will be provided appropriate review documents.

1.48 HEATING COILS

A. Temperature control valves shall be 1/2 inch 2-way. When multiple VAV mixing box heating coils are connected to a common header, a 3-way temperature control valve shall be placed at end of the last terminal box on the hot water supply pipe reverse-return loop and the last terminal box on a multiple box...
branch loop. The reverse-return method of pipe sizing shall be used for all supply and return piping. A 1/2 inch flowset (Superseal or equivalent) valve combined with a 2-row coil shall be the standard size application for all size 8, 10, and 12 boxes.

B. The model “YS” (ball valve – Y strainer) flow set valve shall be installed on the coil inlet. The model “F” flowset (ball-valve and venturi). An additional ball valve shall be installed down stream of the “F” flowset valve.

C. The reheat coil detail is available from the Engineer upon request.

D. Do not design interior rooms without a reheat coil unless it can be demonstrated by calculation that the generated heat load is sufficient to maintain an acceptable room temperature. Experience at UTSW indicates that as a rule only equipment rooms can be designed without a reheat coil.

1.49 EXHAUST DUCT

A. Exhaust branch ducts shall be sized for a velocity not to exceed 1500 Ft/Min. Exhaust Grilles shall be sized for a Noise Criteria (NC) level less than 25.

B. The general exhaust system duct shall be negative while inside the building. In-line exhaust fans are prohibited in the general exhaust system inside the building. However, under certain circumstances exhaust fans mounted directly under the roof are permitted provided that the total discharge duct length does not exceed 5 feet inside the building, and the duct connections are welded.

C. All storage spaces shall be ventilated and should preferably be served with building exhaust air.

D. Toilet rooms shall have a supply and a mechanical exhaust system. Janitor’s closets shall have a mechanical exhaust system.

E. Exhausnts from adjacent toilet rooms shall be arranged to prevent sound transmission between men and women’s areas, and may be used to cool transformer and electrical rooms where practical.

F. Transformer vaults shall have separate ventilating fan or fans connected to emergency power supply. Vault shall be vented to outside in accordance with the National Electric Code.

1.50 LAB EXHAUST DESIGN

A. Chemical Fume Hood exhaust duct shall be sized for a velocity not to exceed 1500 Ft/Min. Low flow alarms are required for each hood. The alarm is remotely monitored at CDAS. Fume hoods located in the North Campus buildings shall be equipped with exhaust controls as specified in Section 15952.

B. For establishing the room balance the hood exhaust shall be calculated based on a face velocity of 110 ft/min at a sash position of 16 inches. However, the exhaust ducting shall be sized based on 110 ft/min with the sash wide open.

C. General area exhaust shall be provided in those cases where the room exhaust requirements exceed fume hood exhaust. The area exhaust grilles shall be placed to provide a uniform exhaust flow rather than bias the flow to one area of the room.

D. Makeup air for exhaust hoods shall be located so to not direct air into face of the hood.

1.51 BIOLOGICAL SAFETY CABINETS

A. Biological Safety Cabinets (BSC) shall not exhaust into the general exhaust system. If exhaust is required, a dedicated exhaust system shall be constructed. Ducts shall be sized for a velocity not to exceed 1500 Ft/Min.

B. The BSC exhaust duct shall be negative while inside the building.

1.52 AIR CONDITIONING UNITS

A. Refer to UT Specification 23 7315 for further information.
B. The floor sink serving the air conditioner shall be separate from the floor drain serving the mechanical room. The floor sink shall be provided with an 18 inch-square concrete curb.

1.53 GAS CYLINDER ROOM DESIGN CONSIDERATION

A. Gas cylinder rooms that contain carbon dioxide, nitrogen, or argon cylinders in excess of 100 lbs shall be exhausted at the following rates:

1. 60 air changes per hour are required for rooms less than 600 cubic feet. If a louver greater equal to 72 square inches free area is installed (12 x 12 grille) in the door, and the louver empties into an exhausted space greater than 3,600 cubic feet the exhaust can be reduced to 30 air changes per hour.

2. Between 600 and 1,200 cubic feet use 45 air changes per hour, or 20 air changes with louver (as noted above).

3. Between 1,200 and 2,400 cubic feet use 20 air changes per hour, or 10 air changes with louver, unless the area is a wet lab (see Section 2.0).

4. Greater than 2,400 cubic feet use 10 air changes per hour or room ventilation requirement, whichever is greater.

B. All rooms using liquid nitrogen Dewars greater than 100 Lbs. in capacity shall have the pop-off valve exhausted at 150 CFM using a 4-inch duct in addition to the room exhaust requirement.

C. Environmental rooms and cold rooms are essentially large freezers and refrigerators, and have either minimal or no ventilation. Extreme care must be used when considering the use of gases.

D. Chilled Water System Consideration. Any equipment other than air handling utilizing chilled water shall do so with a heat exchange device wherein of chilled water does not exceed 20°F. All equipment shall have alternate means of cooling to allow for seasonal maintenance of main chilled water system.

1.54 AIR FILTRATION

A. Air filtration is required for the following:

1. All air conditioner intakes. A two-inch thick 25% pre-filter and 95% (2 micron) final filter is used for the building air handlers. In addition, HEPA filters are also used down stream of the air conditioner fan for all animal research facilities.

2. A one-inch thick pre-filter in all animal room exhaust grilles to contain animal hair.

3. A one-inch thick pre-filter in fly room exhaust grilles to prevent inadvertent release.

4. A 25% pre-filter on all heat recovery coils.

5. HEPA filters are used on exhaust for all experiments using radioactive isotopes, and in some P3 facilities.

1.55 COORDINATION OF DESIGN

A. Final design drawings shall be checked for the following prior to issue:

B. The reflected ceiling plan shall show electrical lighting fixtures (including exit lights), air diffusers, ceiling grilles, ceiling type speakers, ceiling grid, sprinkler heads, etc.

C. Ductwork shall be checked for clearance between ceiling construction and underside of beams, recessed lighting fixtures and other interference where space is limited.

D. Large mechanical system piping shall be coordinated with building construction, beams, etc. to assure clearances and accessibility for maintenance. Piping and electrical switchgear locations are to be coordinated.

E. Coordinate requirements for louvers, equipment supports and other devices serving mechanical systems but furnished under the general construction section of the project.

F. Coordinate piping and VAV mixing box controls access.
G. Coordinate piping and ceiling mounted air handler filter door access.

1.56 ELECTRONIC FILES

A. The electronic design files (AutoCAD V. 2013) generated for the project are considered the property of UTSW, and shall comply with Specification 23 0011. The files shall be reconciled to the as-built drawings, and a closeout set of files on CD shall be provided to the ENGINEER. If building floors are turned over, the latest revision electronic files shall be delivered to the ENGINEER within 1 week of floor acceptance.

1.57 GENERAL PLANNING CRITERIA

A. Do not use machine rooms as return air plenums. The term “Machine Room” refers to equipment rooms that have items of equipment other than those items directly related to the air handling equipment. No pumps, panel boxes, etc. can be installed in a plenum. The use of rooms as plenums, however, is encouraged provided outside air and return air are directed to the plenum and volume control dampers are provided to control the quantity of each entering the plenum. Each component of an air handling system shall be spaced in the unit so that there is ample room on all sides for inspection and maintenance and man size hinged access doors shall be provided for ready access to these spaces.

B. Ventilate machine rooms.

C. All machine rooms shall have locks and a common key system not accessible to building personnel.

D. Provide lifting eyes or trolley rails for heavy equipment.

E. Combinations of machine rooms and janitor closets, or machine room storage spaces, are not acceptable. Main switchgear shall be in a separate room and avoid liquid conveying pipes above the switchgear.

F. Access shall be provided to machine room spaces without going through assigned areas, such as a janitor closet.

G. Walkways shall be provided for roof-mounted machinery so that equipment may be serviced without traffic directly on roof. Roof-mounted equipment shall be accessible by a stair. A hatch without stairs or use of external ladders is not acceptable. Equipment accessible only by a stepladder is prohibited. Catwalks shall be designed to facilitate motor or fan removal.

H. Equipment rooms shall be large enough to provide access to all equipment for maintenance and a means to remove and replace equipment. Adequate “pull spaces” shall be provided for coils, shafts, and filters.

I. Avoid running any pipes including server through electrical rooms.

PART 2 – PRODUCTS

2.1 ATTIC STOCK

A. Provide one set of filters and two sets of belts at conclusion of the project to the Owner for attic stock

PART 3 – EXECUTION

Not Used

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pressure gages and pressure gage cocks. Thermometers and thermometer wells. Pressure/temperature test plugs.

B. Ultrasonic flow meters used for balancing

1.2 REFERENCES

A. ASME B40.1 - Gages - Pressure Indicating Dial Type - Elastic Element.


C. ASTM E77 - Verification and Calibration of Liquid-in-Glass Thermometers.


E. UL 404 - Gages, Indicating Pressure, for Compressed Gas Service.

1.3 SUBMITTALS

A. Submit under provisions of Division 1 and Section 22 0010.

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.

1.4 PROJECT RECORD DOCUMENTS

A. Submit record documents under provisions of Division 1 and Section 22 0010.

B. Accurately record actual locations of meters and gauges.

1.5 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” 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” Weksler Thermal Wells, brass with stem of minimum length to extend beyond the mid-diameter of the pipe, 2-1/2” 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:
   Temperature: 36° to 250°F.
   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
SECTION 230529
SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 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.

1.2 RELATED SECTIONS

H. Section 21 3133 - Fire Protection Piping.
D. Section 22 0548 - Vibration Isolation.
E. Section 23 0701 - Piping Insulation.
F. Section 23 0702 - Equipment Insulation.
G. Section 23 0703 - Ductwork Insulation.
I. Section 22 1116 – Plumbing Piping.
J. Section 23 2113 - Hydronic Piping.
K. Section 23 2213 - Steam and Steam Condensate Piping.

1.3 REFERENCES

A. ASME B31.1 - Power Piping
B. ASME B31.2 - Fuel Gas Piping
C. ASME B31.5 - Refrigeration Piping
D. ASME B31.9 - Building Services Piping
E. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
F. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
G. MSS SP69 - Pipe Hangers and Supports - Selection and Application.
H. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
I. NFPA 13 - Installation of Sprinkler Systems.
J. NFPA 14 - Installation of Standpipe and Hose Systems
K. UL 203 - Pipe Hanger Equipment for Fire Protection Service

1.4 SUBMITTALS

A. Submit under provisions of Section 22 0010.
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.

1.5 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.
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. 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.

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.

F. 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.

G. All rod sizes indicated in this Specification are minimum sizes only. This trade shall be responsible for structural integrity of all supports, anchors, guides, etc. All structural hanging materials shall have a minimum safety factor of 5 built in.

H. 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.

I. 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.

J. 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.

K. Hangers supporting and contacting brass or copper lines 3" in size and smaller shall be Grinnell Fig. CT-99c, adjustable, copper plated, tubing ring. Hangers supporting and contacting brass or copper lines 4" 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. 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. 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.

L. Hangers supporting insulated lines where the outside diameter of the insulation is the equivalent of 8" diameter pipe or smaller in size and supporting all ferrous lines 6" and smaller in size shall be Grinnell Fig. 260, adjustable clevis, with a nut above and below the hanger on the support rod.

M. Hangers supporting and contacting ferrous lines larger than 6" in size and outside of insulation on lines with the outside diameter equivalent to 10" diameter pipe shall be Grinnell Fig. 260, adjustable clevis, with a nut above and below the hanger on the support rod.
N. Glass riser clamps shall be neoprene coated.

O. 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.

P. 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 in Section 23 0701 - PIPING INSULATION. Protect insulation from crushing by means of a section of rigid insulation to be installed at hanger points. 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.

Q. Hangers for large diameter steam and chilled water piping shall be roller style where thermal expansion is expected.

R. 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. Two-hole rigid pipe clamps at 4 ft. o.c. 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. 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.

S. 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. 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. 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. 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). 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.

T. 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. Pipes serving plumbing fixtures and equipment shall be securely supported near the point where pipes penetrate the finish wall. Supports shall be steel plate, angles or special channels such as Unistrut mounted in vertical or horizontal position. Pipe clamps such as Unistrut P2426, P2008, P1109 or other approved clamps shall be attached to supports. Supports shall be attached to wall or floor construction with clip angles, brackets, or other approved method. Supports may be attached to cast iron pipe with pipe clamp, or other approved method. All copper or brass lines shall be isolated from ferrous metals with dielectric materials to prevent electrolytic action.

2.3 CONDUITS

A. All electrical conduits shall be run parallel or perpendicular to adjacent building lines. Single conduits running horizontally shall be supported by "Caddy" or "Minerallac" type hangers from adequately sized rods (minimum 1/4") 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. Conduit shall be secured to channel with galvanized "Unistrut" type conduit clamps or stainless steel "Unistrut" type "Uni-Clips". All hangers shall be fastened to the building structure in the same manner as specified above for pipe hangers. Spacing of hangers shall be adequate for the weight and rigidity of the conduits involved; in any case, no greater than 8' centers. Where feasible, conduits may be fastened to the concrete by one-hole straps.
thoroughly anchored to the concrete in an approved manner. 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. Conduit shall be located so as not to inhibit removal of ceiling tiles.

B. The suspension system for the lay-in ceiling shall not be used to support electrical conduit.

C. 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.

D. All support hardware shall be galvanized or cadmium plated, or stainless steel.

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 on the Drawings and/or specified under Section 220548.

G. 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. 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. All pipe supports shall be designed and installed to avoid interference with other piping, hangers, ducts, electrical conduit, supports, building structures, equipment, etc. 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: 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. 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. 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: 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.
      c) Steel Beam: 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: 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. 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. 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" larger than the diameter of the hanger rod. 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. Cinch anchors, lead shields, expansion bolts, and studs driven by explosion charges are not allowed under any circumstances in the lower 15" of each stem and in the "shadow" of the stem on the top side of the "double tees".
D. Trapezes: 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. Trapeze members including suspension rods shall each be properly sized for the number, size, and loaded weight of the lines they are to support.

E. Finishes: All hangers on piping including clevis hangers, rods, inserts, clamps, stanchions, brackets, shall be dipped in Zinc Chromate Primer before installation. Rods may be galvanized or cadmium plated after threading, in lieu of dipping zinc chromate. Universal concrete inserts shall be cadmium plated.

F. Ductwork: All ductwork shall be supported in accordance with the SMACNA recommendation for the service involved; however, all horizontal ductwork shall be supported at intervals not to exceed 8'-0". 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. For attaching methods for precast double tee structural concrete, refer to details on the Drawings and as specified herein. All ductwork over 36" wide shall be supported with vibration isolation integral with the hangers or supports.

G. Terminal units weighing less than 150 lbs. shall be supported by four 16 gauge, 1" wide sheet metal straps with ends turned under bottom of box at corners and secured by one not over 3/4" in length, 1/4" diameter sheet metal screw per strap. The other strap end shall be attached to the structure by 1/4" diameter threaded bolt into the concrete insert or into drilled-hole threaded concrete expansion anchor. Boxes over 150 lbs. in weight shall be supported the same as described above except two 1/4" diameter sheet metal screws through turned end of strap box shall be provided. 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" diameter galvanized threaded rods providing such channels do not block access panels of boxes. Threaded rods shall be supported from structure by concrete insert or by drilled-hole threaded concrete expansion anchor.

H. Miscellaneous: Provide any other special foundations, hangers and supports indicated on the Drawings, specified elsewhere herein; or required by conditions at the site. 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.

I. 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 abovementioned 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.

2.7 EQUIPMENT CURBS

A. Fabrication: Welded 18 gage galvanized steel shell and base, mitered 3 inch cant, variable step to match roof insulation, factory installed wood nailer.
2.8 CONCRETE FOUNDATIONS ("Housekeeping Pads")

A. Concrete foundations for the support of equipment such as floor mounted panels, pumps, fans, air handling units, etc., shall not be less than 3.5" high (formed by 2x4 lumber) and extend 4" on all sides beyond the limits of the mounted equipment unless otherwise noted and shall be poured in forms built of new dressed lumber. All corners of the foundations shall be neatly chamfered by means of sheet metal or triangular wood strips nailed to the form. Foundation bolts shall be placed in the forms when the concrete is poured, the bolts being correctly located by means of templates. Each bolt shall be set in a sleeve of size to provide 1/2" clearance around bolt. Allow 1" below the equipment bases for alignment and grouting. After grouting, the forms shall be removed and the surface of the foundations shall be hand rubbed with Carborundum. Foundations for equipment located on the exterior of the building shall be provided as indicated. Foundations shall be constructed in accordance with Shop Drawings submitted by the Contractor for review by the Architect/Engineer.

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” and larger valves

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. 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. Provide curbs for mechanical roof installations 14 inches minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.

G. 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. Provide close fitting metal collar or escutcheon covers, as appropriate, at both sides of penetration.

E. Install chrome plated steel or stainless steel escutcheon at finished surfaces.
### SCHEDULES

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<tr>
<th>PIPE SIZE</th>
<th>MAX. HANGER SPACING</th>
<th>HANGER ROD DIAMETER</th>
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<tr>
<td>Inches</td>
<td>Feet</td>
<td>Inches</td>
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<tr>
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<td>1-1/2 to 2</td>
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<tr>
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<td>5/8</td>
</tr>
<tr>
<td>Glass, and at all Joints</td>
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END OF SECTION
SECTION 230553
MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Nameplates.
B. Stencils.
C. Pipe Markers.

1.2 RELATED SECTIONS
A. Division 9 - Painting: Identification painting.
B. Section 230000 - Basic Mechanical Requirements.

1.3 REFERENCES

1.4 SUBMITTALS
A. Submit under provisions of Division 1 and Section 230000.
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.

1.5 PROJECT RECORD DOCUMENTS
A. Submit under provisions of Division 1 and Section 230000.
B. Not used

PART 2 - PRODUCTS

2.1 NAMEPLATES
A. Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 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.

2.3 PIPE MARKERS
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.

2.4 CEILING TACKS
A. Description: Steel with 3/4 inch (20 mm) diameter color coded head.
B. Color code as follows:
1. Yellow - HVAC equipment
2. Red - Fire dampers/smoke dampers
3. Blue - Heating/cooling valves

2.5 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. All items of equipment such as fans, pumps, etc., shall be clearly marked using engraved nameplates as hereinafter specified. The item of equipment shall indicate the same number as shown on the Drawings. The equipment identification will be shown on the Drawings or provided by the Superintendent of Utilities.

2.6 MECHANICAL
A. All items of new mechanical equipment shall be identified by the attachment of engraved nameplates constructed from laminated phenolic plastic, at least 1/16" thick, 3-ply, with black surfaces and white core. Engraving shall be condensed Gothic, at least 1/2" high, appropriately spaced. Nomenclature on the label shall be in accordance with UTSW standards. Nomenclature shall be as described in this section. Equipment to be labeled shall include but not be limited to the following:

- Air Handling Units
- Pumps
- Fan and Coil Units
- Condensing Units
- Air Conditioning Control
- Panels and Switches
- Ventilation Fans
- Exhaust Fans
- Hot Water Generators
- Storage Tanks
- Compressors
- Chillers
- Miscellaneous - similar and/or related items

2.7 PIPING: Pipe markers and arrow markers also shall be provided on but not limited to the piping of the following systems affected by the project:

- Primary Chilled Water Supply
- Primary Chilled Water Return
- Atmospheric Relief
- Low Pressure Steam
- Compressed Air
- Steam Condensate
- Secondary Chilled Water Supply
- Secondary Chilled Water Return
- Medium Pressure Steam
- Medium Pressure Steam

2.8 MARKERS: 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. Concealed areas, for purposes of this identification section, are those areas which cannot be seen except by demolition of the building elements. In addition to the pipe markers, arrow markers shall be used to indicate direction of flow. The following specific instructions shall apply to the application of these markers:

A. 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.
B. Provide an arrow marker with each pipe marker pointing away from the pipe marker to indicate direction of flow.
C. Provide a double ended arrow marker when flow can be in either or both directions.
D. 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.
E. Provide pipe markers and arrow markers at intervals not exceeding 50 feet.
F. Markers shall be located on the two lower quarters of the pipe where view is unobstructed.
G. Use Seton Setmark Type SNA or Brady snap-on type identification for all piping systems, 3/4" thru 6". For piping systems larger than 6", use Seton or Brady strap on markers.
H. Pipe Markers shall conform to ANSI A 13.1-1981 "Scheme for the Identification of Piping Systems". Arrow markers must have same ANSI background colors as their companion pipe markers, or be incorporated into the pipe identification marker.

2.9 NOMENCLATURE
A. The building designators for the new hospital and ancillary buildings will be:
   1. UH – University Hospital
   2. US – University Hospital Support Building
   3. UW – University Hospital Power Plant
B. The new University Hospital floors will be numbered as follows:
   UH0 (crawl space)
   UH1
   UH2
   UH3
   UH4
   UHM (mechanical floor)
   UH5
   UH6
   UH7
   UH8
   UH9
   UH10
   UH11
   UH12
   UHP (penthouse)
C. UTSWMC 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 UTSWMC 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 UTSWMC BACnet control system can contain up to 65,535 (64K) interconnected networks each of which are required to have a unique network number. At UTSWMC, network numbers shall be assigned as follows:
   
   NBBSS
   Where: N = Network Type
   0 = Ethernet
   1 = MS/TP
   2 = P1
   3 = >6 not used
   SS = 00 to 35 for individual I/P segments in a building
   BB = the building number
   00 = not used
01 = DC
02 = DE, CB2
03 = DF, CB1
04 = DH
05 = BL
06 = BP
07 = NTEP
08 = V
09 = BTEP
10 = NA
11 = NB
12 = NC
13 = ND
14 = NE
15 = NF
16 = NG
17 = NL
18 = not used
19 = ZL
20 = HA, SP, St. Paul
21 = HP, POB1
22 = HQ, POB2
23 = WA, ASC, Ambulatory Surgical Center
24 = not used
25 = not used
26 = EC
27 = RC
28 = not used
29 = not used
30 = A
31 = B
32 = C
33 = D
34 = E
35 = F
36 = G
37 = H
38 = J
39 = K
40 = L
41 = M
42 = MA
43 = P
44 = R
45 = S
46 = U
47 = X
48 = Y
49 = CS
50 = PE, STEP
51 = unused
52 = EB
53 = unused
54 = unused
2. 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 UTSWMC, device numbers shall be assigned as follows:

\[
\text{VBBYYY}
\]

Where:

\[
\begin{align*}
\text{V} &= \text{Vendor} \\
0 &= \text{not used} \\
1 &= \text{Alerton controls} \\
2 &= \text{Siemens controls} \\
3 &= \text{Trane} \\
4 &= \text{not used} \\
\text{BB} &= \text{Building number as defined in Section 1} \\
\text{YYYY} &= 0000 to 9999 for devices
\end{align*}
\]

For example, for the 112th Siemens device in NB building the device number would be:

\[
2110112
\]

Or for the 86th Alerton device in CS building the device number would be:

\[
1490086
\]

3. System Naming Convention: To create a consistent naming structure across legacy, proprietary, new/remodel construction, and open protocol implementations at UTSWMC, 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.

a. 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.

b. 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.

c. 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.

(1) Environmental rooms, Refrigerators, and Freezers shall have that designation as part of the name. For example, CY3.333 Refrigerator 33 is described as CY 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.

(2) 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.

(3) 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.

(4) 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 BBF. (includes floor #) AHU-NN. 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.
   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 BBF.AHUNN Type. 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 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, 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 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.Function VLV. Where BB is the one or two letter building designation, F is the floor number, T is Valve type such as:
   - RHW = Reheat Water
   - DHW = Domestic Hot Water
   - CHW = Chilled Water
   - HUM = Humidity
   - SCHW = Secondary Chilled Water
   - PCHW = Process Chilled Water
   - CW = Condenser Water
   - GLY = Glycol

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 BBF.Type EFNN. Where BB is the one or two letter building designation, F is the floor number, 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.MRIEF17 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. Chillers shall be designated BB.CHLRNN. Where BB is the one or two letter building designation, CHLR is a designation for the chiller, NN is an incrementing decimal value that designates the chiller number in that particular building. For example, NTEP.CHLR5 shall be described as NTEP Chiller #5.
   a. Associated chiller information points will be prefaced with the chiller designation in the name and followed by the information type. For example, PE.CHLR2 TONS shall be described as PE Chiller #2 Tons, or PE.CHLR-4 GPM shall be described as PE Chiller #4 Gallons per Minute.

10. Cooling Towers shall be designated BB.CTNN. Where BB is the one or two letter building designation, CT is a designation for the cooling tower, NN is an incrementing decimal value that designates the cooling tower number in that particular building. For example, NTEP.CT2 shall be described as NTEP Cooling Tower #2.
   a. Associated cooling tower information points will be prefaced with the cooling tower designation in the name and followed by the information type. For example, PE.CT2 CW Flow shall be described as PE Cooling Tower #2 Condenser Water Flow, or PE.CT4 SS shall be described as PE Cooling Tower #4 Start/Stop.

11. Boilers shall be designated BB.BLRNN. Where BB is the one or two letter building designation, BLR is a designation for the boiler, NN is an incrementing decimal value that designates the boiler number in that particular building. For example, NTEP.BLR1 shall be described as NTEP Boiler #1.
   a. Associated boiler information points will be prefaced with the boiler designation in the name and followed by the information type. For example, PE.BLR2 ECON OUT WATER TEMP shall be described as PE Boiler #2 Econ Out Water Temp, or NTEP.BLR4 GAS TEMP shall be described as PE Boiler #4 Gas Temperature.

12. 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 9.
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. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.
F. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
G. Identify control panels and major control components outside panels with plastic nameplates.

END OF SECTION
SECTIONS 230593

TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 SUMMARY

A. Perform all 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.

B. The scope of the TAB work as defined in Section 15991 is indicated in order that the Contractor will be advised of the coordination, adjustment, and system modification which will be required under the project work in order to complete the Owner's requirements for final TAB. The TAB firm will not have a contractual relationship with any Contractor referred to herein, but will be responsible to the Construction Inspector and the Owner for the satisfactory execution of the TAB work. The Contractor in his original bid shall allow for the costs required to cover all work which may be required in the TAB phases as defined herein and as may be necessary for the completion of the TAB work as defined by the TAB firm.

1.2 RELATED SECTIONS

A. Section 22 0010 - Basic Mechanical Requirements.
B. Section 22 0548 - Vibration Isolation.
C. Section 23 2115 - Hydronic Specialties.
D. Section 23 3413 - Axial Fans.
E. Section 23 8223 - Power Ventilators.
F. Section 23 3113 - Ductwork.
G. Section 23 3300 - Ductwork Accessories.
H. Section 23 3600 - Air Terminal Units.
I. Section 23 3315 - Air Outlets and Inlets.
J. Section 23 0900 - Energy Management System (EMS).
K. Section 23 0993 - Sequence of Operation.
L. Section 23 0593 - Testing, Adjusting and Balancing.

1.3 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. However, the 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 herein 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. The contractor shall allow adequate time for the 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.

F. 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. Should any such device not be readily accessible, the Contractor shall provide access as requested by the TAB firm. Also, any 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.

1.4 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 his contracted work within the construction schedule. The contractor shall complete his work by systems or floors whichever is the most efficient for scheduling. After awarding 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. 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. Dampers serving requirements of minimum and maximum outside, return and relief air shall provide tight closure and full opening, smooth and free operation.
   c. All supply, return, exhaust and transfer grilles, registers, diffusers and terminal devices installed.
   d. 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.
   e. 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.

f. 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. Check and verify pump alignment and rotation.
   b. Open all valves to their full open position, close bypass stop valves. Set mixing valves to full-flow through systems components. After the system is flushed and checked for proper operation, remove and clean all strainers. The Contractor shall repeat the operation until circulating water is clean.
   c. Record each pump motor amperage on each phase and voltage after reaching rated speed. Readings shall not exceed nameplate rating.
   d. Verify that the electrical heater elements are of the proper size and rating.
   e. 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. Systems shall be cleaned and flushed. Chemicals shall be added to closed systems to treat piping and inhibit corrosion.
   f. 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 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. The Automatic Temperature Control 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 in Paragraph 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. He shall 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. This inspection will establish to the satisfaction of the represented parties whether or not the systems meet the basic requirements for TAB services. 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.

1.5 RESPONSIBILITIES OF THE TAB FIRM

A. Refer to Section 23 0593 entitled "Testing, Adjusting and Balancing".

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION
PART 1 - GENERAL

1.1 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.

1.2 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. 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. The firm shall submit their full incorporated name, Charter Number and Taxpayer's I.D. Number for proper verification of the firm's status.

C. 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. 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.

D. The Firm shall maintain current insurance coverages in the minimum amounts indicated below. 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:
   1. Worker's Compensation as required by law.
   2. General Liability for not less than $2,000,000 aggregate.
   3. Fire Damage, and Extended Coverage, Vandalism and Malicious Mischief, in the full amount of Contract. The above policies shall be carried with companies satisfactory to the Owner. 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.

E. 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.

F. 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. 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. 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.

1.3 REFERENCES


1.4 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 Drawings less the structural sheets.
   2. One set of mechanical floor plans of the conditioned spaces. These Drawings shall be ozalid type (blue or black on light background) reproductions to facilitate marking.
B. Approved submittal data on equipment installed, and related changes as required to accomplish the test procedures outlined in Paragraphs 1.06 through 1.10 of this Specification will be available through the Owner’s Representative.

1.5 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. This is intended to be accomplished after the system components are installed and operating as provided for in the contract documents. 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 2002, Sixth Edition.
B. 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 balanceability and provide commentary.
      b. During construction, review all HVAC submittals such as control diagrams, air handling devices, etc., that pertain to commissioning work and balanceability.
      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. 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.
      d. Test one (1) 8” single duct terminal box for performance capability and leakage as described in Section 15930. 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 three (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 second test will be at the Contractor’s cost and the time allowed will restart when the box is received at the TAB Firm.
e. Test one (1) 8" dual duct box for performance capability and leakage as described in Section 15930. 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 three (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 second test will be at the Contractor's cost and the time allowed will restart when the box is received by the TAB firm.

f. Test 10% of the single and dual duct boxes for casing and damper leakage when the shipment arrives at the project site. All testing (except for the initial boxes) shall be performed on site. Boxes requiring re-testing will be charged to the Contractor at the unit price provided to the Owner.

g. 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. 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" increments until fully closed. Track the three (3) valve's response time in relation to sash movement and the lab differential.

h. Witness Air Handling Unit leakage and deflection testing as specified in other sections. Typical for Air Handling Units 10,000 cfm and larger. Provide test results to UTSW representative.

i. Witness Fan vibration testing as specified in other sections. Provide test results to UTSW representative.

j. Attend Commissioning meetings, as required, to support OFPC 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. The written document need not be formal, but must be understandable and legible. Data from malfunctioning equipment shall not be recorded in the final TAB report. 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.

1.6 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. 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 +5% of the value shown on the drawings. Air handling unit and fan volumes shall be adjusted by changing fan speed and adjusting volume dampers associated with the unit. 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. Air distribution devices shall be balanced with air patterns as specified. Duct volume dampers shall be adjusted to provide air volume to branch ducts where such dampers are shown. The 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 15 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 15 Contractor shall make any required changes.

3. Ampere Readings: Measure and record full load amperes for motors.

4. Static Pressure: 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. 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. 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**: Set controls for full cooling and for full heating loads. Read and record entering and leaving dry bulb and wet bulb temperatures (cooling only) at each cooling coil, heating coil and HVAC terminal unit. 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**: Adjust each exhaust inlet and supply diffuser, register and grille to within ±5% of design air CFM. Include all terminal points of air supply and all points of exhaust. Note: For Labs and Rooms that are negative exhaust air flow shall be set to design +10% and supply to design -5%. Positive areas will have opposite tolerances.

9. **Pitot Tube Traverses**: 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. Locations of these traverse test stations shall be described on the sheet containing the data.

10. Maximum and minimum air flow on terminal boxes.

### 1.7 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. The general scope of balancing by the TAB Consultant will include, but not be limited to, the following:

1. **Adjusted System Tests**: Adjust balancing valves at each coil for design flow, ±5%. Adjust balancing valves at pumps to obtain design water flow. Record pressure rise across pumps and GPM flow from pump curve. 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**: Read and record entering and leaving water temperature at each water coil. Adjust as necessary to secure design and conditions. Provide final readings at all thermometer well locations.

3. **Pressure Readings**: Water pressure shall be recorded at all gauge connections. 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. 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. For coils equipped with 3 way valves, the rated pressure drop shall first be adjusted through the coils. 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.

### 1.8 SOUND VIBRATION AND ALIGNMENT (Optional – edit as necessary)

**A. Sound**: Read and record sound levels at up to 15 locations in the building designated by the Engineer. All measurements shall be made using an Octave Band Analyzer. All tests shall be conducted when the building is quiet in the presence of the Engineer, if he so desires.

**B. Vibration**: Read and record vibration for all water circulating pumps which have motors larger than 10 HP. Include equipment vibration, bearing housing vibration, foundation vibration, building structure vibration, and other tests as directed by the Engineer. Readings will be made using portable IRD (or approved equal) equipment capable of filtering out various unwanted frequencies and standard reporting forms. Maximum vibration at any point listed above, or specified, shall not exceed 1 mil on fans and 1 mil on pumps unless otherwise specified. Equipment manufacturers shall rectify all systems exceeding vibration tolerances.

### 1.9 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 its 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. Each system will be tested in accordance with written control sequence verification procedures. The written control sequence verification will document the performance of the specified control sequence and the control manufacturers as built drawings. The written control sequence verification will identify each components sequence, safety devices and alarms. The written control sequence verification will test multiple components in a manifold system. The written control sequence verification will test the systems in normal power and emergency power.

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. Record all the information on a point verification log.

1.10 STAIRWELL PRESSURIZATION SYSTEMS

A. With all doors closed, measure the door pull to determine that the opening force required is below 30 foot-pounds.

B. With all doors closed, measure the pressure differential across each door to verify the pressure differentials at each floor.

C. Measure the air flow in the stairwell with the maximum number of doors fully open by pitot tube traverse, if traverse locations are available. If traverse locations are not available, measure air flow at each outlet.

D. Verify with smoke that the smoke detector in the stair pressurization fan inlet shuts the fan down.

1.11 REPORTS
A. The activities described in this section shall culminate in a report to be provided in triplicate (3) individually bound and an electronic report formatted in the same manner as the bound report on a CD to the OFPC representative. Neatly type and arrange data. 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. Record all failures and corrective action taken to remedy incorrect situation. The intent of the final report is to provide a reference of actual operating conditions for the Owner's operations personnel. The report will be organized in the following manner:

1. Title Sheet
2. Table of Contents (Per system)
3. AHU Data (Numerical sequence)
   a. Air Distribution Data, Traverse Data, All Supporting Data, etc.
4. FCU, CRAC, etc. with supporting data
5. Fan Data with supporting data
6. Chilled Water System Data (Heat Transfer Equip., Pumps, etc.)
7. Heating Water System Data (Heat Transfer Equip., Pumps, etc.)
8. Condenser Water System Data (Cooling Towers, Heat Transfer Equip., Pumps, etc.)
9. Control Verification (Sequences, Sensor Calibration, Point to Point, Graphics, etc)
10. Appendix (Miscellaneous supporting documentation relative to systems performance Fan and Pump Curves, Control Schematics, Correspondence, etc.)

B. 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.

C. 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.

D. Submit reports on hard copy and 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
<table>
<thead>
<tr>
<th>Component</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total static pressure (total external), specified and actual</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Inlet pressure</strong></td>
<td></td>
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<tr>
<td><strong>Discharge pressure</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Fan RPM</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Return Air/Outside Air Data (if fans are used, same data as for 3 above)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Identification/location</strong></td>
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<tr>
<td><strong>Design return air flow</strong></td>
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<tr>
<td><strong>Actual return air flow</strong></td>
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<tr>
<td><strong>Design outside air flow</strong></td>
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<tr>
<td><strong>Return air temperature</strong></td>
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<tr>
<td><strong>Outside air temperature</strong></td>
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<tr>
<td><strong>Required mixed air temperature</strong></td>
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<tr>
<td><strong>Actual mixed air temperature</strong></td>
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<td><strong>Electric Motors</strong></td>
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<td><strong>Manufacturer</strong></td>
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<td><strong>HP/BHP</strong></td>
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<td><strong>Phase, voltage, amperage, nameplate, actual</strong></td>
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<td><strong>RPM</strong></td>
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<td><strong>Service factor</strong></td>
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<td><strong>Starter size, heater elements, rating</strong></td>
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<tr>
<td><strong>V-Belt Drive</strong></td>
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<td><strong>Identification/location</strong></td>
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<td><strong>Required driven RPM</strong></td>
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<tr>
<td><strong>Driven sheave, diameter and RPM</strong></td>
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<tr>
<td><strong>Belt, size and quantity</strong></td>
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<tr>
<td><strong>Motor sheave, diameter and RPM</strong></td>
<td></td>
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<tr>
<td><strong>Center-to-center distance, maximum, minimum and actual</strong></td>
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<tr>
<td><strong>Duct Traverse</strong></td>
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<tr>
<td><strong>System zone/branch</strong></td>
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<tr>
<td><strong>Duct size</strong></td>
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<td><strong>Area</strong></td>
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<tr>
<td><strong>Design velocity</strong></td>
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<td><strong>Design air flow</strong></td>
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<td><strong>Test velocity</strong></td>
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<tr>
<td><strong>Test air flow</strong></td>
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<tr>
<td><strong>Duct static pressure</strong></td>
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<td><strong>Air temperature</strong></td>
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<td><strong>Air correction factor</strong></td>
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<td><strong>Air Monitoring Station Data</strong></td>
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<td><strong>Identification/location</strong></td>
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<td><strong>System</strong></td>
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<td><strong>Size</strong></td>
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<td><strong>Area</strong></td>
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<td><strong>Design velocity</strong></td>
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<td><strong>Design air flow</strong></td>
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<td><strong>Test velocity</strong></td>
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<td><strong>Test air flow</strong></td>
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<td><strong>Air Distribution Test Sheet</strong></td>
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<td><strong>Air terminal number</strong></td>
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<tr>
<td><strong>Terminal type</strong></td>
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<td><strong>Terminal size</strong></td>
<td></td>
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<tr>
<td><strong>Area factor</strong></td>
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</tbody>
</table>
f. Design velocity  
g. Design air flow  
h. Test (final) velocity  
i. Test (final) air flow   

10. Pump Data  
a. Identification/number  
b. Manufacturer  
c. Size/model  
d. Impeller  
e. Service  
f. Design flow rate, pressure drop, BHP  
g. Actual flow rate, pressure drop, BHP  
h. Discharge pressure  
i. Suction pressure  
j. Total operating head pressure  
k. Shut off, discharge and suction pressure  
l. Shut off, total head pressure  
m. Pressure differential settings  

11. 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  

12. 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  

13. 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  

14. Vibration Test on equipment having 10 HP motors or above  
a. Location of points:  
   1) Pump bearing, drive end  
   2) Pump bearing, opposite end  
   3) Motor bearing, center (if applicable)  
   4) Motor bearing, drive end  
   5) Motor bearing, opposite end
6) Casing (bottom or top)
7) Casing (side)
8) Pipe after flexible connection (discharge), if applicable
9) Pipe after flexible connection (suction), if applicable
b. Test readings:
   1) Horizontal, velocity and displacement
   2) Vertical, velocity and displacement
   3) Axial, velocity and displacement
c. Normally acceptable readings, velocity and acceleration
d. Unusual conditions at time of test
e. Vibration source (if non-complying)

15. 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. Safeties
   1) VSD Normal Operation
   2) VSD Bypass Operation
f. Alarms
g. Sequences of Operation

PART 2 – PRODUCTS  Not Used

PART 3 – EXECUTION  Not Used

END OF SECTION
SECTION 230701

PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Piping insulation.
B. Jackets and accessories.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION
A. Section 21 3113 - Fire Protection Systems: Placement of hangers and hanger inserts.
B. Section 22 1116 – Plumbing Piping: Placement of hangers and hanger inserts.
C. Section 23 2113 - Hydronic Piping: Placement of hangers and hanger inserts.
D. Section 23 2213 - Steam and Steam Condensate Piping: Placement of hangers and hanger inserts.

1.3 RELATED SECTIONS
A. Section 22 0010 – Basic Mechanical Requirements.
B. Section 23 0553 - Mechanical Identification.

1.4 REFERENCES
A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
E. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal
G. ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
H. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
J. ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.
K. ASTM C578 - Preformed, Block Type Cellular Polystyrene Thermal Insulation.
L. ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
M. ASTM C591 - Rigid Preformed Cellular Urethane Thermal Insulation.
N. ASTM C610 - Expanded Perlite Block and Pipe Thermal Insulation.
O. ASTM C640 - Corkboard and Cork Pipe Thermal Insulation.
Q. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
S. ASTM D2842 - Water Absorption of Rigid Cellular Plastics.
W. UL 723 - Surface Burning Characteristics of Building Materials.

1.5 SUBMITTALS
A. Submit under provisions of Section 22 0010.
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. Manufacturer's Installation Instructions: Indicate procedures, which ensure acceptable workmanship and installation standards will be achieved.

1.6 QUALITY ASSURANCE
A. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with NFPA 255.
B. Manufacturer of product may be requested by Owner to inspect the installation.

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 22 0010.
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.

1.9 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 HOT AND COLD DOMESTIC WATER (INCLUDING LABS)
A. All hot and cold water lines in buildings, including valves, strainers, unions, flanges, etc., except where specifically noted to the contrary, shall be insulated.
B. All cold water lines shall be insulated with 1/2" 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" thick, "25-50" rated, closed cell elastomeric thermal insulation such as "Self Seal Armaflex 2000". 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. All elastomeric insulating products shall be guaranteed not to react with copper piping. Valves shall be insulated with mitered pipe covering with voids filled with glass fiber blanket insulation. Valves and fittings shall be vapor sealed with a water base asphaltic emulsion. 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. 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. Seams in jacket shall be placed in the least noticeable locations. Where seams, joint or fittings are rough they shall be covered with an application of insulating cement trowelled on smoothly before the canvas is applied with Arabol adhesive. The canvas must be free of wrinkles and have a smooth, neat appearance.
C. All hot water piping systems shall be insulated as specified above for cold water, and the insulation thickness shall be one inch (1") thick.
D. 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. Vertical roof drain piping inside the building shall not be insulated. In addition, drain piping from mechanical rooms, and other areas potentially receiving chilled water or condensate from air handlers, shall be similarly insulated for a minimum of 15 feet from all floor drains.

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 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:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Insulation Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot; and smaller</td>
<td>2&quot;</td>
</tr>
<tr>
<td>2-1/2&quot; and larger</td>
<td>2-1/2&quot;</td>
</tr>
</tbody>
</table>

Refer to details on the Drawings. The phrase "subject to freezing temperatures" shall be interpreted to mean all areas not within the confines of heated building spaces.

2.4 STEAM AND CONDENSATE PIPING - BUILDINGS
A. Contractor shall install dimensional, Pittsburgh Corning high temperature foamglass, on steam and condensate piping. Prior to application of any insulation, all metal surfaces shall be thoroughly cleaned. Insulation shall be applied to the piping with butt joints staggered and all joints tightly butted. The insulation shall be held in place using stainless steel bands. The bands shall be spaced at 12 inches on center. A jacket of aluminum or stainless steel shall be applied to the completed installation, 8'-0" above finished floor. 15 mil PVC jacket shall be applied to pipes 8'-0" above finished floor. The longitudinal joint of the jacketing shall be placed with overlap directed to bottom of pipe. The jacketing shall be overlapped a minimum of 3 inches, and it shall be held in place using 3/4 inch bands applied at 12 inches on center. Note that the use of asphaltic materials on higher-than-ambient service is specifically prohibited.

B. Fiberglass (rigid) insulation on flanges, valves and other fitting shall consist of prefabricated fitting covers of the same thickness as specified for adjoining pipe insulation. Use Insultech blanket on all team valves and flanges 4" and larger.

C. Fitting insulation shall be applied in same manner as pipe application. Fitting cover jacketing shall be equal to Gasco, Pabco or RPR Metals prefabricated fitting covers of 0.016" paper coated aluminum, secured as recommended by the manufacturer.

D. The insulation thickness shall be as follows:

<table>
<thead>
<tr>
<th>Nominal IPS</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot; and less</td>
<td>1-1/2&quot;</td>
</tr>
<tr>
<td>2-1/2&quot; thru 4&quot;</td>
<td>2&quot;</td>
</tr>
<tr>
<td>5&quot; thru 10&quot;</td>
<td>2-1/2&quot;</td>
</tr>
<tr>
<td>12&quot; and above</td>
<td>3&quot;</td>
</tr>
</tbody>
</table>

E. Hangers shall bear on the outside of the insulation and shall not be in contact with the pipe. Curved metal shields shall be used between the hangers or support points and the bottom of the insulated pipe. 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. Required metal shield sizes are as follows:

<table>
<thead>
<tr>
<th>Nominal IPS</th>
<th>Metal Thickness</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 2&quot;</td>
<td>14 gauge</td>
<td>12&quot;</td>
</tr>
<tr>
<td>2-1/2&quot; thru 6&quot;</td>
<td>12 gauge</td>
<td>16&quot;</td>
</tr>
<tr>
<td>8&quot; and above</td>
<td>10 gauge</td>
<td>20&quot;</td>
</tr>
</tbody>
</table>

F. Shields shall be installed at all locations of support. They shall be made of galvanized iron, or black iron painted on both sides with two coats of aluminum paint.
G. Where expansion bends occur in the lines, a two-foot (2') double layer contraction joint shall be provided in the main line starting two feet from the end of the main line ells on both sides of the expansion loop. Expansion joints shall consist of two 1-1/2" thick x 24" long pipe covering cuts into 17-1/4" and 6" lengths to provide a 3/4" space by 10-1/4".

H. A 3/4" space on inside layer of expansion joints shall be filled with needled fiberglass blanket loose fill and the 3/4" space on the outer layer shall also be filled with the same loose fill. On two inch (2") or smaller IPS piping, both inner and outer layer shall be 1" thick "FOAMGLAS".

I. Securing of aluminum jacket shall be made by the use of 3/4" x 0.016" aluminum or stainless steel bands and seals. The shields at support points shall be secured with 1/2" x 0.020" stainless steel bands and seals. The pipe primer shall be a red lead oxide primer. The metal jacketing and fitting covers shall be fabricated of 0.016" aluminum or stainless steel with a smooth finish.

J. Insulation installed under this paragraph inside the building downstream of the pressure reducing station shall be "FOAMGLAS" with factory applied Class I, Fire Rated, Kraft-Aluminum ("FRK"), jacketing. It shall be applied in strict accordance with the manufacturer's recommendations after the pipe has been primed with one (1) coat of red lead oxide primer. It will be necessary to include expansion joints at regular intervals on dual temperature service. Thickness shall be as follows:

<table>
<thead>
<tr>
<th>Pipe sizes up to 2-1/2&quot;</th>
<th>- 1&quot; thick</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe sizes 3&quot; and over</td>
<td>- 2&quot; thick</td>
</tr>
</tbody>
</table>

K. No 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 any moisture leakage to drain.

L. 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.

2.5 STEAM AND CONDENSATE PIPING - CRAWLSPACE

A. Dimensional standard cellular glass insulation, Pittsburgh Corning high temperature foamglass shall be installed on steam and condensate piping. Prior to application of any insulation, all metal surfaces shall be thoroughly cleaned. The insulation shall be held in place using stainless steel bands or 14-gauge copper clad wire. The bands shall be spaced at a maximum of 12 inches on center. A jacket of aluminum or stainless steel shall be applied to the completed installation. The Longitudinal joint of the jacketing shall be placed with the overlap directed to bottom of pipe. The jacketing shall be overlapped a minimum of 3 inches, and it shall be held in place using 3/4 inch bands of 0.016" thick stainless steel, applied at 12 inches on center.

B. High temperature fiberglass insulation on flanges, valves and other fitting shall consist of prefabricated fitting covers of the same thickness as specified for adjoining pipe insulation.

C. Fitting covers shall be applied in same manner as pipe application. Fitting cover jacketing shall be equal to or better than Gasco, Pabco or RPR Metals prefabricated fitting covers of 0.016" paper coated aluminum, secured as recommended by the manufacturer.

D. The insulation thickness shall be as follows:

<table>
<thead>
<tr>
<th>Nominal IPS</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot; and less</td>
<td>1-1/2&quot;</td>
</tr>
<tr>
<td>2-1/2&quot; thru 4&quot;</td>
<td>2&quot;</td>
</tr>
<tr>
<td>5&quot; thru 10&quot;</td>
<td>2-1/2&quot;</td>
</tr>
<tr>
<td>12&quot; and above</td>
<td>3&quot;</td>
</tr>
</tbody>
</table>

E. Hangers shall bear on the outside of the insulation and shall not be in contact with the pipe. Curved metal shields shall be used between the hangers or support points and the bottom of the insulated pipe. 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. Required metal shield sizes are as follows:
F. Shields shall be installed at all locations of support. They shall be made of galvanized iron, or black iron painted on both sides with two coats of aluminum paint.

G. Where expansion bends occur in the lines, a two-foot (2') double layer contraction joint shall be provided in the main line starting two feet from the end of the main line ells on both sides of the expansion loop. Expansion joints shall consist of two 1-1/2" thick x 24" long pipe covering cuts into 17-1/4" and 6" lengths to provide a 3/4" space by 10-1/4".

H. For pipe sizes greater than two inch (2"), a 3/4" space on inside layer of expansion joints shall be filled with needled fiberglass blanket loose fill and the 3/4" space on the outer layer shall also be filled with the same loose fill. On two inch (2") or smaller IPS piping, both inner and outer layer shall be 1" thick high temperature fiberglass.

I. Securing of aluminum jacket shall be made by the use of 3/4" x 0.016" aluminum or stainless steel bands and seals. The shields at support points shall be secured with 1/2" x 0.016" stainless steel bands and seals. The pipe primer shall be a red lead oxide primer. The metal jacketing and fitting covers shall be fabricated of 0.016" aluminum or stainless steel with a smooth finish.

J. Fitting insulation shall be applied in same manner as pipe application. Protruding metal parts (such as valve stems) shall be completely sealed off. Fitting cover jacketing shall be equal to Gasco, Pabco or RPR Metals prefabricated fitting covers of 0.016" paper coated aluminum, secured as recommended by the manufacturer.

K. Valves, fittings, etc., in congested areas around coil and heat exchanger equipment, etc., shall be insulated by building up fitting segments and premolded sections as necessary.

L. No 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 any moisture leakage to drain.

M. 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.

2.6 CHILLED WATER PIPING

A. Chilled Water Piping – Insulation shall be installed on chilled water lines to the blending station at the building circulating pump shall be dimensional standard cellular glass insulation. The insulation will be installed on larger pipe sizes as appropriate. Prior to application of any insulation, all metal surfaces shall be thoroughly cleaned. 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. Regular insulation shall be applied to the piping with butt joints staggered and all joints tightly butted and sealed with a 1/4" bead of joint sealer 1/2" from outside edge. Hold in place with 14 ga. copper clad wire 9" o.c. After insulation has been wired in place, a 1/16" minimum thick, 3" wide band of asphaltic vapor seal mastic shall be brushed or trowelled on the outside of the 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" thickness equal to Premetco precast, pre rolled Z-lock Kraft paper lined pipe covering with zee type closure and 3/4" wide snap straps with permanent sealant shall then be fitted to O.D. of insulation and applied over the insulated pipe with 3" end and side caps secured with aluminum bands on 12" 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.

B. Provide insulation on flanges, valves and other fitting shall consist of prefabricated fitting covers of the same thickness as specified for adjoining pipe insulation.

C. Fitting covers shall be applied in same manner as pipe application except that 16 ga. 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” paper coated aluminum, secured as recommended by the manufacturer.

D. The insulation thickness shall be as follows:

<table>
<thead>
<tr>
<th>Nominal IPS</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up thru 2”, 2-1/2”</td>
<td>2”</td>
</tr>
<tr>
<td>3”, 4” thru 14”</td>
<td>2-1/2”</td>
</tr>
<tr>
<td>16” and above</td>
<td>3”</td>
</tr>
</tbody>
</table>

E. Hangers shall bear on the outside of the insulation and shall not be in contact with the pipe. Curved metal shields shall be used between the hangers or support points and the bottom of the insulated pipe. 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. Required metal shield sizes are as follows:

<table>
<thead>
<tr>
<th>Nominal IPS</th>
<th>Metal Thickness</th>
<th>Lengths of Shield</th>
</tr>
</thead>
<tbody>
<tr>
<td>up thru 2”</td>
<td>14 gauge</td>
<td>12”</td>
</tr>
<tr>
<td>2-1/2” thru 6”</td>
<td>12 gauge</td>
<td>16”</td>
</tr>
<tr>
<td>8” and above</td>
<td>10 gauge</td>
<td>20”</td>
</tr>
</tbody>
</table>

F. Shields shall be made of galvanized iron, or black iron painted on both sides with two coats of aluminum paint.

G. Where expansion bends occur in the lines, a two foot (2’) double layer contraction joint shall be provided in the main line starting two feet from the end of the main line ells on both sides of the expansion loop. Contraction joints shall consist of two 1-1/2” thick x 24” long pipe covering cuts into 17-1/4” and 6” lengths to provide a 3/4” space by 10-1/4”. A slip joint mastic (Pittseal III) shall be placed between layers from the 3/4” space provided on the inside layer to the 3/4” space on the outside layer.

H. The 3/4” space on inside layer shall be filled with mineral wool loose fill and the 3/4” space on the outer layer shall also be filled with same loose fill and joint sealer pressed 1/2” deep into space for sealing (Pittseal III). Around the outside layer at the 3/4” space, there shall be wrapped a 4” wide piece of glass fabric and sealed down with vapor seal mastic. On pipe sizes smaller than aforementioned, the same contraction joint shall be provided using one inch (1”) thick insulation pipe covering for the inner layer. On two inch (2”) IPS, both inner and outer layer shall be 1” thick insulation.

I. The joint and vapor seal mastic shall be Pittsburgh Corning Corporation Pittcote 300. (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.) The mastic reinforcement shall be 10 x 10 mesh asphalt impregnated glass cloth. Securing of aluminum jacket shall be made by the use of 3/4” x 0.016” aluminum bands and seals. The shields at support points shall be secured with 1/2” x 0.020” stainless steel bands and seals. The pipe primer shall be Pittsburgh Corning Corporation Pittcote 300. The metal jacketing and fitting covers shall be fabricated of 0.016” aluminum with a smooth finish. The slip joint sealer shall be Pittsburgh Corning Corporation’s Pittseal III.

J. Insulation installed inside the building downstream of the blending station shall be insulation with factory applied Class 1, Fire Rated, Kraft-Aluminum, vapor barrier jacketing as manufactured by Pittsburgh Corning. It shall be applied in strict accordance with the manufacturer’s recommendations after the pipe has been primed with one (1) coat of Foster No. 60-26 Primer or Pittcoat 300 Primer. (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.) It will be necessary to include expansion joints at regular intervals on dual temperature service. Thickness shall be as follows:

Pipe sizes up to 2-1/2” - 1” thick
Pipe sizes 3” and over - 2” thick
K. Fitting covers shall be built up of shaped segments of foamglass insulation. These fitting covers shall be adhered in place using "Foster No. 30-35" vapor seals, then smoothly covered by a one-quarter inch (1/4") 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 Arabol adhesive.

L. Valves, fittings, etc., in congested areas around coil and heat exchanger equipment, etc., shall be insulated by building up fitting segments and premolded sections, plus white vapor seal mastic, plus Manville No. 301 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.

M. 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.

N. 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.

2.8 CONDENSATE DRAIN PIPING
A. Condensate drain piping from fan and coil units, coil banks, drinking fountain refrigeration units, and other items of piping or equipment subject to condensation forming on the surface shall be insulated with a minimum of 3/8" thick "25-50" rated, elastomeric thermal insulation. Elastomeric products shall be supplied in a preslit tubular form with a pressure sensitive adhesive system for closure and vapor sealing of the longitudinal joint. All elastomeric insulating products shall be guaranteed not to react with copper piping.

2.9 HEATING HOT WATER PIPING – BUILDINGS
A. Hot water piping and fittings for heating systems, including unions, valves, strainers, etc., shall be insulated as specified above for "Steam and Condensate - Buildings". Special attention is directed to removable covers.
B. No part of the hot water heating system piping will require "Metal-On" covering.

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 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. 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. For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

H. All piping, equipment, ductwork, all plenums including metal and masonry construction, fans, etc., 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.

I. 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.

J. 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 E84-89 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.

K. 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 three inches (3"). 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 15010.

L. 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.

M. 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.

N. 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.

O. 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.
P. 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.

Q. The handling and installation of all insulation materials shall be performed in strict accordance with the manufacturer’s recommendations.

3.3 INSULATION "R" VALUE SCHEDULE (R = thickness / k)

<table>
<thead>
<tr>
<th>Service Temp °F</th>
<th>Oper Mean °F</th>
<th>1” &amp; less to 2”</th>
<th>1-1/4” to 2”</th>
<th>2-1/2”</th>
<th>5” &amp; 8” &amp; over</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot(1) 350+</td>
<td>.33 @ 250</td>
<td>7.5</td>
<td>7.5</td>
<td>10.0</td>
<td>12.0</td>
</tr>
<tr>
<td>Hot(2) 251-350</td>
<td>.30 @ 200</td>
<td>6.5</td>
<td>6.5</td>
<td>8.5</td>
<td>11.5</td>
</tr>
<tr>
<td>Hot(3) 201-250</td>
<td>.29 @ 150</td>
<td>5.2</td>
<td>5.2</td>
<td>6.9</td>
<td>8.5</td>
</tr>
<tr>
<td>Hot(4) 141-200</td>
<td>.27 @ 125</td>
<td>5.6</td>
<td>5.6</td>
<td>5.6</td>
<td>5.6</td>
</tr>
<tr>
<td>Hot(5) 105-140</td>
<td>.26 @ 100</td>
<td>3.8</td>
<td>3.8</td>
<td>5.8</td>
<td>5.8</td>
</tr>
<tr>
<td>Cold(6) 40-55</td>
<td>.25 @ 75</td>
<td>2.0</td>
<td>3.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Cold(7) below 40</td>
<td>.25 @ 75</td>
<td>4.0</td>
<td>6.0</td>
<td>6.0</td>
<td>6.0</td>
</tr>
</tbody>
</table>

(1) HTHW; Steam @ over 120#
(2) HTHW; Steam @ 16# to 120#; med & hp condensate; water and fire line freeze protection
(3) HTHW; Steam @ 0# to 15#; LP Condensate
(4) 
(5) 
(6) Ch. Wtr; Dom. Cold wtr; Storm; Cold condensate
(7) Ch. Wtr;

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.

A minus 15 percent tolerance, on the insulation performance listed shall be permitted for manufacturers’ standard insulation systems.

END OF SECTION
SECTION 230703

DUCTWORK INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Ductwork insulation.
B. Insulation jackets.

1.2 RELATED SECTIONS
A. Section 22 0010 – Basic Mechanical Requirements.
B. Section 23 0553 - Mechanical Identification.

1.3 REFERENCES
A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
C. ASTM C553 - Mineral Fiber Blanket and Felt Insulation.
D. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.
E. ASTM E84 - Surface Burning Characteristics of Building Materials.
H. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
I. UL 723 - Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS
A. Submit under provisions of Section 22 0010.
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. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

1.5 QUALITY ASSURANCE
A. Materials: Flame spread/smoke developed rating of 25/50 in accordance with NFPA 255.

1.6 QUALIFICATIONS
A. Applicator: Company specializing in performing the work of this section with minimum three years experience.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Deliver, store, protect and handle products to site under provisions of Section 22 0010.
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.
D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.8 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
   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" on center on bottom of duct and where required elsewhere to
      hold insulation securely against the duct as noted in the published recommendations of the Insulation
      Manufacturer.
   C. After insulation is in place, all joints and seams shall be sealed with Foster 30-35 white vapor barrier emulsion
      applied over a 3" 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" and over in height, the Contractor
      shall apply a strip of fiberglass board 1" thick by 6" wide, sealing same to the other insulation with mastic.
   E. Vapor sealing of joints and seams is not required on hot duct application where concealed.

2.2 INSULATION B
   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 his option may substitute Insulation A where Insulation B is called for.

2.3 INSULATION C
   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 wrapped tightly on the ductwork with all circumferential joints butted and longitudinal
      joints overlapped a minimum of 2". Adhere insulation to metal with 4" strips of insulation bonding adhesive at
      8" on center. On circumferential and longitudinal joints, the 2" flange of the facing shall be secured using 9/16" 
      flare door staples applied 6" on center and taped with 4" wide fiberglass tape embedded in Foster 30-35 white 
      vapor barrier Emulsion and covered with Foster 30-35 white vapor barrier Emulsion until the tape is completely 
      covered. All pin penetrations or punctures in facing shall also be taped. Vapor sealing of joints is not required 
      on hot duct application where concealed.

2.4 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.

2.5 Low pressure supply duct taps to ceiling diffusers shall be externally insulated including top of ceiling diffuser 
   with 2" Insulation C.

2.6 Flexible round ducts are specified in Section 15890 as factory 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.
   C. No interior walls of ductwork shall be insulated.

3.2 INSTALLATION
   A. Install materials in accordance with manufacturer's instructions.
   B. Insulated ductwork conveying air below ambient temperature:
      1. Provide insulation with vapor barrier jackets.
      2. Finish with tape and vapor barrier jacket.
      3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
      4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and 
         expansion joints.
C. Insulated ductwork conveying air above ambient temperature:
   1. Provide with or without standard vapor barrier jacket.
   2. 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. External Duct Insulation Application:
   1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
   2. Secure insulation without vapor barrier with staples, tape, or wires.
   3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
   4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
   5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
G. All piping, equipment, ductwork, all plenums including metal and masonry construction, fans, etc., 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. 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.
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 E84-89 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 three inches (3"). 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 0010.
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 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.
L. 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.
M. 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.
N. 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.
O. 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.
P. 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

<table>
<thead>
<tr>
<th>Duct Type</th>
<th>Insulation Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold Supply Round</td>
<td>1 1/2&quot; Insulation A</td>
</tr>
<tr>
<td>Hot Supply Round</td>
<td>1&quot; Insulation A</td>
</tr>
<tr>
<td>Cold Supply Flat Oval</td>
<td>1 1/2&quot; Insulation A</td>
</tr>
<tr>
<td>Hot Supply Flat Oval</td>
<td>1&quot; Insulation A</td>
</tr>
<tr>
<td>Cold/Hot/or Combination Rectangular</td>
<td>1-1/2&quot; Insulation B</td>
</tr>
<tr>
<td>Hot and Cold Combination Supply Round</td>
<td>2&quot; Insulation C</td>
</tr>
<tr>
<td>Outside Air</td>
<td>1&quot; Insulation B</td>
</tr>
</tbody>
</table>

END OF SECTION
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 covered by this Section.
B. Comply with other Division 23 Sections, as applicable. Refer to other Divisions for coordination of the Work.

1.2 SUMMARY
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 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 Section 230800.
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.

1.4 REFERENCE STANDARD
A. 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
7. Local Building Codes

1.5 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.

1.6 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.


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.

10. Schedule of airflow monitoring stations including airflow characteristics.

11. 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.

12. 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.

13. 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.

C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE Standard 135-2001 for each protocol.

D. Samples for Initial Selection: For each type of sensor cover with factory-applied color finishes.

E. 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.

F. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

G. Field quality-control test report forms.

H. 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.


4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

5. Calibration records and list of set points.
1.7 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:
   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.

1.8 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 waterproof wrapping.

1.9 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.
   c. 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 UTSWMC 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 & 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

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.
   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" 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.
12. Mouse: Three button with scroll wheel, optical.
13. 2 kVA UPS.
15. Operating System: Microsoft Windows XP or 7.
   a. Protocol Compliance: Control units shall use BACnet or Modbus protocol.
16. Printer: Color, inkjet type commercial printer with print speed of 12 color pages per minute, 1200 x 1200 dpi, USB cable. Provide with an extra set of ink cartridges.
17. 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.
18. 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.
  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.
  13. Communications Card: 10/100bT Ethernet, Bluetooth 2.1, IEEE 802.11b/g/n wireless.
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. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.

2. 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. UTSWMC will approve acceptable UPS manufacturers.

2.5 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.

2.6 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 °F and 95°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% to +17%), allowing for power source fluctuations and voltage drops. The controllers shall also function normally under ambient conditions of 32 Degrees to 122 Degrees
F and 10-95% 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 +/-5% at 400 FPM insuring primary air flow condition shall be controlled and maintained to within +/-5% 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 base 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 ±0.001 inches of water over a range of - 0.2 to + 0.2 inches of water.

   a. CAV FUME HOOD MONITOR
   b. The DDC Fume Hood Monitor shall continuously monitor the fume hood face velocity.
   c. Monitor shall be mounted to accurately monitor the face velocity.
   d. Monitor will be visible to the fume hood user and display the actual face velocity.
   e. Monitor will issue an audible alarm when the face velocity is below operating parameters.
   f. The monitor will connect to the EMS system so fume hood face velocity and alarms can be monitored remotely.
2.7 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% 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°F at a maximum inlet pressure to the valve of 100 psig. Valves for low-pressure steam shall be sized for 80% pressure drop of inlet pressure. Valves shall be equipped with stainless steel stem and disc with linear flow characteristics. Applications, which require steam valves larger than 2”, 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 steam 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 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” 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” must provide bubble-tight seal at 150 PSIG. Liners are to be resilient material suitable for 250°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” X 1” 6063T5 extruded aluminum hat channel with .125” minimum wall thickness with mounting holes for flange and enclosed duct mounting.

3. Dampers shall be available in two-inch size increments from 8” horizontal and vertical to 48”. Requirements over 48” shall be standard modules with interconnected hardware (jack shafting).

4. All damper blades shall be 6” 6063T5 heavy gage extruded aluminum airfoil for high velocity performance. Blades on all dampers must be not over 6” wide. Blade bearing shall be molded synthetic with 1/2” 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” 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% 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.

2.8 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 (+/-0.12%) 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% of full scale output for supply voltage variations +/-10% 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.
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 sq. ft.
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 sq. ft.
6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches or 75% 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 (+/- 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 sq. ft.
4. Averaging Elements in Ducts: Use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; 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. Humidity Sensors: Bulk polymer sensor element.

E. 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 24VAC.

2.9 **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 Pumps**: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.

C. **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.

D. **Low Limit Temperature Switch**: Minimum 20 ft. 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.

E. **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.

F. **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.

G. **Current Switches**: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

H. **Electronic Valve/Damper Position Indicator**: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

I. **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.

2.10 **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 at 50 and 100 ppm.

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.

2.11 **AIRFLOW MEASUREMENT STATIONS (AFMS)**

A. **Airflow Measurement Station**: Multiport, self-averaging pitot tube station.
   1. **Acceptable Manufacturers**: Ebtron.
   2. **Casing**: Galvanized-steel frame.
   3. **Sensing Manifold**: Copper manifold with bullet-nosed static pressure sensors positioned on equal area basis.
   4. **Pressure loss**: Less than 0.005” w.c. @ 2000 FPM.
   5. **Accuracy**: +/- 2% @ 6000 FPM & +/- 0.5% @ 2000 FPM.

B. **Traverse Probes**: Duct or fan inlet mounted.
   1. Provide airflow traverse probes mounted in the ductwork or fan inlet capable of continuously measuring the air volume.
   2. The airflow traverse probes shall contain multiple total and static pressure sensors places at concentric area centers along the exterior surface of the cylindrical probe and internally connected.
to their respective averaging manifolds. Sensors shall not protrude beyond the surface of the
probe, nor be adversely affected by particle contamination normally present in building system
airflows.
3. The fan inlet airflow traverse probes shall have dual end support swivel brackets suitable for
mounting in the fan inlet bell and symmetrical averaging signal takeoffs and fittings, and shall be of
aluminum construction with hard anodized finish.
4. The airflow traverse probes shall not induce a measurable pressure drop, nor shall the sound level
within the system be amplified by its presence. The probes shall be capable of producing steady,
non-pulsating signals of standard total and static pressure, without need for flow corrections or
factors, with an accuracy of 2% of actual flow.

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: +/- 0.5% of reading at calibrated velocity
   b. Differential Temperature: +/- 0.15 deg F over calibrated temperature range
   c. Computational Error: +/- 0.05%
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.
B. Thermal Mass Flow Meters (Natural Gas): Meters shall be insertion style complete with wetted materials to
be stainless steel.
1. Accuracy: +/- 1.0% 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.
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, +/- 1.0%.
2. Repeatability: +/- 0.1%
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.

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."

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 five (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.

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
UTSWMC 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.

Network Numbering

1. The UTSWMC 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 communications. 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 UTSWMC BACnet control system can contain up to 65,535 (64K) interconnected networks each of which are required to have a unique network number. At UTSWMC, network numbers shall be assigned as follows:

NBBSS
Where:  
N = Network Type
0 = Ethernet
1 = MS/TP
2 = P1
3 => 6 not used
SS = 00 to 35 for individual I/P segments in a building.
BB = the building number.
00 = not used
01 = DC
02 = DE, CB2
03 = DF, CB1
04 = DH
05 = BL
06 = BP
07 = NTEP
08 = V
09 = BTEP
10 = NA
11 = NB
12 = NC
13 = ND
14 = NE
15 = NF
16 = NG
17 = NL
18 = not used
19 = ZL
20 = HA, SP, St. Paul
21 = HP, POB1
22 = HQ, POB2
23 = WA, ASC, Ambulatory Surgical Center
24 = not used
25 = not used
26 = EC
27 = RC
28 = not used
29 = not used
30 = A
31 = B
32 = C
33 = D
34 = E
For example, a BACnet Ethernet network in P building on the primary segment would be:

```
NBBSS
04300
```
or simply network number 4300

**Device Numbering**

2. 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 UTSWMC, device numbers shall be assigned as follows:

```
VBBYYYY
```

Where: 

- **V** = Vendor.
- **0** = not used
- **1** = Alerton controls
- **2** = Siemens controls
- **3** = Trane
- **4** = not used

BB = Building number as defined in section 1

YYYY = 0000 to 9999 for devices

For example, for the 112th Siemens device in NB building the device number would be:

```
2110112
```

Or for the 86th Alerton device in CS building the device number would be:

```
1490086
```

**System Naming Convention**

3. To create a consistent naming structure across legacy, proprietary, new/remodel construction, and open protocol implementations at UTSWMC, 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.

3.1. 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.

3.2. 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.

3.3. 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.

3.3.1. 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.

3.3.2. 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.

3.3.3. 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.

3.3.4. ARC rooms shall be designated as BBF.NNN ARC. For example, J1.116 ARC described as J 1 116 ARC Room.

3.4. 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.

3.4.1. Air Handler Fans shall be designated BB.AHUN Type Fan. 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, 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.

3.4.2. Air Handler Valves shall be designated BB.AHUN Type VLV. 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 either Supply Air or Return Air. For example, NC.AHU1 CD VLV shall be described as NC AHU 1 Cold Deck VLV.

3.4.3. Air Handler Dampers shall be designated BB.AHUN Type Damper. 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 either Supply Air or Return Air. For example, L.AHU2 OA Damper shall be described as L AHU B2 Outside Air Damper.

3.4.4. Air Handler Safeties shall be designated BB.AHUN 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.

3.4.5. Air Handler Temperatures and Set points shall be designated BB.AHUN 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 or HUM for Humidity. For example, NA.AHU4 SAT shall be described as NA AHU 4 Supply Air Temperature.

3.5. Valves shall be designated BB.T.Function VLV. Where BB is the one or two letter building designation, T is Valve type such as:

- RHW = Reheat Water
- DHW = Domestic Hot Water
- CHW = Chilled Water
- HUM = Humidity
- SCHW= Secondary Chilled Water
- PCHW = Process Chilled Water
- CW = Condenser Water
- GLY = Glycol

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.

3.6. Exhaust Fans shall be designated BB.Type EFN. 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.MRIEF17 shall be described as NE MRI EF 17.

3.7. 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.

3.8. 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.

3.9. Chillers shall be designated BB.CHLRN. Where BB is the one or two letter building designation, CHLR is a designation for the chiller, NN is an incrementing decimal value that designates the chiller number in that particular building. For example, NTEP.CHLR5 shall be described as NTEP Chiller #5.

3.9.1. Associated chiller information points will be prefaced with the chiller designation in the name and followed by the information type. For example, PE.CHLR2 TONS shall be described as PE Chiller #2 Tons, or PE.CHLR4 GPM shall be described as PE Chiller #4 Gallons per Minute.

3.10. Cooling Towers shall be designated BB.CTNN. Where BB is the one or two letter building designation, CT is a designation for the cooling tower, NN is an incrementing decimal value that designates the cooling tower number in that particular building. For example, NTEP.CT2 shall be described as NTEP Cooling Tower #2.

3.10.1. Associated cooling tower information points will be prefaced with the cooling tower designation in the name and followed by the information type. For example, PE.CT2 CW Flow shall be described as PE Cooling Tower #2 Condenser Water Flow, or PE.CT4 SS shall be described as PE Cooling Tower #4 Start/Stop.

3.11. Boilers shall be designated BB.BLRNN. Where BB is the one or two letter building designation, BLR is a designation for the boiler, NN is an incrementing decimal value that designates the boiler number in that particular building. For example, NTEP.BLR1 shall be described as NTEP Boiler #1.

3.11.1. Associated boiler information points will be prefaced with the boiler designation in the name and followed by the information type. For example, PE.BLR2 ECON OUT WATER TEMP shall be described as PE Boiler #2 Econ Out Water Temp, or NTEP.BLR4 GAS TEMP shall be described as PE Boiler #4 Gas Temperature.

3.12. 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.
SECTION 230955
CONTROL SEQUENCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Related documents which govern the work specified in this section.
   1. Procurement General Conditions.
      a. Special Conditions.
      b. Other applicable sections of the specifications.

1.2 DESCRIPTION OF WORK

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 230900 of these specifications.

PART 2 - SEQUENCE OF OPERATION

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. 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.

2.2 LABORATORY AIR HANDLING UNITS

A. This is a medium pressure single duct constant volume unit. The unit consists of a supply fan with VFD, motorized outside air dampers, motorized return and relief dampers, and chilled water cold deck coil and steam hot deck coil.

B. The DDC Controller shall start and stop the supply and return air fans through a protocol board in the VFD and open the O.A. damper.

C. The DDC Controller shall monitor the supply air temperature and modulate the return and relief dampers, chilled water and steam control valves to maintain supply air temperature setpoint (adjustable).

D. The DDC Controller shall monitor the mixed air temperature and override the return and relief air damper control to prevent the mixed air temperature from falling below setpoint.

E. NOT USED.

F. The DDC Controller shall monitor the supply fan discharge static pressure and end of duct static pressure and modulate the supply fan VFD with an analogue output to maintain the supply fan discharge static pressure setpoint (adjustable) as reset by the end of duct static pressure.

G. The DDC Controller shall monitor the actual supply air flow and return air flow and modulate the return fan VFD with an analogue output to maintain CFM differential setpoint (adjustable) between supply and return fan volumes.
H. A specialized sequence of 100% outside air in case of emergency magnet cooling shall be provided on all units serving Imaging Bays or MRI magnet areas.

1. The DDC controller will monitor an oxygen detector in each magnet room. Should the oxygen level in any magnet room fall below the set point, the DDC controller shall open all dampers to the supply box to maximum volume in the affected room. The DDC controller will open emergency purge exhaust dampers and turn on the purge exhaust fan.

2. The DDC will close the return air damper and open the outside air and relief dampers of the air handling unit to provide 100% outside air ventilation. If the outside air temperature is below 40 F the steam coil control valve shall modulate to full open, and the chilled water valve shall open to 25% position.

3. The DDC will send an alarm signal to the energy management system.

4. When the oxygen detector indicates room oxygen level returned to set point, the system will continue at 100% outside air to the room for an additional 30 minutes, then a reminder signal shall be sent to the central system.

5. This emergency sequence may only be reset to regular operation from a supervisor level at the central system.

I. Smoke detectors furnished and installed by Division 16 in the discharge and return air of the unit shall, upon detection of smoke, de-energize the supply fan and close the relief and outside air dampers. An alarm will be sent to the energy management system. When the alarm returns to normal the unit will automatically restart.

J. Static pressure sensor located on the suction side of the return air shall de-energize the supply and return fans upon detection of abnormal suction pressure and an alarm shall be sent to the EMS. Static pressure sensor located on the discharge side of the supply air fan shall de-energize the supply fan upon detection of abnormal discharge pressure and an alarm shall be sent to the EMS.

K. On system shutdown, the DDC Controller shall de-energize the supply and return fans, close the O.A. and relief dampers, open the return air damper and close all heating and cooling valves to flow through the coils.

L. The DDC Controller shall monitor the low limit temperature controller mounted on the up stream side of the supply fan. Should the low limit temperature controller trip, the DDC Controller shall close the outside air damper, shut down the fans, open the cold deck chilled water coil valve 100%, and start the chilled water pumps. An alarm shall be sent to the EMS.

2.3 TOILET EXHAUST FANS

A. The DDC Controller shall start and stop the toilet exhaust fan through the automatic side of the HOA and monitor the exhaust fan status through current sensing switch and send an alarm to the EMS operator on fan failure.

2.4 STAIR PRESSURIZATION

A. Upon detection of smoke in any part of the building or any other fire alarm signal, the stair pressurization fans will be started and run full open continuously until reset by the EMS.

2.5 DUAL DUCT TERMINAL UNITS

A. The VAV terminal units shall be controlled by a factory mounted DDC Controller.

B. The DDC Controller shall monitor the space temperature and modulate the hot and cold duct dampers to maintain the space temperature setpoint (adjustable).
C. With the terminal unit hot duct damper at full flow, an increase in space temperature shall cause the hot duct
damper to modulate to minimum flow position. On further increase in space temperature, the hot duct damper
shall modulate closed and the cold duct damper shall modulate open to minimum flow position. On a further
increase in space temperature, the cold duct damper shall modulate from minimum to maximum flow to
maintain the space temperature setpoint. On a decrease in space temperature, the reverse shall occur.

D. The DDC Controller shall monitor each inlet airflow and modulate the hot and cold duct dampers to maintain
pressure independent temperature control between the minimum and maximum air flow limits (adjustable) for
both hot and cold ducts.

E. The DDC Controller shall monitor each dual duct discharge air temperature.

2.6 LIGHTING CONTROL

A. The DDC Controller shall monitor the Div. 26 Electrical Lighting System through an Open Processor
Gateway.

B. Based on Time of Day, the DDC Controller shall be able to turn the lighting “on” and “off”.

2.7 LABORATORY EXHAUST FANS

A. The DDC Controller shall start and stop the Laboratory exhaust fans through a protocol board in the VFD.

B. The DDC Controller shall monitor the operation of the Laboratory exhaust fans and on lead fan failure,
start the stand-by exhaust fan and send an alarm to the EMS.

C. The laboratory exhaust system shall consist of multiple exhaust fans with a minimum one exhaust fan as
stand-by.

D. The DDC Controller shall start and stop each exhaust fan through a protocol board in the VFD. The fans
will be started and stopped from the EMS. Fans are controlled on static pressure from sensors at each
floor (Part 2 and 3 work). Fans shall be turned on and ramped up to maximum rpm to maintain static
pressure at all sensors above the minimum set point. When multiple fans are running in parallel, fan
speeds shall be equal and ramp together to 90% of maximum, when the next fan will be started. When all
sensors are satisfied, the fans will ramp down and fans will drop off line. The DDC Controller shall rotate
the lead and stand-by fans to equalize runtime per the direction of the owner. The DDC Controller shall
alarm the EMS on fan failure.

E. The TAB contractor establishes design static pressure setpoint during system commissioning.

2.8 CHILLED WATER SYSTEM

A. The Chilled Water Loop shall consist of chilled water pumps with VFD’s and a differential pressure by-pass
valve. The DDC Controller shall start and stop the chilled water pumps as a Lead/Lag pumping system.

B. The DDC Controller shall monitor the chilled water supply and return temperatures and the primary chilled
water flow and calculated the BTU consumption.

C. The DDC Controller shall monitor the differential pressure between the chilled water supply and return at
the last AHU on the chilled water loop. On a demand for cooling, the DDC Controller shall modulate the
chilled water by-pass valve to maintain the differential pressure set-point (adjustable). When the chilled
water by-pass valve is unable to maintain the differential pressure set-point, the DDC Controller shall open
the chilled water isolation valve and start the lead pump and modulate the pump’s VFD to maintain the
differential pressure set-point (adjustable). As the chilled water demand increases to 95% of the lead chilled water pumps capacity as determined by the output signal to the pump VFD, the DDC Controller shall start the second pump and both pumps shall ramp together. On further increase in chilled water demand, the third chilled water pump shall start and all three pumps shall ramp together. On a decrease to 50% of pump capacity, the first pump shall be stopped and the remaining pumps shall continue to ramp together. On a decrease to 40% of pump capacity, the second pump shall be stopped and the last pump shall operate to maintain setpoint. The DDC Controller shall rotate the pumps to equalize runtimes.

D. On a failure of a pump, the DDC Controller shall enable the standby pump for operation and send an alarm to the EMS Operator.

2.9 DUAL DUCT VARIABLE VOLUME AIR HANDLING UNIT

A. The Air Handling Units shall be dual duct medium pressure variable air volume units consisting of a mixing plenum with O.A., return dampers, cold deck with chilled water coil, a hot deck with steam heating coil and a return fan with flow measuring station and VFD. The supply and return fans have VFD’s that interface with the EMS.

B. The DDC Controller shall start and stop the supply and return air fans through the protocol chip in the VFD. When the air handling unit starts, the outside air damper shall open to minimum position.

C. The DDC Controller shall monitor the cold deck temperature and modulate the cold deck control valve to maintain the cold deck set-point (adjustable).

D. The DDC Controller shall monitor the hot deck temperature and modulate the hot deck control valve to maintain the hot deck set point (adjustable).

F. The DDC Controller shall monitor the supply fan discharge static pressure and modulate the supply fan variable frequency drives (VFD) to maintain the static pressure set-point (adjustable) as reset by the lowest static pressure monitored in the hot or cold ducts. Static pressure sensor located on the discharge side of the supply air fan shall de-energize the supply fan upon detection of abnormal discharge pressure and an alarm shall be sent to the EMS. The supply air volumes will be determined by the sum of the volume flow demands from the dual duct VAV boxes (Parts 2 and 3). The DDC Controller shall monitor the supply and return air flows and modulate the return air fan variable frequency drive (VFD) to maintain a fixed CFM differential (adjustable) between supply and return air fans to maintain a positive pressure in the space.

G. The DDC Controller shall monitor the low limit temperature controller mounted on the up stream side of the supply fan. Should the low limit temperature controller trip, the DDC Controller shall close the outside air damper, shut down the fans, open the cold deck chilled water coil valve 100%, and start the chilled water pumps. An alarm shall be sent to the EMS.

H. Smoke detectors furnished and installed by Division 26 in the discharge and return air of the unit shall, upon detection of smoke, de-energize the supply and return fans and close the relief and outside air dampers. An alarm will be sent to the energy management system. When the alarm returns to normal the unit will automatically restart.

I. The DDC Controller shall use the fan discharge static pressure sensors located on the discharge side of the supply and the suction side of the return fan to prevent the VFD from exceeding static pressure set-point limit (field adjustable). Should the limit be exceeded, the fans shall be shut down, the relief and outside air dampers shall close, and an alarm shall be sent to the EMS.
J. On system shutdown, the DDC Controller shall de-energize the supply and return fans, close the O.A. and relief dampers, open the return air damper and close all heating and cooling valves to flow through the coils.

2.10 DOMESTIC AND LABORATORY HOT WATER CONTROL

A. The Domestic Hot Water System consists of two (2) steam converters – one converter generates 110°F DHW and one converter generates 140°F DHW. Two (2) pumps circulate the DHW.

B. The DDC Controller shall monitor the DHW tank temperature and modulate the converter steam valves to maintain DHW setpoints (adjustable).

C. The DDC Controller shall monitor the DHW temperature and if the temperature reaches 150°F, the DDC Controller shall close the steam control valves and de-energize the respective pump and send an alarm to the EMS operator.

D. The DDC Controller shall monitor the DHW pump status and on pump failure send an alarm to the EMS operator.

2.11 PENTHOUSE VENTILATION

A. The DDC Controller shall monitor the space temperature and on sensing setpoint shall cycle on the exhaust fan.

2.12 FAN COIL UNITS

A. The Fan Coil Units shall be single duct low pressure constant volume units each consisting of a filter bank, steam heating water coil, chilled water cooling coil, and supply fan with HOA.

B. The DDC Controller shall start and stop the supply fans through their HOA’s. The fan coil shall be controlled by a field mounted Terminal Equipment Controller (TEC). The TEC shall monitor the discharge air temperature space temperature and modulate the fan coil chilled water and hot water valves to maintain space temperature setpoint (adjustable). The fan shall operate continuously during occupied conditions. The TEC shall monitor a current sensing relay to determine the fan status

C. The DDC Controller shall monitor the return air temperature and modulate the chilled water or steam control valve to maintain space temperature setpoint (adjustable) between a dead band of 65°F heating and 80°F cooling. On a call for heating with the space temperature at set point, the DDC Controller shall modulate the steam control valve to maintain space temperature at setpoint. On an increase in space temperature above setpoint the reverse shall occur. On a call for cooling with the space temperature at set point, the DDC Controller shall modulate chilled water control valve to maintain space temperature setpoint. The DDC Controller shall prevent the supply air temperature from falling 55°F (adjustable). On a decrease in space temperature the reverse shall occur. Between the heating and cooling setpoints, the control valves shall be closed.

D. A static pressure sensor located on the suction side of the return air shall de-energize the supply and return fans upon detection of abnormal suction pressure and an alarm shall be sent to the EMS.

E. Smoke detection from the smoke detector in the stairwell will initiate system shut down. On system shutdown, the DDC Controller shall de-energize the supply and return fans, and close all heating and cooling valves to flow through the coils.
2.20 ADDITIONAL START/STOP AND MONITORING POINTS

A. EMS shall start/stop and monitor miscellaneous systems as per the included Point Schedule.

PART 3 – EXECUTION -- NOT USED

END OF SECTION
SECTION 233113

DUCTWORK

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Low pressure ductwork.
B. Medium pressure ductwork.
C. Duct cleaning.

1.2 RELATED WORK

A. Section 22 0010 - Basic Mechanical Requirements.
B. Section 23 0529 - Supports and Anchors: Sleeves.
C. Section 22 0548 - Vibration Isolation.
D. Section 23 0703 - Duct Insulation.
E. Section 23 3300 - Ductwork Accessories.
F. Section 23 3600 - Air Terminal Units.
G. Section 23 0593 - Testing, Adjusting, and Balancing.

1.3 REFERENCES

A. ASHRAE - Handbook of Fundamentals; Duct Design.
B. ASHRAE - Handbook of Equipment; Duct Construction.
C. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
E. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
F. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
G. ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate.
H. ASTM C 14 - Concrete Sewer, Storm Drain, and Culvert Pipe.
I. ASTM C 443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
J. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
K. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
L. SMACNA - Low Pressure Duct Construction Standards.
M. SMACNA - High Pressure Duct Construction Standards.
N. UL 181 - Factory-Made Air Ducts and Connectors.

1.4 REFERENCES

A. Fundamentals Handbook, American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
B. Equipment Handbook, ASHRAE.
C. HVAC Duct Construction Standards, Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
D. HVAC Duct System Design, SMACNA.
E. Round Industrial Duct Construction Standards, SMACNA.
F. Engineering Design Manual for Air Handling Systems, United McGill Corporation (UMC).

G. Assembly and Installation of Spiral Duct and Fittings, UMC.

H. Engineering Report No. 132 (Spacing of Duct Hangers), UMC.

1.5 DEFINITIONS

A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.
B. Low Pressure: 2 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 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A, NFPA 90B and NFPA 96 standards.

1.7 SUBMITTALS

A. Shop Drawings shall be submitted on all items of sheet metal work specified herein. Shop Drawings of ductwork at air units shall be submitted at a minimum scale of 3/8” equal to one foot.

B. Shop Drawings shall be submitted on all other ductwork at a minimum scale of 1/4” = 1 foot. Shop Drawings shall indicate location of all supply, return, exhaust and light fixtures from the approved reflected ceiling plans.

C. Submit shop drawings and product data under provisions of Section 22 0010.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 22 0010.
B. Store and protect products under provisions of Section 22 0010.

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. 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. All exhaust ductwork including toilet room exhausts shall be constructed and leak tested as specified for medium pressure supply ducts.

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. The work shall be guaranteed for a period of one (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. 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 metal sizes.
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" in width. Each sheet shall be stenciled with manufacturer's name and gauge. Coils of sheet steel shall be stenciled throughout on ten foot (10') centers with manufacturer's name and must be visible after duct is installed. Sheet metal must conform to SMACNA sheet metal tolerances as outlined in SMACNA's "HVAC Duct Construction Standards."

F. Where ducts, 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 non-lab “General” and toilet exhaust ductwork)

A. The scope of low pressure ductwork is defined as all ductwork downstream of terminal units, and all non-lab exhaust ductwork. 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 2" 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 1985 SMACNA HVAC Duct Construction Standards for Metal and Flexible Duct are the minimum which shall be used for this project. 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 shall be radius type and have a centerline radius of 1-1/2 times the duct diameter or width. Elbows in round ducts may be smooth radius as described above or 5-piece 90 degree elbows and 3-piece 45 degree elbows. 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.

E. Sealant: 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. Note that, except as noted, oil or solvent based sealants are specifically prohibited for use on this project. For exterior applications, "Uni-Weather" (United McGill Corp.) neoprene based sealant shall be used. No other sealants may be used. 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" wide open weave fiberglass tape. Sufficient additional sealant shall then be applied to completely imbed the cloth. All sealants shall be UL rated at no more than flame spread of 5 and smoke developed of 0.

2.3 DUCTWORK MEDIUM PRESSURE (Includes all lab exhaust ductwork)

A. The scope of medium pressure ductwork is defined as all ductwork downstream of all air handlers, up to and including terminal units, all return air ductwork, and all lab exhaust (LE) ductwork. 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.

B. 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. For exterior applications, "Uni-Weather" (United McGill Corp.) solvent based sealant shall be used. No other sealants may be used. 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" wide open weave fiberglass tape. Sufficient additional sealant shall then be applied to completely imbed the cloth.

C. Oval ducts shall be spiral flat oval or welded flat oval equal to those of United McGill Sheet Metal Company with gauges and reinforcing as recommended by the manufacturer for medium pressure or the ducts may be Shop fabricated of completely welded construction of the following gauge:

<table>
<thead>
<tr>
<th>Major Axis</th>
<th>Gauges</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 to 20</td>
<td>No. 24 gauge</td>
</tr>
<tr>
<td>20 to 30</td>
<td>No. 22 gauge</td>
</tr>
<tr>
<td>30 to 46</td>
<td>No. 20 gauge</td>
</tr>
<tr>
<td>46 to 50</td>
<td>No. 18 gauge</td>
</tr>
<tr>
<td>50 and Up</td>
<td>No. 16 gauge</td>
</tr>
</tbody>
</table>

D. Oval fittings shall be equal to those of United McGill Sheet Metal Company with requirements, sealing, etc., similar to that specified for round medium pressure work.

E. Oval duct reinforcing methods shall be submitted as Shop Drawings for approval. Reinforcing galvanized angles shall be of sizes specified for same size rectangular ducts. Galvanized angles shall be used where standing seams are specified for rectangular ducts. Attaching methods shall be shown on Shop Drawings and submitted for approval.

F. Hangers for round and flat oval ducts shall have a maximum spacing of 10 feet and shall be supported on galvanized steel straps, continuous around bottom of ducts, of the following sizes:

<table>
<thead>
<tr>
<th>Duct Size</th>
<th>Low Pressure</th>
<th>Medium Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>0&quot; thru 18&quot;</td>
<td>1&quot; x 16 gauge</td>
<td>1&quot; x 16 gauge</td>
</tr>
<tr>
<td>19&quot; thru 36&quot;</td>
<td>1&quot; x 12 gauge</td>
<td>1&quot; x 12 gauge</td>
</tr>
<tr>
<td>37&quot; thru 84&quot;</td>
<td>2&quot; x 12 gauge</td>
<td>1-1/2&quot; x 12 gauge</td>
</tr>
</tbody>
</table>

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. Design pressure for testing ductwork shall be six inches (6") of water. Total allowable leakage shall not exceed 1% of the total system design air flow rate. 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). 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. The contractor shall inform the project inspector when the joints may be visually inspected for voids, splits, or improper sealing of the joints. 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, and 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 lab exhaust ductwork 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 at his option use DUCTMATE coupling system on rectangular ductwork. Contractor may at his option where space permits use rectangular ductwork with DUCTMATE system in lieu of oval ductwork. No other flange-type duct joining system may be used.

J. Rectangular 90 degree elbows shall be constructed with single thickness turning vanes. Radius type rectangular elbows shall have a centerline radius of 1-1/2 times the duct diameter or width. Contractor shall have the option to substitute short radius vaned elbows, but shall request the substitution at the time of submittal of Shop Drawings, and shall request the substitution as required in Section 15010. 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. 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 ELBOWS

A. Where rectangular elbows are shown, or are required for good air flow, contractor shall provide and install turning vanes. Job fabricated turning vanes, if used, shall be fabricated of the same gauge and type of material as the duct in which they are installed. Vanes must be fabricated for same angle as duct offset. Radius elbows shall have a centerline radius of not less than one and one-half (1-1/2) times the duct width. Submit Shop Drawings on factory fabricated and job fabricated turning vanes. Provide turning vanes in all rectangular radius elbows and offsets.

B. 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. In most cases, this will necessitate the installation of an angle iron support on the outside of the cheek parallel to the line of the turning vanes.

C. Where turning vanes are to be provided and installed as required above, in ducts of over 12" thickness (vanes are over 12" long), contractor shall provide and install Tuttle and Bailey double thickness vanes or approved equal. The installation of the turning vanes shall be as described for single thickness vanes.

2.5 FLEXIBLE DUCTS

A. Low Pressure Insulated Flexible Duct may be used where shown on the drawings. Duct shall be made with factory preinsulated duct composed of dead soft, spiral wound, triple locked corrugated aluminum core covered with a minimum of 1-1/2" thick, 3/4 lb. density fiberglass blanket sheathed in a vapor barrier of fiberglass reinforced aluminum foil and mylar laminate. 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. The C factor shall be 0.24 to meet HUD requirements. The duct shall be rated for a positive working pressure of 10" w.g. and a temperature of up to 250 degrees F. The duct must comply with the latest NFPA Bulletin 90A and be listed and labeled by Underwriter's Laboratories, Inc., as Class I Air Duct, Standard 181, and meet GSA, FHA and other U. S. Government standards; flame spread, not over 15; smoke developed, not over 10. Flexible ducts shall be not more than 51" in length, shall be installed in straight runs only, and shall be Flexmaster Type TL-M or approved equal.

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. The fittings on air mixing 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. Insulation of flexible duct shall be slipped over connection to point where insulation abuts mixing box or insulation on duct. 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.)

2. Low Pressure Taps (Conical Bell Mouth Fittings)
   a. Conical fittings may 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. (This does not apply to medium pressure duct.) 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 so as to minimize flexible duct lengths and sharp bends.
   b. The conical fitting shall be made of at least 26 gage zincized 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 to be provided with minimum 24 gage 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 bellmouth fitting shall be Series 3000G as manufactured by Flexmaster U.S.A., Inc., or Buckley Air Products, Inc., ‘AIR-TITE’.

B. Medium and High Pressure Insulated Flexible Duct shall be the same construction as the Low Pressure Duct, factory applied insulation of 1" minimum thickness, 3/4 lb. density with a permeability rating of 0.30. The duct shall be supported by a corrosion resistant metal spiral, or a coated spring steel helix and solid innerliner mechanically interlocked or permanently bonded to the helix wire. Ratings shall be as described for Low Pressure Duct above. Flexible ducts shall be not more than 2'-0" in length, used for alignment or sound/vibration purposes only, and may only be installed in straight runs. Flexible duct shall NOT be used for changes of direction of airflow. Installation, clamps and sealing shall be the same as specified for rigid duct.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer also to requirements included in Part 2 of this specification.

B. 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.

C. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

D. Slope underground ducts to plenums or low pumpout points at 1:500. Provide access doors for inspection.

E. Coat buried, metal ductwork without factory jacket with one coat and seams and joints with additional coat of asphalt base protective coating.

F. 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 4 diameters of straight duct to the entrance of all terminal units.
G. Connect diffusers or troffer boots to low pressure ducts with 2 feet maximum length of flexible duct. Hold in place with strap or clamp, and seal as specified.

H. 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. All horizontal ducts up to and including 40 inches in their greater dimension shall be supported by means of No. 18 U.S. gauge band iron hangers attached to the ducts by means of screws, rivets, or clamps and fastened to above inserts with toggle bolts, beam clamps or other approved means. Duct shall have at least one pair of supports 8'-0" on centers. Clamps shall be used to fasten hangers to reinforcing on sealed ducts.

B. Horizontal ducts larger than 40 inches in their greatest dimension shall be supported by means of hanger rods bolted to angle iron trapeze hangers. Duct shall have at least one pair of supports 8'-0" on centers according to the following:

<table>
<thead>
<tr>
<th>Angle Length</th>
<th>Rod Dia.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4'-0&quot;</td>
<td>1-1/2&quot; x 1-1/2&quot; x 1/8&quot;</td>
</tr>
<tr>
<td>6'-0&quot;</td>
<td>1-1/2&quot; x 1-1/2&quot; x 1/8&quot;</td>
</tr>
<tr>
<td>8'-0&quot;</td>
<td>2&quot; x 2&quot; x 1/8&quot;</td>
</tr>
<tr>
<td>10'-0&quot;</td>
<td>3&quot; x 3&quot; x 1/8&quot;</td>
</tr>
</tbody>
</table>

C. Vertical ducts shall be supported where they pass through the floor lines with 1-1/2" x 1-1/2" x 1/4" angles for ducts up to 60". Above 60", the angles must be increased in strength and sized on an individual basis considering space requirements.

3.3 MEDIUM PRESSURE DUCT SUPPORTS

A. All horizontal rectangular ducts shall have duct hanger requirements as follows:

<table>
<thead>
<tr>
<th>Max. Duct Dimen.</th>
<th>Steel Steel</th>
<th>Min. Hanger Size</th>
<th>Max. Spacing</th>
<th>Min.# Hngrs</th>
<th>Trapeze Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max.</td>
<td>Rod</td>
<td>Strap Width</td>
<td>10'</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Dimen.</td>
<td>Width</td>
<td>Hangers</td>
<td>Hanger Ring Size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 thru 18&quot;</td>
<td>--</td>
<td>1&quot; x 16 ga.</td>
<td>10'</td>
<td>2</td>
<td>--</td>
</tr>
<tr>
<td>19&quot; thru 36&quot;</td>
<td>--</td>
<td>1&quot; x 16 ga.</td>
<td>10'</td>
<td>2</td>
<td>--</td>
</tr>
<tr>
<td>37&quot; thru 60&quot;</td>
<td>3/8&quot;</td>
<td>1&quot; x 16 ga.</td>
<td>8'</td>
<td>2</td>
<td>2&quot; x 2&quot; x 1/4&quot;</td>
</tr>
<tr>
<td>61&quot; thru 120&quot;</td>
<td>3/8&quot;</td>
<td>1-1/2&quot; x 12 ga.</td>
<td>8'</td>
<td>2</td>
<td>2&quot; x 2&quot; x 1/4&quot;</td>
</tr>
<tr>
<td>121&quot; thru 240&quot;</td>
<td>3/8&quot;</td>
<td>--</td>
<td>4'</td>
<td>3</td>
<td>2-1/2&quot; x 2-1/2&quot; x 3/16&quot;</td>
</tr>
</tbody>
</table>

B. All horizontal round ducts shall have ducts hangers spaced 10'-0" maximum with requirements as follows:

<table>
<thead>
<tr>
<th>Duct Dia.</th>
<th>Min. Hanger Size</th>
<th>Hangers</th>
<th>Hanger Ring Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
C. Hanger straps on duct width of 60 inches and under shall lap under the duct a minimum of 1 inch and have minimum of one fastening screw on the bottom and two on the side.

D. Hanger straps on duct widths over 60 inches shall be bolted to duct reinforcing with 3/8" bolts minimum.

E. Use 3/8" minimum bolts for securing round duct hanger straps to band straps.

### 3.4 DUCTWORK APPLICATION SCHEDULE

<table>
<thead>
<tr>
<th>AIR SYSTEM</th>
<th>MATERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Pressure Supply</td>
<td>Steel, Aluminum</td>
</tr>
<tr>
<td>(Heating Systems)</td>
<td></td>
</tr>
<tr>
<td>Low Pressure Supply</td>
<td>Steel, Aluminum</td>
</tr>
<tr>
<td>(Systems with Cooling Coils)</td>
<td></td>
</tr>
<tr>
<td>Buried Supply or Return</td>
<td>Steel, Concrete</td>
</tr>
<tr>
<td></td>
<td>Reinforced Plastic</td>
</tr>
<tr>
<td>Medium and High Pressure Supply</td>
<td>Steel</td>
</tr>
<tr>
<td>Return and Relief</td>
<td>Steel, Aluminum</td>
</tr>
<tr>
<td>General and Toilet Exhaust</td>
<td>Steel, Aluminum</td>
</tr>
<tr>
<td>Kitchen Hood Exhaust</td>
<td>Steel, Stainless Steel, Glass Fiber</td>
</tr>
<tr>
<td>Dishwasher Exhaust</td>
<td>Steel, Stainless Steel, Glass Fiber</td>
</tr>
<tr>
<td></td>
<td>Reinforced Plastic</td>
</tr>
<tr>
<td>Lab Exhaust</td>
<td>Steel, Stainless Steel</td>
</tr>
<tr>
<td>Fume Hood Exhaust</td>
<td>Stainless Steel, Fiberglass Reinforced Plastic</td>
</tr>
<tr>
<td>Outside Air Intake</td>
<td>Steel</td>
</tr>
<tr>
<td>Combustion Air</td>
<td>Steel</td>
</tr>
<tr>
<td>Evaporative Condenser Intake and Exhaust</td>
<td>Steel</td>
</tr>
<tr>
<td>Emergency Generation Ventilation</td>
<td>Steel</td>
</tr>
</tbody>
</table>

### 3.5 CLEANING OF SYSTEMS
A. Before turning the installation over to the Owner, all ducts shown shall be blown clean of all dust and dirt that has collected in the ducts.

END OF SECTION
SECTION 233300
DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Volume control dampers.
B. Fire dampers.
C. Combination fire and smoke dampers.
D. Backdraft dampers.
E. Air turning devices.
F. Flexible duct connections.
G. Duct access doors.
H. Duct test holes.
I. Dust collector systems.

1.2 RELATED WORK

A. Section 22 0548 - Vibration Isolation.
B. Section 23 3113 - Ductwork.
C. Section 23 3600 - Air Terminal Units: Medium and high pressure damper assemblies.

1.3 REFERENCES

B. SMACNA - Low Pressure Duct Construction Standards.
D. UL 555 - Fire Dampers and Ceiling Dampers.

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 22 0010.

B. Provide shop drawings for shop fabricated assemblies indicated, including volume control dampers duct access doors duct test holes. Provide product data for hardware used.

C. Submit manufacturer's installation instructions under provisions of Section 22 0010 for fire dampers and combination fire and smoke dampers.

1. Submittal(s) for fire and combination fire/smoke dampers shall include the following:

a. Provide a schedule for all fire and combination fire and combination fire/smoke dampers.
   Assign identification numbers for each damper. Provide a set of 11” x 17” drawings bound
   with the schedule identifying each damper in plan with the unique identification number.

b. Provide air quantity, size, free area of damper, pressure drop and proposed velocity through
   each damper.

c. Provide manufacturer’s data of damper and its accessories or options.
PART 2 -- PRODUCTS

2.1 DAMPERS

A. Furnish and install 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. 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. Splitter dampers shall be fabricated of steel not lighter than 16 gauge. The leading edge of the damper shall be hemmed. Each splitter shall be a minimum of 12" long or 1-1/2 times the width of the smaller of the two branches it controls, whichever is greater. Dampers shall be carefully fitted, and shall be controlled by locking quadrants equal to Ventlok No. 555 on exposed uninsulated ductwork, No. 644 on exposed externally insulated ductwork and No. 677 (2-5/8" diameter) chromium plated cover plate for concealed ductwork not above lay-in accessible ceilings. Furnish and install end bearings for the damper rods on the end opposite the quadrant when No. 555 or No. 644 regulators are used, and on both ends when No. 677 regulators are used.

C. On concealed ductwork above lay-in accessible ceilings use Ventlok No. 555 or No. 644 locking quadrant for splitter dampers.

D. 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.

E. Volume dampers shall be equal to those of American Foundry. Blades shall not exceed 48 inches (48") in length or twelve inches (12") in width and shall be of the opposed interlocking type. The blades shall be of not less than No. 16 gauge galvanized steel supported on one-half inch (1/2") diameter rust-proofed axles. Axle bearings shall be the self-lubricating ferrule type.

F. Install all dampers furnished by the Temperature Control manufacturer's in strict accordance with the manufacturer's recommendations and requirements of these Specifications. All adjustable dampers installed in externally insulated ductwork shall be installed with Ventlok No. 639, or equal, elevated dial operators. Insulation shall extend under the elevated dial. All adjustable dampers installed in internally insulated ductwork shall be installed with Ventlok No. 635, or equal, dial operators. All damper shaft penetrations in the ductwork shall be installed with Ventlok No. 609 end bearings.

2.2 FIRE AND FIRE/SMOKE DAMPERS

A. Fire Dampers:
   1. Furnish and install where shown on the drawings or required by the Specifications, fire dampers meeting the following requirements.
   2. Each fire damper shall be constructed and tested in accordance with Underwriters Laboratories Safety Standard 555, 4th Edition. All dampers shall possess a 1-1/2 hour or 3 hour (as appropriate for the construction shown in the architectural) drawing protection rating, 160 or 165 degree F fusible link, and shall bear a U.L. label in accordance with Underwriters' Laboratories labeling, procedures. Fire dampers shall be constructed such that the damper frame material and the curtain material shall be galvanized.
   3. Fire dampers shall be curtain blade type and the damper shall be so constructed that the blades are out of the air stream to provide a 100 percent free area of the duct in which the damper is housed.
   4. The damper manufacturer's literature submitted for approval prior to the installation shall include performance data developed from testing, in accordance with AMCA 500 Standards and shall show the
pressure drops for all sizes of dampers required at anticipated air flow rates. Maximum pressure drop through the damper shall not exceed 0.05 inch water gauge.

5. Fire dampers shall be equipped for vertical or horizontal installation as required by the locations shown in the drawings. Fire dampers shall be installed in wall and floor openings utilizing steel sleeves, angles and other material and practices required to provide an installation equivalent to that utilized by the manufacturer when the respective dampers were tested by Underwriters Laboratories. (Note: Prefco Model 5500 E6-M fire dampers do not require sleeves.) Mounting angles shall be a minimum of 1-1/2 inch by 1-1/2 inch by 14 gauge and bolted, tack welded or screwed to the sleeve at maximum spacings of 12 inches and with a minimum of two connections at all sides. Mounting angles shall overlap at least equal to the gauge of the duct defined by the appropriate SMACNA Duct Construction Standard, latest edition, and as described in NFPA 90A. The entire assembly, following installation, shall be capable of withstanding 6” water gauge static pressure.

6. The damper installation shall be in accordance with the damper manufacturer's instructions.

7. All fire dampers shall comply with the specification as written above and shall be Ruskin Model IBD2 (Style C, CR or CO), Greenheck Model FD-150 (Type C, CR or CO), or Prefco Model 5500 (E6-M, CR, or CO).

8. The Contractor shall completely caulk the damper into the sleeve if recommended by the damper manufacturer using manufacturer recommended material(s).

B. Combination Fire/Smoke Dampers:

1. Furnish and install where shown on the Drawings, or as required by the Specifications, combination fire/smoke dampers meeting the following requirements.

2. Each combination fire/smoke damper shall be 1-1/2 hour fire rated under UL Standard 555, 4th Edition, and shall be further classified by Underwriters Laboratories as a Leakage Rated Damper for use in control systems under smoke the latest version of UL 555S, and bear a UL label attesting to same. The damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this Specification. Testing and UL qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be no higher than Leakage Class I (4 cfm per square foot at one inch water gage pressure and 8 cfm per square foot at 4 inches water gage pressure). The maximum air pressure drop through each combination fire/smoke damper shall not exceed 0.10 inch water gage at the design air quantity. (Note that this may require a larger damper than the connected duct size.)

3. The damper frame shall be a minimum of 20 gauge galvanized steel formed into a structural hat channel shape with tabbed corners for reinforcement, as approved in testing by Underwriters Laboratories. Bearings shall be integral high surface area non electrolytic materials construction to incorporate a friction free frame blade lap seal, or molybdenum disulfide impregnated stainless steel or bronze oilite sleeve type turning in an extruded hole in the frame or an extruded frame raceway. The dampers may be either parallel or opposed blade type. The blades shall be constructed with a minimum of 14 gauge equivalent thickness. The blade edge seal material shall be able to withstand 450 degrees F. The jamb seals shall be flexible stainless steel compression type or lap seal type.

4. In addition to the leakage ratings specified herein, the combination fire/smoke dampers and their operators shall be qualified under UL555S to an elevated temperature of 250 degrees F. Electric operators shall be installed by the damper manufacturer at the time of damper fabrication. The damper and operator shall be supplied as a single entity which meets all applicable UL555 and UL555S qualifications for both dampers and operators. The manufacturer shall provide a factory assembled sleeve. The sleeve shall be a minimum of either 20 gauge for dampers where neither width nor height exceeds 48 inches or 16 gauge where either dimension equals or exceeds 48 inches.

5. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (open and close) under HVAC system operation conditions, with pressures of at least 4 inches water gage in the closed position, and 2500 fpm air velocity in the open position.

6. Each combination fire/smoke damper shall be equipped with a UL Classified Firestat/releasing device. The firestat/releasing device shall electrically and mechanically lock the damper in a closed position when the duct temperatures exceed 165 degrees F and still allow the appropriate authority to operate
the damper as may be required for smoke control functions. The damper must be operable while the
temperature is above 250 degrees F. The actuator/operator package shall include two damper position
indicator switches linked directly to damper blade to provide capability of remotely indicating damper
position. One switch shall close when the damper is fully open, and the other switch shall close when
the damper is fully closed. The firestat/releasing device and position indicator switches shall be capable
of interfacing electrically with the smoke detectors, building fire alarm systems, and remote
indicating/control stations.

7. The damper releasing device shall be mounted within the airstream. The device shall be activated and
the damper shall close and lock when subjected to duct temperatures in excess of approximately 285
degrees F.

8. Motors for operation of smoke dampers shall be smoke system fail safe, spring return normally open
supplies and normally closed returns, or as indicated in the plans, and shall be furnished and installed
by the damper manufacturer as required by the U.L. rating, mentioned above. Motors shall be electric
or pneumatic to match the type of temperature control system specified elsewhere in this specification.
All required relays, EP switches, wiring piping and other labor and material necessary to completely
interconnect the smoke detector system shall be furnished by the Contractor.

9. Each damper shall be furnished in a square or rectangular configuration. The Contractor shall furnish
and install sleeves manufactured by the approved damper manufacturer for each damper. The sleeves
shall be constructed with square or rectangular to square, rectangular, round, or oval adapters as
required. Dampers shall be installed in the sleeves in accordance with manufacturers U.L. installation
instructions. The entire assembly, following installation, shall be capable of withstanding 6" w.g. static
pressure.

10. All combination fire/smoke dampers shall comply with the specification as written above and shall be
Ruskin Model FSD-60, Greenheck Model FSD-33, or Prefco Model 5020-1 (or Model 5010 for manual
reset dampers).

11. The Contractor shall completely caulk the damper into the sleeve as recommended by the damper
manufacturer using manufacturer recommended material(s).

C. Submittal and Installation:

1. The air quantity through each fire and combination fire and smoke damper will be identified in Part 2 of
the construction. Damper to be full size of the duct size or wall opening as shown on the drawings.

2. Access doors as specified elsewhere shall be provided to make all parts of the damper accessible.
Doors shall open not less than 90 degrees following installation and shall be insulated type where
installed in insulated ducts.

3. Contractor shall install each damper square and true to the building. The installation shall not place
pressure on the damper frame, but shall enclose the damper as required by UL555.

4. After each fire damper and combination fire and smoke damper has been installed and sealed in their
prescribed opening, and prior to the installation of the ceilings, the Contractor shall, as directed by the
Construction Inspector, activate part or all the dampers as required to verify “first-time” closure.
Activation of the damper shall be accomplished by manually operating the resettable link,
disconnecting the linkage at the fusible link of the fire damper, and manually operating the fire/smoke
damper through the pneumatic or electronic controls as appropriate. Failure of the damper to close
properly and smoothly on the first attempt will be cause to replace the entire damper assembly.

2.3 FLEXIBLE CONNECTIONS

A. Where ducts connect to fans, including roof exhausters, flexible connections shall be made using “Ventglas”
fabric that is fire resistant, waterproof, mildew resistant and practically air tight, and shall weigh approximately
thirty ounces (30 oz.) per square yard. There shall be a minimum of one-half inch (1/2") slack in the
connections, and a minimum of two and one-half inches (2-1/2") distance between the edges of the ducts
except that there shall also be a minimum of one inch (1") of slack for each inch of static pressure on the fan
system. This does not apply to Air Handling Units with internal isolation.
2.4 ACCESS DOORS

A. Furnish and install in the ductwork, hinged rectangular or round "spin-in" access doors to provide access to all fire dampers mixed air plenums, upstream of steam reheat coils, automatic dampers, etc. Where the ducts are insulated, the access doors shall be double skin doors with one inch (1") of insulation in the door. Where the size of the duct permits, the doors shall be eighteen inches (18") by sixteen inches (16"), or eighteen inches in diameter, and shall be provided with Ventlok No. 260 latches (latches are not required in round doors). Latches for rectangular doors smaller than 18” x 16” shall be Ventlok No. 100 or 140. Doors for zone hearing coils shall be Ventlok, stamped, insulated access doors, minimum 10” x 12”, complete with latch and two (2) hinges, or twelve inches (12") in diameter. Round access doors shall be "Inspector Series" spin-in type door as manufactured by Flexmaster USA, or approved equal. Doors for personnel access to ductwork shall be nominal twenty-four inches (24") 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.

2.5 SCREENS

A. Furnish and install screens on all duct, fan, etc., openings furnished by this Contractor which lead to, or are, outdoors. Screens shall be No. 16 gauge, one-half inch (1/2") mesh in removable galvanized steel frame. Provide safety screens meeting OSHA requirements for protection of maintenance personnel on all fan inlets and fan outlets to which no ductwork is connected.

2.6 TEST OPENINGS

A. Furnish and install in the return air duct and in the discharge duct of each fan unit Ventlok No. 699 instrument test holes. The test holes shall be installed in locations as required to measure pressure drops across each item in the system, e.g., O.A. louvers, filters, fans, coils, intermediate points in duct runs, etc.

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 and high pressure systems where indicated. Refer to Section 15930 - Air Terminal Units.

D. Provide fire dampers, and combination fire and smoke dampers at locations indicated, where ducts and outlets pass through fire-rated components. Install with required perimeter mounting, angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

E. Demonstrate re-setting of fire dampers to Owner's representative.

F. Provide backdraft dampers on exhaust fans or exhaust ducts where indicated.

G. 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.
H. Provide duct access doors for inspection and cleaning before and after duct mounted filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated. Provide minimum 8 x 8 inch (200 x 200 mm) size for hand access, 18 x 18 inch (450 x 450 mm) size for shoulder access, and as indicated.

I. Provide duct test holes where indicated and where required for testing and balancing purposes. Refer also to Section 23 0593.

J. On any individual floor or suite of floors, all air distribution devices visible from occupied spaces must be by the same manufacturer, mixing of similar devices by different manufacturers is not allowed.

END OF SECTION
PART 1 - GENERAL

1.1 WORK INCLUDED
A. Diffusers.
B. Registers/grilles.

1.2 RELATED WORK
A. Section 22 0010 - Basic Mechanical Requirements.
B. Section 23 3113 - Ductwork.
C. Section 23 3300 - Ductwork Accessories.

1.3 REFERENCES
B. AMCA 500 - Test Method for Louvers, Dampers and Shutters.
D. ARI 650 - Air Outlets and Inlets.
F. SMACNA - Low Pressure Duct Construction Standard.

1.4 QUALITY ASSURANCE
A. Test and rate performance of air outlets and inlets in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.
B. Test and rate performance of louvers in accordance with AMCA 500.

1.5 REGULATORY REQUIREMENTS
A. Conform to ANSI/NFPA 90A.

1.6 SUBMITTALS
A. Submit product data under provisions of Section 22 0010.
B. Provide product data for items required for this project.
C. Submit schedule of outlets and inlets indicating type, size, location, application, and noise level.
D. 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.
E. Submit manufacturer's installation instructions under provisions of Section 22 0010.
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. 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. Selections shall meet the manufacturer's own published data for the above performance criteria. 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 or less than 25 FPM. Noise levels shall not exceed an NC level of 25 as discussed in the ASHRAE Guide for the type of space being served.

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. Where called for on the schedules, the grilles, registers and ceiling outlets shall be provided with deflecting devices. These shall be the standard product of the manufacturer, subject to review by the Architect, and equal to brand scheduled.

2.2 ACCEPTABLE MANUFACTURERS - CEILING DIFFUSERS

A. Titus.
B. Krueger.
C. Price
D. Nailor Hart

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.

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.

F. On any individual floor or suite of floors, all air distribution devices visible from occupied spaces must be by the same manufacturer, mixing of similar devices by different manufacturers is not allowed.

END OF SECTION
SECTION 233350
FILTERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Filters.
B. Housings and frames.
C. Filter gages.

1.2 RELATED SECTIONS

A. Section 22 0010 - Basic Mechanical Requirements.
B. Section 23 0513 - Motors.
C. Section 23 0703 - Ductwork Insulation.
D. Section 23 3113 - Ductwork.
E. Section 26 0519 - 600-Volt Cable, Wire, and Connectors.
F. Section 26 2726 - Wiring Devices and Floor Boxes.

1.3 REFERENCES

B. AMCA 500 - Test Methods for Louver, Dampers, and Shutters.
C. NFPA 70 - National Electrical Code.
D. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
E. ANSI/UL-900 - Test Performance of Air Filter Units.
F. ANSI/UL-586 - Test Performance of High Efficiency Porcelain, Air Filter Units.

1.4 SUBMITTALS

A. Submit under provisions of Section 22 0010.
B. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
C. Product Data:
   1. Provide literature which indicates dimensions, weights, capacities, ratings, performance, gages and finishes of materials, and electrical characteristics and connection requirements.
   2. Provide data of media, Performance data, assembly, and frames.
   3. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
D. Manufacturer's installation instructions.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 22 0010.
B. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience, who issues complete catalog data on total product.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 22 0010.
B. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and fitting lugs. Inspect for damage.
C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.09 EXTRA MATERIALS

A. Furnish under provisions of Section 22 0010.
B. Provide two sets for each unit of filters. Tag to identify associated unit.

1.10 SCHEDULES ON DRAWINGS

A. In general, all capacities and characteristics are shown in schedules on the Drawings. Reference shall be made to the schedules for such information. The capacities shown are minimum capacities. Variations in the capacities of the scheduled equipment supplied under this contract will be permitted only with the written direction of the Owner. All equipment shall be shipped to the job with not less than a prime coat of paint or as specified hereinafter. Where installation instructions are not included in these Specifications or on the Drawings, the manufacturer's instructions shall be followed. All equipment affected by altitude shall be rated to operate at the altitude where it is installed.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Type "A": Permanent Washable
   1. American Air Filter HV-2
   2. Farr Type 44
   3. Air-Maza P-5

B. Type "B": 2" Sectional Renewable
   1. American Air Filter RENU
   2. Farr D/C 22

C. Type "C": Replaceable Dry type, Moderate Efficiency
   1. Farr 30/30
D. Type "D": Replaceable Dry Type Medium and/or High Efficiency
   1. American Air Filter
   2. Cambridge
   3. Farr RIGA-FLO

E. Type "E": 30" Replaceable Dry Type Medium and/or High Efficiency
   1. Farr N/S Model III
   2. American Air Filter
   3. Cambridge

F. Type "F": Automatic Renewable
   1. American Air Filter

G. Side Access Housings
   1. Farr 3P Universal Glide Pack
   2. American Air Filter

H. Frames
   1. American Air Filter
   2. Farr Type 8

I. Filter Gages
   1. Dwyer "Magnehelic"
   2. Dwyer #25 Manometer

J. Substitutions: Under provisions of Section 22 0010 The equipment or material supplied by any of these
   acceptable manufacturers or an approved equal shall comply with all of the Provisions of this specification.

2.2 GENERAL DESCRIPTION

A. Configuration: Fabricate with fan(s), coils, etc., plus accessories, including:
   1. Filters.
   2. Filter Housings and Frames.
   3. Filter Gages.

B. Performance Base: Sea level conditions.

C. Fabrication: Conform to AMCA 99 and ARI 430.

D. Performance: Refer to schedules.

2.3 FILTERS

A. All air filters shall be listed as Class 2 in accordance with Underwriters Laboratories, Inc., Building
   Materials Director requirements, except ultrahigh efficiency filters (HEPA) shall be manufactured of
   materials that are so listed by UL. All filters other than the ultrahigh efficiency type are to be rated in
   accordance with ASHRAE Test Standard 52-76 and performance characteristics are to be published in the
   manufacturer's literature. When specified performance characteristics are not published in the
   manufacturer's literature, the submittal data shall include certified documentation of performance by an
   approved independent test laboratory.
B. Type "A": Permanent, Washable: Viscous coated, high velocity filters. The net velocity through the filters shall not exceed 500 fpm. Filters shall be 2" (two inches) thick and the initial clean resistance to air flow shall not exceed 0.10" (one tenth inch) w.g. Filters shall be installed in side access or front access frames, as shown on the drawings. Filters in front access frames shall be furnished with lift handles. Furnish one complete set of spare filters for each system.

C. Type "B": Sectional, Renewable Media: Air filters shall be 2" (two inches) thick adhesive coated glass fiber media pads enclosed in sectional frames of not less than 16 (sixteen) gage galvanized steel and equipped with a quick opening mechanism for changing filter-media. The air flow capacity of the filters shall be based on a net filter face velocity not exceeding 350' (three hundred and fifty feet) per minute with an initial resistance no greater than 0.10" (one tenth inch) water gage. When used as prefilters, and mounted in the same holding frames as higher efficiency secondary air filters, the air flow capacity may be based on 500' per minute with an initial resistance not to exceed 0.17" water gage. Filters shall have an average arrestance of not less than 70 to 75% when tested in accordance with ASHRAE Test Standard 52.

D. Type "C": Replaceable, Dry Type, Moderate Efficiency: Filters shall be of the pleated media, disposable type, 2" (two inches) deep in direction of air flow. Each filter cell shall utilize a nonwoven, lofted cotton media with a net effective area of not less than 4.6 square feet of media per 1.0 square feet of filter face area, a media support grid, and enclosing high wet strength cell sides. The 96% free area welded wire support grid shall be continuously bonded to the leaving air face of the media to properly support the radially tapered, pleated media in the air stream through the life span of the filter. The media itself shall be cemented to the inside perimeter of the cell sides to prevent bypass of unfiltered air. Filter efficiency shall average not less than 25 to 30% when tested in accordance with ASHRAE Test Standard 52-76. Initial clean resistance to air flow shall not exceed 0.30" w.g. at 500 fpm filter face velocity. The 24" x 24" size shall be certified to have a dust holding capacity of not less than 200 grams of ASHRAE Test Dust when operated at 500 fpm to a final resistance of 1.0" w.g.

E. Type "D": Replaceable, Dry Type, Medium and/or High Efficiency: Filters shall be 12" deep of the extended surface, supported pleat type. Each filter shall consist of high density, microfine glass fiber media, media support grid, contour stabilizers, and enclosing galvanized steel frame. Media shall be laminated to a nonwoven synthetic backing to form a lofted surface for maximum dust holding capacity. The edges of the media shall be continuously bonded to the internal surfaces of the galvanized steel frame to prevent bypass of unfiltered air. Filter efficiency shall average not less than 50 to 55%, 80 to 85%, 90 to 95% when tested in accordance with ASHRAE Test Standard 52-76. Filters shall be 24" x 24" x 12" deep with an initial clean resistance not to exceed 0.35, 0.50, 0.65 inches w.g. at 500 fpm face velocity. The 24" x 24" size shall be certified to have a dust holding capacity of not less than 400, 235, 130 grams of ASHRAE Test Dust when operated at 500 fpm face velocity to a final resistance of 1" w.g.

F. Type "E": Replaceable Dry Type, Medium and/or High Efficiency: Filters shall be of the extended surface, unsupported, packet type, approximately 30" deep in direction of airflow. Each filter shall consist of pockets of high density, microfine glass fiber media, laminated to a nonwoven synthetic backing to form a lofted surface for maximum dust holding capacity, sealed to an enclosing frame (header) of not less than 26 gage formed galvanized steel. The configuration of the pockets shall be controlled by progressive link stitching so that uniform velocities are maintained in the air passages through the filter. Stapling of media will not be acceptable. All stitching points shall be sealed with a hot melt adhesive. Net effective filter area shall be at least 22.5 square feet per 1.0 square feet of filter face area. Filter efficiency shall average not less than 50 to 55%, 80 to 85%, 90 to 95% when tested in accordance with ASHRAE Test Standard 52-76. Initial clean resistance shall not exceed 0.29, 0.39, 0.48 inch w.g. at 500 fpm face velocity. The 24" x 24" filters shall be certified to have a dust holding capacity of not less than 740, 480, 325 grams of ASHRAE Test Dust when operated at 500 fpm face velocity to a final resistance of 1" w.g.

G. Type "F": Automatic, Renewable Media: Filtering medium shall be a glass fiber material of progressive density, both in number and diameter of fibers, with a scrim backing. This material shall be precharged
with a filter adhesive and be wound tightly on a spool to form a compact roll. Rolls of clean media shall be installed at the top or at one end of the filter casing and be fed automatically to rewind spools at the bottom or at the opposite end of the filter after the media has accumulated its dirt load. Each filter section shall incorporate a spring loaded brake plate on the clean media spool as well as a pressure plate on the used media spool to insure uniform and compact rewinding of the used media. The rolls of used media shall be located completely outside the filtered air stream and the rolls of clean media shall be fully enclosed to prevent the media from being soiled by the unfiltered air. A control panel, incorporating a runout light and a manual bypass switch, shall be installed on the exterior wall of the filter section enclosure on whichever side of the casing is most convenient for maintenance purposes. The filter media shall be advanced automatically by means of a differential pressure switch. The pressure switch shall be adjustable to make it possible to increase or decrease the frequency of movement of the filter media. A signal light shall be activated by a runout switch furnished for each individual section which indicates that the end of any one roll supply has been reached. The runout switches shall sense an end-of-roll condition directly without the use of cable linkage. The media rewind spools shall be driven by fractional horsepower gear motors or by a motor operating through a gear reducer. Power to the drive motor shall be controlled from the load side of the fan motor so that the filter will not operate whenever the fan is not running. The filter media shall have an average arrestance of not less than 75% when tested in accordance with ASHRAE Test Standard 52 and shall have a minimum dust holding capacity of not less than 75 grams of ASHRAE Test Dust per square foot of media when operated at 500 fpm media velocity with an average air friction of 0.5 inch w.g. All electrical work specified herein shall be factory prewired to terminal strips in the control enclosure. Roll filters shall be of the horizontal or vertical type as shown on the Drawings.

2.4 HOUSINGS AND FRAMES

A. Side access housings shall be fabricated of not less than 16 gauge galvanized steel. Housings shall each be equipped with hinged access doors at both ends, provision for receiving filters of any manufacturer without alteration to the housings, and extruded aluminum channels capable of receiving both the after filters and 2" deep panel type prefilters. The housings shall incorporate a permanent provision for sealing the filters against leakage around the entire perimeter of each filter, eliminating the need to purchase replacement filters with factory applied gasket strips. Replaceable woven pile seals shall be an integral component of the downstream flange of each extrusion so that the seals are compressed by the pressure drop across the filters, preventing bypass of unfiltered air. Side access housing shall not exceed 12 inches in direction of airflow and shall be of all welded construction with factory prepunched standing flanges for ease of attachment to adjacent equipment and/or ductwork. Doors are to be fitted with positive sealing, heavy duty multiple latches and with sponge neoprene gaskets.

B. Unitary front access holding frames shall be fabricated of not less than 16 gauge galvanized steel with holes prepunched for convenient assembly into banks. Frames shall be a minimum of 2-5/8" deep for maximum structural strength and resistance to racking. All joints in the field assembled banks of frames shall be thoroughly caulked to prevent bypass of unfiltered air between frames and surrounding ductwork or plenum chambers. Frames shall each be fitted with polyurethane foam gaskets, held in place by long lasting adhesive, and with a minimum of four heavy duty spring type fasteners. Fasteners shall attach to the frames without requiring tools and shall be capable of withstanding 25 pounds of pressure without deflection.

2.5 FILTER GAGES

A. Each individual filter or filter bank handling 2,000 cfm or more shall be equipped with a diaphragm actuated dial and pointer type gage with zero adjustment capability. The range of the scale shall be no greater than 1" w.g. above the filter manufacturer's recommended final resistance for the type of filter to which the gage is being applied. Each gage shall be provided with an adjustable signal flag, two static pressure tips with compression fittings, two three-way vent valves with compression fittings, two lengths of aluminum tubing, and a mounting plate with screws.
B. Provide dry contact switch to indicate high pressure limit (adjustable) for connection by others to FCMS system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

1. Type "A" - Permanent Washable: Install one set at start-up. Clean and recoat filters with adhesive as required prior to final acceptance. At final acceptance, remove and install second set. Wash and recoat first set and turn over to Owner.

2. Type "B" - Sectional, Renewable Media: Install set of pads at start-up. Replace filter pads as required prior to final acceptance. At final acceptance, remove and discard the partially used pads and install a new set. Furnish Owner with one additional set of clean filter pads.

3. Type "C" - Replaceable, Dry Type, Moderate Efficiency: Install 2" deep fiberglass throwaway filters at start-up. Replace throwaway filters as required prior to final acceptance. At final acceptance, remove and discard the partially used throwaway filters and install a set of moderate efficiency filters. Furnish Owner with an additional set of unused moderate efficiency filters.

4. Types "D" and "E" - Replaceable, Dry Type, Medium and/or High Efficiency: Install 2" (two inch) deep fiberglass throwaway filters at start-up. Replace throwaway filters as required prior to final acceptance. At final acceptance, remove and dispose of the used throwaway filters. Install first set of medium and/or high efficiency filters and, where called for, required prefilters. Furnish Owner with an additional set of unused medium and/or high efficiency filters.

5. Type "F" - Automatic Roll Filters: Install first roll of media at stamp. Replace any rolls that run out prior to final acceptance. At final acceptance, turn over to the Owner the partially used roll media in place as well as an additional set of unused roll filter media.

B. Install in conformance with UL 900.

C. Assemble high pressure units by bolting sections together.

END OF SECTION
SECTION 233600
AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Variable volume terminal units.
B. Dual duct terminal units.
C. Variable volume regulators.
D. Integral sound attenuator.
E. Integral damper motor operators.
F. Integral controls.

1.2 REFERENCES

B. UL 181 - Factory-Made Air Ducts and Connectors.
C. ADC 1062 - Air Distribution and Control Device Test Code.
D. ARI 880 - Standard for Air Terminals.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Division 1 and Section 22 0010.
B. Submit shop drawings indicating configuration, general assembly, and materials used in fabrication.
C. Submit product data under provisions of Division 1 and Section 22 0010.
D. 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.
E. 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.
F. Submit manufacturer's installation instructions under provisions of Division 1 and Section 22 0010.
G. A sample 8 inch size production run unit shall be submitted for examination and approval by the Engineer, RCM office and the Owners Testing and Balancing (TAB) Consultant. 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. 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. This period shall restart if the sample box is rejected and another box is resubmitted. If rejected for any reason, the Contractor shall expedite the corrections documented, and shall resubmit a sample box as soon as possible. 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. If approved, the unit shall remain in the possession of the Owner at the job site for comparison with units as shipped to project. The unit shall be installed in the project, at an accessible, marked location. The unit manufacturer shall test and certify that each box used on this project has been tested as specified.
1.4 OPERATION AND MAINTENANCE DATA
   A. Submit operation and maintenance data under provisions of Division 1 and Section 22 0010.
   B. Include manufacturer’s descriptive literature, operating instructions, maintenance and repair data, and parts lists.

1.5 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.

1.6 WARRANTY
   A. Provide one-year manufacturer's warranty under provisions of Division 1 and Section 22 0010.

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. The insulation shall be foil faced with the edges and seams sealed or “captured”, encapsulating all fibers of the insulation. The insulation shall be neatly installed with no rough edges to interrupt the smooth flow of air through the box. The casing shall be insulated throughout its interior. 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.
         b. 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. 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".) The only exception shall be flow sensors installed in the inlet duct connections. 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.
         c. The terminal units shall be constructed with inlet and discharge ductwork connections. 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). The discharge connection shall include 1” 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.
      2. Casing Leakage: Assembled Units shall be so constructed and sealed to limit air leakage to the following listed quantities at 6” static pressure. Leakage curves or tables will be required as part of the submittal data. The following is the maximum allowable casing leakage including all components:

<table>
<thead>
<tr>
<th>Diameter (Area x 2000 fpm)</th>
<th>Maximum Allowable CFM</th>
<th>Maximum Allowable CFM Casing Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>607 of 792</td>
<td>607 of 792</td>
<td>607 of 792</td>
</tr>
</tbody>
</table>
3. Access Plenum and Door: An access panel shall be provided immediately downstream of the dampers for inspection and service of the dampers 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") access door as manufactured by Ventlok. Door frame may be bolted, screwed or flanged and sealed to the casing. Door shall be gasketed and shall be double all construction or insulated similar to main casing. Door shall be held in place with latches or other captive retainer devices. If the damper assembly is easily removed from the rear of the box, the access size can be reduced to 8" round or 8" x 8" for inspection only.

4. Damper Construction: 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. The damper shafts shall operate in rust-proof self-lubricating bearings. Damper shafts penetrating the unit casings shall be sealed against leakage, and bearings shall be installed for protection against wear in the casing penetration. Damper shafts shall be formed of, or cut from solid stock; no hollow shafts will be allowed. The dampers shall seat against gasketed stops or the dampers shall have gasketed edges. The dampers shall be so constructed to prevent "oil canning" of the damper blade. The units shall be tested for leakage in both inlets with 6" static pressure imposed on one inlet at a time. The maximum percent leakage from all tests shall be reported. Leakage curves as a function of pressure shall be supplied as part of the submittal data. The damper actuator linkage, if used, shall be constructed of material of sufficient strength to avoid buckling under extreme loads. Also, linkages shall not allow play greater than 5 degrees of damper movement. 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.

5. Damper Leakage: The following is the maximum damper leakage allowable for the various size diameter inlets at 6" w.g. differential pressure. The damper leakage shall not exceed the values listed in the table below at 6" S.P., following ARI 880 Testing Procedures.

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Maximum Allowed CFM (Area x 2000 fpm)</th>
<th>Maximum Allowable CFM Damper Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>4&quot;-5&quot;-6&quot;</td>
<td>393</td>
<td>6.0</td>
</tr>
<tr>
<td>7&quot;-8&quot;</td>
<td>698</td>
<td>10.5</td>
</tr>
<tr>
<td>9&quot;-10&quot;</td>
<td>1091</td>
<td>16.5</td>
</tr>
<tr>
<td>11&quot;-12&quot;</td>
<td>1571</td>
<td>20.0</td>
</tr>
<tr>
<td>13&quot;-14&quot;</td>
<td>2138</td>
<td>30.0</td>
</tr>
</tbody>
</table>

6. Unit Pressure Drop: For dual duct units with an integral attenuator mixer, but with no other accessories, the static pressure across the assembly with an equivalent 2000 fpm inlet velocity through one inlet shall not exceed 0.50 inches water gauge, with the total flow through either inlet. Single duct unit pressure drop shall be limited to 0.15 inches water gauge under the same conditions above.

7. Certification: The unit manufacturer shall certify that each unit used on this project will perform as specified. Each unit shall bear a tag or decal listing the following specified information:
   a. Test Pressure
   b. Leakage CFM (damper)
   c. Leakage CFM (casing)
8. Mixing: Dual duct terminal units as specified herein shall provide mixing within the units, and not rely upon the discharge ductwork to provide for the completion of the mixing process. The horizontal average temperature of the air as it leaves the terminal unit shall not vary more than 1°F for each 20°F of temperature difference between the two inlet air supplies. (For example, if the cold supply air is 55°F and the hot supply air is 95°F, the difference is 40 degrees. The allowable temperature variation of the discharge air is, thus, 2°F.) The temperature of the discharge air shall be measured using a pattern of four vertical, evenly spaced columns, and three horizontal, evenly spaced rows. The rows and columns shall be spaced so that the resulting 12 points shall be at the centers of equal areas. The plane of the points shall be perpendicular to the direction of air flow, within 4 inches of the discharge of the terminal unit, within the discharge ductwork. The three readings in each column shall be averaged to determine compliance with the 1°F criteria.

9. Flow Measurement: Air flow thru the unit shall be accomplished by the use of a 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: 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. No credit for lined discharge duct, branching, flow division, end reflection, room absorption or any other effects shall be allowed.

<table>
<thead>
<tr>
<th>Octave Band</th>
<th>Center Frequency (Hz)</th>
<th>Sound Power Level (dB re 10^-12 Watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>125</td>
<td>76</td>
</tr>
<tr>
<td>3</td>
<td>250</td>
<td>66</td>
</tr>
<tr>
<td>4</td>
<td>500</td>
<td>63</td>
</tr>
<tr>
<td>5</td>
<td>1000</td>
<td>58</td>
</tr>
<tr>
<td>6</td>
<td>2000</td>
<td>60</td>
</tr>
<tr>
<td>7</td>
<td>4000</td>
<td>55</td>
</tr>
</tbody>
</table>

   b. Radiated Sound: 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. No credit for ceiling plenum, ceiling tiles, room absorption, or any other effects shall be allowed.

<table>
<thead>
<tr>
<th>Octave Band</th>
<th>Center Frequency (Hz)</th>
<th>Sound Power Level (dB re 10^-12 Watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>125</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>2000</td>
<td>47</td>
</tr>
<tr>
<td>7</td>
<td>4000</td>
<td></td>
</tr>
</tbody>
</table>

   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: A minimum of ten percent (10%) 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. 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 ten percent (10%) of each size (but no less than one unit of a size, unless 100% of the size has been tested) of the units shall be tested. If this testing, in the Owner's opinion, shows that ten percent (10%) or more of the units tested do not perform as specified, then one hundred percent (100%) of all sizes of the units shall be tested for conformance with these specifications. 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). A method of repair or replacing the units will be negotiated. 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 Non-Performance", or as required to prove that the units perform as specified. 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. 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: All Terminal Units shall be as manufactured by Titus (Model MDV-3100-UT or MDC-3100-UT), Metal*Aire (Series 400DDUT), or Nailor Industries 3000-UT or 3200-UT. Note that the model and series numbers listed may differ slightly from catalogue information. No other manufacturers or models are acceptable. Even though specific manufacturers may be named herein, the material supplied by any approved manufacturer shall meet all of the provisions of this specification without exception.

13. HOT WATER COILS: 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. Air side pressure drop shall be limited to 0.2” wg at box rated flow. Full fin collars shall be provided for accurate fin spacing and maximum fin-to-tube contact. 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. Male sweat-type water connections shall be provided. Side and end plates shall be a minimum of 18 gauge galvanized sheet metal construction. All coils shall be constructed and tested in accordance with UL and/or ARI Standards. The tube ends shall be protected with tube end caps of sheet metal similar to the casing material, and shall be insulated within the caps.

14. General Performance: Devices using mechanical CFM limiters will not be accepted, nor shall it be necessary to change control components to make airflow rate changes. 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. 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. The terminal unit manufacturer will furnish and install the control power disconnect and control voltage transformer. The performance of DDC controls, especially in connection with terminal units, shall be the responsibility of the DDC controls manufacturer.
15. Control Performance: Assemblies shall be able to be reset to any airflow between zero and the maximum cfm shown on Drawings. 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. The control devices shall be designed to maintain the desired flow regardless of inlet flow deflection. 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: The control sequence arrangements shall be as described below, 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. The desired sequence shall be adjustable according to space usage or a change in space conditions.

**Constant Volume**

Note: Inlets are same diameter.

<table>
<thead>
<tr>
<th>Box Size</th>
<th>max heating flow</th>
<th>min. mixing flow</th>
<th>max. cooling flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>10&quot; DIA.</td>
<td>1000 - 1000 - 1000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

450 fpm min., 2000 fpm max inlet velocity

Constant volume operation with full mixing of hot and cold air flow between demands for full heating and full cooling, with adjustable total air flow. The terminal control assembly shall not allow excessive hot air flow to be delivered to the space if the pressure in the cold duct becomes less than design during the mixing or full cooling demand. Therefore, depending on the type of controls, the maximum hot air supplied may necessarily be slightly less than the maximum cold air supplied.
Variable Volume – Dual Duct

Box Size

10" DIA:

1000 - 300 - 700

max heating flow
min mixing flow
max cooling flow

450 fpm min., 2000 fpm max. inlet velocity

Actual Shape, Slope, and Cross-over Determined by PID

Separate maximum CFM values for hot and cold ducts with zero minimum flow for both hot and cold ducts, with adjustable mixing of hot and cold airflow to allow for adjustable minimum total airflow from the terminal unit. Refer to terminal unit schedule for minimum mixed flow.
**Single Duct Units - VAV**

10" DIA.: 800/300

*Box Size max/min cooling flow*

450 fpm min., 2000 fpm max. inlet velocity

---

**HOT WATER FLOW**

100% HEATING

30% (min)

0

-2°F  -1°F  Set  +1°F  +2°F  Room Temperature

**COLD** 100% (max)

Increasing CFM value for cold air supply occurs only when the hot water valve is fully closed. The hot water valve stays in the closed position (normally closed valve) until the cold supply air reaches its minimum. The hot water flow then increases until reaching its maximum scheduled flow. Note that the minimum air flow is shown as 30 percent of the nominal air flow for the individual terminal unit. Refer to terminal unit schedule for minimum air flow.

**17. DDC Systems:** Electronic motors and controllers shall be installed by the terminal unit manufacturer unless specifically prohibited by the by the controls manufacturer. In such an event, the controls manufacturer shall be responsible for the installation of the controls. The controls manufacturer shall be responsible for the operational performance of the entire system. The terminal unit manufacturer shall remain responsible only for the performance of the mechanical components of the unit.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer also 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.
D. Support units individually from structure. Do not support from adjacent ductwork.
E. Connect to ductwork in accordance with Section 23 3113.
F. Install heating coils in accordance with Section 23 8216.

3.2 TERMINAL UNIT SCHEDULE

A. Refer to drawings for schedule.

END OF SECTION
SECTION 260000

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Provisions established within the Conditions of the Contract and Division 1, 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 1 requirements.

1.3 REFERENCES
A. ADA – Americans with Disabilities Act.
B. EIA – Electronics Institute of America.
C. FM – Factory Mutual.
D. NEC – National Electrical Code.
E. NECA's Standard of Installation.
G. OSHA – Occupational Safety and Health Act.
H. TDH – Texas Department of Health (Hospital Licensing Standards).
I. UL – Underwriters Laboratories, Inc.

1.4 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 switchgear, switchboards, distribution panelboards, branch circuit panelboards, motor control centers, transformers, breakers, and feeders.
   2. Connection of electric power to heating, ventilating, and air conditioning equipment.
   3. Interior and/or exterior 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.
   7. Temporary power service for construction work.

1.5 WORK SEQUENCE
A. Install work in phases to accommodate Owner’s occupancy requirements during the construction period and as outlined in Division 1.

1.6 ALLOWANCES
A. Refer to Division 1.

1.7 ALTERNATES
A. Refer to Division 1.

1.8 REGULATORY REQUIREMENTS
A. Conform to applicable codes and ordinances. Refer to paragraph 1.3 above.
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.

1.9 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. Obtain permission of Owner before proceeding.
C. In some cases the existing system(s) will be expanded or replaced. Contractor shall thoroughly familiarize himself 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.

1.10 ELECTRICAL COORDINATION DRAWINGS
A. Prepare and submit a set of coordination drawings showing major elements, components, and systems of electrical equipment and materials in relationship with other building components.
B. Prepare drawings to an accurate scale of 1/4 inch = 1 foot, 0 inches or larger. Indicate the locations of all equipment and materials, including clearances for servicing and maintaining equipment. Indicate movement and positioning of large equipment into the building during construction.
C. Prepare floor plans, reflected ceiling plans, elevations, sections, and details to coordinate and integrate all installations. Indicate locations where space is limited and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
   1. Equipment room layouts.
   2. Motor control centers.
   3. Transformers.
   4. Switchboards and panelboards.
   5. Equipment connections.
   6. Control panels.
   7. Wiring diagrams (indicating field installed electrical power and control wiring and cabling layouts, overcurrent protective devices, equipment, and equipment connections).
   8. Work in pipe spaces, chases.
  10. Ceiling plenums, which contain piping, ductwork, or equipment in congested arrangement.
  11. Building ground ("UFER" ground) system.

1.11 SEQUENCING AND SCHEDULING
A. Construct Work in sequence under provisions of Division 1.
B. Any 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. It is critical that electric supply be maintained on all Campuses. 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.

1.12 TEMPORARY POWER REQUIREMENTS
A. Provide power distribution system sufficient to accommodate construction operations requiring power, use of power tools, electrical heating, lighting, and start-up/testing of permanent electric-powered equipment prior to its permanent connection to electrical system. Provide overload protection.
B. Provide sufficient temporary lighting to ensure proper workmanship by combined use of daylight, general lighting, and portable plug-in task lighting.
C. Provide temporary power, including emergency generators, as may be required to accommodate power supply requirements during periods of construction.
1.13 TESTING
A. Upon completion of the work test the individual components for proper voltage and operation.
B. Balance loads connected to panel to achieve a maximum imbalance of 10 percent or less.

1.14 WARRANTIES
A. Refer to Division 1 for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.
B. 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.
C. 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.

1.15 RECORD DRAWINGS AND SPECIFICATIONS
A. Keep a complete set of Drawings and Specifications in job site office for showing actual installation of electrical systems and equipment. Use this set of Documents for no other purpose.
B. Record Drawings: Where material, equipment, or system components are installed differently from that shown, indicate differences clearly and neatly on Record Drawings using ink or indelible pencil.
C. Record Specifications: Mark specifications to indicate approved substitutions, change orders, actual equipment and materials used.
D. At project completion submit Record Drawings and Specifications to Engineer. All electrical drawings shall be submitted in mylar reproducible.
E. Electronic Media Transfer: AutoCAD files specific to each floor shall be turned over (under formal transmittal letter) to the owner within 1 week of each floor acceptance. The electronic files shall have the latest changes incorporated, and represent the most accurate design issued for construction. The files shall comply with Specification 220011. The files shall be in AutoCAD 2010.

1.16 TRAINING
A. Refer to other 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.

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.

PART 3 - EXECUTION

3.1 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.

3.2 CUTTING AND PATCHING
A. Cut and patch walls, floors, etc., resulting from work in existing construction.
B. Make opening 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.

3.3 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. 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.

END OF SECTION
PART 1 - GENERAL

1.1 PURPOSE

A. This document establishes design requirements for electrical projects on UTSW campus.

B. This document addresses design criteria not specifically covered by the National Electric Code (NEC), or set requirements that may meet the minimum requirements of the NEC.

C. Applicability: This document applies to all electrical 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.

D. Terms and Definitions

1. UTSW – University of Texas Southwestern Medical Center at Dallas.
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 Physical Plant Office (P Building).
5. ENGINEER – UTSW Engineer.
6. INSPECTOR – UTSW Inspector

1.2 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. All 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.

F. Plugmold varies between each campus, and shall match the existing style.

G. Each Laboratory peninsula equipped with a sink shall have a GFIC duplex receptacle with a dedicated circuit mounted 72” above finished floor. The receptacle is for future installation of filtration units. The receptacle shall be mounted centerline in the vertical electrical chase directly above the sink.
H. Laboratory Four-plex Receptacles (Dry Lab or PC Lab) – All laboratory four-plex receptacles shall be wired with a maximum of two (2) four-plex receptacles per circuit. Receptacles shall be mounted 18 inches Above Finished Floor (AFF) unless otherwise specified.

I. UPS or surge suppressors are generally provided at point-of-use by the end user.

1.3 ELECTRICAL DESIGN FOR OFFICES

A. Each enclosed office shall be provided with a dedicated circuit. Sharing circuits between enclosed offices is not permitted, and shall be segregated whenever encountered.

B. Receptacles shall be mounted 18 inches Above Finished Floor (AFF) unless otherwise specified.

C. A four-plex wall receptacle and combination data/phone box shall be installed at 18 inches above finished floor (AFF) at each location where a computer workstation is located unless otherwise specified by the end user.

D. A duplex wall receptacle and combination data/phone box shall be placed adjacent to any conference table located within an office.

E. A duplex wall receptacle with dedicated circuit and combination dataphone box shall be placed adjacent to any common use network printer or area fax machine. Workstation printers shall be placed on the office/cubicle circuit.

F. A wall receptacle with dedicated circuit shall be provided for any area copier. The voltage could be either 208 or 120 Volts.

G. Administrative assistant’s workstation shall be provided with two dedicated circuits. This is to allow for additional copiers, faxes, etc.

H. Conference rooms are generally laid out with a motorized projector screen, ceiling mounted projector, floor mounted receptacle/data, and supplemental fluorescent downlight with dimming capability.

I. Receptacles rated for less than 20 amps are prohibited.

1.4 HOUSEKEEPING RECEPTACLES

A. Housekeeping receptacles shall be provided in general use corridors outside offices and corridors.

1.5 ELECTRICAL CONDUIT HOME RUNS

A. All wiring on UTSW campus shall be rated for 90°C service.

B. Electrical conduit home run diameter shall not be less than ¾ inch diameter for any circuit.

C. Metal Clad (MC) cable is prohibited for use on UTSWMC campus, except in special cases. Written approval of the Engineer and Inspector is required before MC can be installed. Unlike rigid metallic conduit, a new set of wires cannot be pulled through MC cable making it unsuitable for renovation purposes.
1.6 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. Approval is required from the ENGINEER.
B. 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 262417.
C. It is common practice to convert lab to offices. Therefore, branch panels shall not be located inside laboratories.
D. MLO panels shall not to be used.
E. 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 VARIABLE FREQUENCY DRIVES (VFD)
A. UTSW uses VFD’s, which readily interface with Siemens Control Systems. UTSW Specification 230514 shall be used for all VFD’s.

1.8 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. All components and motors shall be sized for 120% of design. With the introduction of the premium efficiency motors, a new problem has arisen which is generally unknown by many end users. Designs of premium efficiency motors vary by manufacturers. In short, designing a motor with improved efficiency has resulted in a lower X/R ratio, causing higher inrush currents. These higher currents can cause circuit breaker trip when using a full voltage starter.
C. Therefore, all motors greater than 5 HP shall be premium efficiency TEFC and IEEE 841 (severe duty) rated. Motors greater than 75 HP shall additionally use a Cutler-Hammer (IT) soft starter if a VFD is not specified.

1.9 ELECTRICAL DUCT HEATERS
A. Duct heaters shall be of the finned-tubular design to prevent electrical shock from accidental contact.
B. For sizing considerations no credit is taken for heat generated in the room from equipment not hard-wired to a disconnect switch.

1.10 ELECTRICAL DISCONNECTS
A. Disconnects shall be located in plain view of the electrical load (within six feet). 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.

1.11 SPECIAL USE LIGHTS
A. Safe lights are used in dark rooms during film developing. The bulbs are red in color. In order to prevent accidental illumination of a darkroom during the film developing process the fluorescent light switch is
placed 6 feet above finish floor, and the safe light switch is placed 4 feet above finish floor. A 'dark room in use' sign is used outside the door.

B. Ultraviolet lights (UV) are used in special applications such as tissue culture or sterilization of water. Ultraviolet light is used to kill bacteria. UV light causes retinal damage, and must be shielded from direct exposure to the eyes.

C. When designing tissue culture rooms where UV light will be used area-wide, there are two methods to use:

1. Use a standard light fixture with UV bulbs. Place a sign outside the door warning of UV light hazards along with a light switch with red pilot light showing energized status. Provide a lockable cover similar to a thermostat lockable cover for the switch. Doors shall not have vision panels or have the vision panel painted so UV light cannot escape the room.

2. Special louvered UV lights can be purchased which protect occupants working in the room. However, any person working on a ladder will not be protected. Special warning signs are required to protect maintenance personnel from accidental exposure while working at ceiling height.

1.12 Power Factor correction to 0.95 required for all added electric loads over 1 MW.

END OF SECTION
SECTION 260500
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Provisions established within the Conditions of the Contract and Division 1, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 WORK INCLUDED
A. Hinged cover enclosures and cabinets
B. Contactors
C. Control relays
D. Push buttons, and selector switches
E. Terminal blocks and accessories
F. Penetration sealing systems (fire stops)
G. Electrical/control portion of HVAC work covered by Division 23 pertaining to basic electrical materials and methods shall follow the requirement set forth by this specification.

1.3 APPLICABLE CODES AND STANDARDS
A. NFPA 70, National Electrical Code (latest edition)
C. Applicable publications of NEMA, ANSI, IEEE, and ICEA
D. Underwriters Laboratories, Inc. Standards (UL)
E. Federal, city, state, and local codes and regulations having jurisdiction
F. OSHA requirements
G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
H. NEMA WD 1 – General-Purpose Wiring Devices
I. UL 98 - Enclosed Switches

1.4 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. 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. The Contractor shall review the Drawings and specifications for clarification of his responsibility in the handling and installation of equipment and material. 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. All materials and equipment shall be of types and manufacturer specified wherever practical. 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. 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.

1.5 SUBMITTALS
A. Provide submittals in addition and in accordance with Section 260000, 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.

1.6 DELIVERY, STORAGE AND HANDLING
A. Provide factory-wrapped waterproof flexible barrier material for covering materials, where applicable, to protect against physical damage in transit. 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 260500-1. Exceptions shall be specifically designated on the Drawings.

<table>
<thead>
<tr>
<th>Location</th>
<th>Environment</th>
<th>Enclosure Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indoor Utility</td>
<td>Dry, subject to dust, falling dirt and dripping non-corrosive liquids</td>
<td>NEMA 12</td>
</tr>
<tr>
<td>Indoor</td>
<td>Clean, Dry</td>
<td>NEMA 1</td>
</tr>
<tr>
<td>Outdoor</td>
<td>Subject to windblown dust and rain, splashing water, and hose-directed water</td>
<td>NEMA 4</td>
</tr>
<tr>
<td>Indoor</td>
<td>Wet, subject to hose-directed water</td>
<td>NEMA 4</td>
</tr>
<tr>
<td>Outdoor</td>
<td>Subject to falling rain, sleet, and external ice formation</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>Indoor or Outdoor</td>
<td>Subject to corrosion, windblown dust and rain, splashing water and hose-directed water</td>
<td>NEMA 4X</td>
</tr>
</tbody>
</table>

B. Enclosures shall have the following properties:
      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. 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: Where indicated, provide 115V single-phase fan motor, filtered with air plenum, finger guard, and stainless steel grille. Washable aluminum filter, accessible for cleaning from outside the enclosure; 20,000-hour continuous operation without lubrication or service. Provide matching exhaust grille assembly. Mount fan in lower side corner, exhaust grille in opposite upper side corner.

2.2 CONTACTORS
A. Acceptable Manufacturers
   1. General Electric Company
   2. Square D Company
   3. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 260000 and Division 01 for substitution requirement.
B. Contactors: NEMA ICS 2; electrically held or mechanically held as indicated on Drawings. 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: Provide when indicated on Drawings. Minimum capacity shall be 100 VA. 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. General Electric Type CR120A
2. Cutler-Hammer Type M-300
3. Square D Company
4. Allen-Bradley
5. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 260000 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 0.2 to 60 seconds (minimum) or with range as indicated. 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 PUSH BUTTONS, AND SELECTOR SWITCHES

A. Acceptable Manufacturers

1. Allen-Bradley
2. Square D
3. Cutler Hammer
4. Siemens
5. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 260000 and Division 01 for substitution requirement.

B. For non-hazardous, indoor, dry locations, including control panels, and individual stations, provide heavy duty, NEMA 13, oil tight type pushbuttons, indicating lights, selector switches, and stations for these devices.

C. For non-hazardous, outdoor, or normally wet locations, or where otherwise indicated, provide heavy duty corrosion resistant, NEMA 4, watertight type pushbuttons, indicating lights, or selector switches mounted in NEMA 4 watertight enclosures. Provide special gasketing required to make complete station watertight.

D. For hazardous locations, provide control station listed by UL for Class I, Divisions 01 and 02, Groups C and D; Class II, Division 01 and 02, Groups E, F, and G. Specific type shall be in accordance with area classification as indicated on the Drawings.

E. For corrosive locations, provide nonmetallic components and enclosures meeting NEMA Type 4X.

F. Provide devices meeting the requirements of NEMA ICS 2, and having individual, extra large nameplates indicating their specific function. Provide push-button stations with laminated plastic nameplates indicating the drive they control. Provide contacts with NEMA designation rating A600. Install provisions for locking pushbuttons and selector switches in the OFF position wherever lockout provisions are indicated. Nameplates shall be as specified in Section 260553.

G. Utilize selector switches having standard operating levers. All indicating lights shall be LED type, push-to-test type. Provide ON or START pushbuttons colored black. Provide OFF or STOP pushbuttons colored red.

2.5 TERMINAL BLOCKS AND ACCESSORIES

A. Signal And Control Terminals

1. Acceptable Manufacturers

   a. Phoenix Contact
   b. Buchanan
   c. Weidmüller
   d. Entrelec
   e. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 230000 and Division 01 for substitution requirement.

2. Signal and Control Terminals: Modular construction type, DIN 46 277/3 channel mounted; screw clamp compression connectors, rated 300 volts. Minimum terminal width of 0.24 inch, capable of
holding two No. 12 or two No. 14 AWG conductors in each connector. Terminal identification numbers shall be thermoset characters (black) on a white background. Provide 25 percent spare terminals.

B. Power Terminals
1. Acceptable Manufacturers
   a. Buchanan
   b. Ilsco
   c. Square D Company
   d. Burndy
   e. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 260000 and Division 01 for substitution requirement.

2. Power Terminals: Unit construction type, closed back type, with tubular pressure screw connectors, rated 600 volts, size as required. Provide 25 percent spare terminals.

2.6 PENETRATION SEALING SYSTEMS (FIRE STOPS)
A. Provide penetration sealing where conduit, cable tray, etc. pass through rated walls, ceilings, and floors. See Section 078413, Fire Stopping, and Section 078446, Joint Sealants, for sealing requirements and systems.

2.7 UL LISTING
A. All equipment and materials shall be new and conform to the requirements of this Section. All equipment and materials shall be UL listed, and shall bear their label whenever standards have been established and level service is regularly furnished. 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 assembles 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. Direct attachment to dry wall is not permitted.
B. Provide accessory feet for freestanding equipment enclosures.
C. Install trim plumb.

3.3 ERECTION OF EQUIPMENT
A. Manufacturer’s Installation Instructions: 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. 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 0 inches (to top).
   2. Pushbuttons:  4 feet 0 inches (to center).
   3. Control Panels: 6 feet 0 inches (to top).
C. Mounting: Equipment and control devices shall be supported independent of conduit connections. Panels or cabinets shall be mounted on metal frame supports independently of equipment. Control devices and metal enclosures shall be bolted or welded to steel channel or steel plate. 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. 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
SECTION 260501

ELECTRICAL DEMOLITION

PART 1 – GENERAL

1.1 WORK INCLUDED
A. Electrical demolition for remodeling.

1.2 RELATED WORK
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 260000 - 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.

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. Provide temporary wiring and connections to maintain existing systems in service during construction.
B. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain written permission from Owner at least (2) weeks before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.
C. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Obtain written permission from Owner at least (2) weeks before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.
D. Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain written permission from
Owner at least (2) weeks before partially or completely disabling system. Minimize outage duration. 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. Cut embedded or concealed conduit flush with walls and floors, and patch surfaces.
D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
E. Disconnect and remove abandoned panelboards and distribution equipment.
F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
G. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
H. Repair adjacent construction and finishes damaged during demolition and extension work.
I. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
J. 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: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
C. Luminaries Indicated to be Reused: Remove existing luminaries for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. 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. Deliver those materials that the Owner desires to the Owner’s specified location.
B. For those materials not required by the Owner, dispose of them in accordance with applicable regulations.

END OF SECTION
SECTION 260519
BUILDING WIRE, CABLE AND CONNECTORS (600 VOLTS AND BELOW)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Provisions established within the Conditions of the Contract and Division 01, the remaining Sections of the Specifications, and the Contract Drawings are collectively applicable to this Section.

1.2 REFERENCES
   B. NEC - National Electrical Code.
   D. UL - Underwriters Laboratories, Inc.
   E. NEMA WC 3 - Rubber-Insulated wire and Cable for the Transmission and Distribution of Electrical Energy.
   F. NEMA WC 5 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

1.3 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.

1.4 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years experience.

1.5 REGULATORY REQUIREMENTS
   A. Conform to requirements of ANSI/NFPA 70.
   B. Furnish products listed by UL as suitable for purpose specified and shown.

1.6 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.

1.7 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 Co.
   2. American Insulated Wire Corp.
   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: ANSI/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. In the case of “home runs” over 50’ in length (100’ for 277 volt) no conductor smaller than a No. 10 wire shall be used. 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.
   1. 480 Volt Branch Circuits: The voltage drop in the case of 480/277 volt circuits shall not exceed 1.0% at maximum load and 70.0% power factor.
   2. 208/120 Volt Branch Circuits: The voltage drop in the case of 208/120 volt circuits shall not exceed 2.0% at maximum load and 70.0% 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 Wire-Nut model 71-B through 76-B.

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. 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. 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. 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. 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. 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. Except as otherwise shown on Drawings, no more than three conductors may be run in parallel, and they shall be so arranged and terminated as to insure equal division of...
the total current between all conductors involved. 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. 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. 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.

<table>
<thead>
<tr>
<th>208/120V</th>
<th>480/277V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase A</td>
<td>Black</td>
</tr>
<tr>
<td>Phase B</td>
<td>Red</td>
</tr>
<tr>
<td>Phase C</td>
<td>Blue</td>
</tr>
<tr>
<td>Neutral</td>
<td>White</td>
</tr>
<tr>
<td>Ground</td>
<td>Green</td>
</tr>
<tr>
<td>Isolated ground</td>
<td>Green/yellow</td>
</tr>
</tbody>
</table>

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
SECTION 260524
TEMPERATURE CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

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.

B. Refer to Division 23 of these Drawings and Specifications for information as to the scope of this work.

1.2 REFERENCE DOCUMENTS

A. The Basic Electrical Requirements are hereby made a part of this section of the work. Refer to Section 260000.

B. Refer to Division 23 for work and materials.

C. Refer to Sections 260533 Series for materials to be furnished and installed.

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 also all instructions and wiring diagrams necessary to select the materials required to install this equipment properly.

END OF SECTION
SECTION 260526
GROUNDING

PART 1 - GENERAL

1.1 WORK INCLUDED
A. Power system grounding
B. Communication system grounding
C. Electrical equipment and raceway grounding and bonding

1.2 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. 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. Bond both ends of metallic conduit.
C. Ground Rods shall be copper-encased steel, 3/4" diameter, minimum length 10 feet.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Install ground system as indicated, in accordance with the applicable requirements of the National Electrical Code and the National Electrical Contractors Association's "Standard of Installation".
B. Install grounding conductors continuous, without splice or connection, between equipment and grounding electrodes. 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. Terminate each end on a grounding lug, bus, or bushing.
D. Connect grounding electrode conductors to metal water pipe using suitable ground clamp. Make connections to flanged piping at street side of flange. Provide bonding jumper around water meter.
E. Install Fusion Welded ground connectors where they are concealed or inaccessible.

F. Ground each outlet by the use of an approved grounding pig tail attached to the junction box.

G. No strap grounding clamps shall be used; connections requiring bolting shall be made up with Monel metal bolts, washers and nuts. Connections shall be made only after surfaces have been cleaned, or ground to expose virgin metal.

H. Install external ground wire on liquid tight flexible metal conduit with grounding bushings in addition to the internal equipment grounding conductor. Connectors shall have a factory external lug and be listed.

I. Conductor connections shall be made by means of solderless connectors such as serrated bolted clamps or split bolt and nut type connectors.

J. The neutral of each transformer shall be bonded to system ground at one point only. This point shall be ahead of the first secondary protective device.

K. Use minimum 6 AWG copper conductor for communications service grounding conductor. Leave 10 feet slack conductor at cabinet.

L. Where required, provide grounding and bonding at Utility Company's metering equipment in accordance with Utility Company's requirements.

M. Terminate equipment ground conductor at disconnects and other electrical equipment using a factory equipment ground bar. Field installed lugs are not acceptable.

N. Provide a UL listed ground bar in all enclosures containing overcurrent protective devices. These ground bars shall be provided by the manufacturer of the equipment and may be field installed. The individual equipment ground bar shall accept at least two conductors. 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.

B. Measure ground resistance from system neutral connection at service entrance to convenient ground reference point using suitable ground testing equipment. Resistance shall not exceed 10 ohms.

END OF SECTION
SECTION 260529

SUPPORTING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install all necessary hangers, supports, bases, and connections for properly installing all electrical equipment and materials.

1.2 REFERENCE DOCUMENTS

A. The Basic Electrical Requirements are hereby made a part of this section of the work. Refer to Section 260000.

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. Pipe straps for EMT may be plated stamped steel.

C. Rod hangers shall be rust inhibited and selected for weight supported but shall not be smaller than No. 8. Rod hangers for conduits shall be with bolted fastening equal to Minerallac conduit hangers.

D. “Caddy Clips” are not allowed.

E. 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.

F. Supports of vertical runs of conduit of more than 12'-0" shall be galvanized U-bolts or Kindorf C-210 riser pipe clamps on channel iron bearing plates.

G. Supports for panelboards, cabinets, terminal boards, junction and pull boxes shall be angle iron or framing channel equal to B-Line B22 galvanized.

H. 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.

I. 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.

J. Supports on roofs shall be Miro Industries Model 02 for conduits 2" and smaller and Model 24-R for larger conduits, each fastened to the roof.

K. Concrete pads shall provide support for floor mounted electrical equipment.
L. Non-ferrous magnetic material shall be used in magnet areas such as: fiberglass, aluminum, copper, or stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. 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. Use materials specified hereinbefore. Cable, strap, or wire hangers or fasteners shall not be used.

B. Maintain horizontal and vertical alignment of raceways and to not adversely effect the building structure in strength or appearance.

3.2 CONDUIT SUPPORTS

A. Support conduits within 3' 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. Support vertical run conduits at not more than 10'-0" on center in addition to the above. 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" long at 36" on center and such that flexible conduit does not rest on any equipment, pipes, ductwork, walls, floors, or ceilings.

3.3 EQUIPMENT

A. Support cabinets and boxes to the floor and to the structure above independent of all raceways entering the boxes. Structural walls or columns may be used to support cabinets or boxes only after specific permission is given by the Architect.

B. 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. Plywood backboards of 3/4" thickness and BC grade painted to match the equipment finish may be used as a part of the rack. Plywood shall be fire retardant/rated.

C. Support outlet boxes and junction boxes 100 cubic inches and smaller independently from but equal to supports specified for raceways. 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.

D. Arrange that all supports for boxes, devices, cabinets or equipment that are flush mounted to be concealed behind the walls or ceiling where mounted.

E. Provide concrete bases for all floor mounted equipment such as switchboards and floor mounted transformers to aid in housekeeping and to provide that the equipment has a flat and level surface on which to be mounted and anchored. Concrete work shall conform to the requirements for finished concrete work indicated under other Divisions of Work. Unless indicated otherwise, bases shall be reinforced concrete with No. 4 bars 9" o.c. each way and 1-1/2" minimum cover; be 3-1/2" high above finished floors; be 6" high above other finished grades; protrude 3" beyond all sides of the equipment mounted thereon; have exposed corners chamfered; and have exposed portions rub finished.

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. 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. 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. Supports shall be job rust inhibited at all cuts, breaks, welds, or other points where rust inhibitor coating is broken.

END OF SECTION
SECTION 260533
CONDUITS AND BOXES

PART I - GENERAL

1.1 WORK INCLUDED

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
   5. Liquid-tight flexible metal conduit and fittings
   6. Non-metallic conduit and fittings

B. Boxes:
   1. Wall and ceiling outlet boxes
   2. Pull and junction boxes

1.2 REFERENCES

A. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated
B. ANSI/NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies
C. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing
D. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports
E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

1.3 SUBMITTALS

A. Submit manufacturer’s product data floor boxes, outlet boxes, surface metal raceways, multi-outlet assemblies and wireways

1.4 STORAGE AND HANDLING

A. Handle raceways carefully to avoid damage, breaking, denting and scoring. 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 on this project shall include the following:
   1. Service entrance
   2. Electrical power and lighting feeders
   3. Electrical power and lighting circuits
   4. Telephone systems
   5. Control systems (other than HVAC)
   6. Fire alarm and signaling systems
   7. CCTV rough-in system
8. 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. Conduit fittings, including flexible, shall have insulated throats or bushings. Rigid conduits shall have insulated bushings, unless grounding bushings are required by NEC Article 250-92. Grounding bushings shall have insulated throats.

D. Rigid and intermediate metal conduit shall be hot-dipped galvanized. Fittings shall be threaded type. Expansion fittings shall be OZ Type DX.

E. Electrical metallic tubing shall be galvanized. Fittings shall be all steel compression type. Expansion fittings shall be OZ Type TX.

F. Flexible metal conduit shall be heavy-duty zinc-coated steel. Fittings shall be heavy-duty zinc-coated malleable steel. Flexible metal conduit fittings shall have external grounding lugs for installations other than lighting whips. Provide an external bonding conductor connected to both flexible connectors.

G. Liquid-tight flexible conduit and fittings shall consist of single strip, continuous, flexible interlocked, double-wrapped steel, galvanized inside and outside, forming smooth internal wiring channel with liquid-tight covering of flexible polyvinyl chloride (PVC).

H. Liquid-tight flexible conduit fittings shall be heavy-duty zinc-coated steel with external factory ground lugs. Provide an external bonding conductor connected to both liquid-tight flexible connectors.

I. Nonmetallic conduit and fittings shall be suitable for temperature rating of conductor but not less than 90°C.

J. Crimp or set-screw type fittings are not acceptable.

K. Minimum conduit size shall be 3/4”, except for:
   1. 1/2" flexible metallic conduit may be used as fixture whips
   2. 1/2" EMT conduit may be used for individual drops to outlets with one #12 AWG circuit. Each box shall have a separate drop.
   3. 1/2" EMT conduit may be used for individual drops to lighting switches with four maximum #12 AWG current carrying conductors. Each box shall have a separate drop.
   4. 1/2" EMT conduit may be used for individual drops to low voltage thermostats and similar HVAC controls. Each box shall have a separate drop.

L. MC conduit is allowed in non-visible areas and must be bundled and supported per code. MC cable is allowed for whips to light fixtures but shall not be daisy chained from fixture to fixture.

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. The following exceptions permitted:

1. EMT
   a. In sizes up to and including 4", may be used inside dry locations where not subject to mechanical damage. EMT may be used in air conditioned spaces, such as accessible ceilings, dry wall partitions and exposed where 6' above the floor. 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' of the floor. 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. PVC
   a. Install PVC conduit directly buried in earth or where subject to corrosive environment.
   b. Schedule 40 where direct buried.
   c. Schedule 80 where exposed, size adjusted to have same fill area as if Schedule 40 were used, and where used underground outside building lines.
   d. Type EB, Utility Duct, encased in concrete and Type DB for direct burial designed for use of 90° wire where specifically shown on plans.

3. Liquid-tight
   a. Install liquid-tight flexible metal conduit for connections to rotating, vibrating, moving or movable equipment, including dry-type transformers. Install external equipment ground wire on flexible conduit with grounding bushings. Maximum length shall be 6'-0" minimum of 3'-0".

4. Flexible Metal Conduit
   a. Install standard flexible metal conduit (not liquid-tight) with internal ground wire, in spaces above ceilings. Install flexible conduit connection such that vibration is not transmitted to adjoining
conduit or building structure. Maximum length shall be 6'-0" minimum of 3'-0", minimum size shall be 3/4" except for lay-in light fixtures where it may be 1/2".

5. Each wall box shall have a separate drop extending up to accessible ceiling. 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. Wire ties are not permitted. 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. 4" x 4" penta-treated pine installed in pitch pans on roof, spaced at intervals not to exceed 5'-0"

E. Install conduits outside of building lines at a minimum depth of 30 inches below finished grade. Maintain twelve inches earth or two inches concrete separation between electrical conduits and other services or utilities underground. Encase all plastic service entrance conduits with concrete; otherwise, concrete encasement shall not be required except as specifically detailed or noted on the drawings. Rigid conduit shall be PVC coated for stub ups above grade.

F. Ducts in concrete encased ductbanks shall be independently supported by interlocking module spacers by Formex or equal. Spacers shall provide 3" separation between adjacent ducts. Spacers shall be installed at 6' maximum intervals.

G. Ducts in concrete encased ductbanks shall be terminated in manholes, pull boxes, and vaults with interlocking terminators by Formex or equal. A watertight tapered plug shall be furnished and installed in unused duct openings. Where terminators are installed in new work, they shall be poured-in-place.

H. Install underground conduits with sealing glands equal to OZ Type FSK exterior to the conduit and OZ type CSB, or equal internally at the point where conduits enter the building to prevent water seepage into the building.

I. Metal conduit fittings shall be approved for grounding purposes or shall be jumpered with copper grounding conductors of appropriate ampacity. Leave termination of such jumpers exposed.

J. 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
      d. PVC all sizes
   2. Conduit Straight Runs in Excess of 100 Feet:
      a. EMT all sizes
      b. IMC all sizes
      c. RMC all sizes
      d. PVC all sizes
   3. Conduits entering environmental rooms and other locations subject to thermal expansion and as required by NEC.
   4. 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. Both ends of this green grounding conductor shall be accessible for inspection.

K. Expansion fittings are not required where offsets, expansion loops, or flexible conduit are placed in conduit runs.
L. Install conduit concealed in walls, partitions and above ceilings. Install conduit exposed in ceiling area (at structure) of boiler rooms, mechanical rooms and in other similar rooms where ceilings are not called for. Install conduit concealed in slab when finished areas below do not have ceiling.

M. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.

N. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.

O. Provide 200 lb. nylon cord in empty conduit.

P. 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 - WIREWAYS

A. Bolt wireways to steel channels fastened to the wall or in self-supporting structure. Install level.

B. Gasket each joint in oil-tight wireway.

C. Mount raintight wireway in horizontal position only.

3.4 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. 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. Provide a minimum 6-inch separation. 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. Boxes shall not be permitted to move laterally. Boxes shall be secured between two studs. 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" 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.

P. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.

Q. Outlet boxes supporting fixtures shall be securely anchored in place in an approved manner. 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. Lighting fixture outlets shall be coordinated with mechanical and architectural equipment and elements to eliminate conflicts and provide a workable neat installation.

R. Set floor boxes level and flush with finish flooring material.

S. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.

T. Support pull and junction boxes independent of conduit.

U. For each outlet box containing a lighting switch or controller, provide a neutral for each circuit contained.

V. Cut-In Switch Box Installation by UTSWMC 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.
   2. Sectional switch boxes shall be allowed for minor work performed by UTSWMC Shop personnel.
   3. Switch boxes shall be three (3) inches deep minimum with ears.
   4. Switch boxes shall be secured to the wall using two "sheet rock clamps".
   5. Conduit drops may be 1/2" flexible conduit with equipment ground conductor.
   6. Provide one (1) drop for each box.
   7. Switch boxes shall not be ganged.
   8. Switch boxes shall be tight in cut hole without any "wobble."
   9. Cut in switch boxes shall not be allowed unless explicit notes are on construction documents.

W. 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 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.

3. Switch boxes shall be three (3) inches deep minimum with ears.

4. Switch boxes shall be secured to the wall using two “sheet rock clamps”.

5. Conduit drops may be 1/2” flexible conduit with equipment ground conductor.

6. Provide one (1) drop for each box.

7. Switch boxes shall not be ganged.

8. Switch boxes shall be tight in cut hole without any “wobble.”

9. Conduit may be 1/2” flexible conduit with equipment ground conductor.

10. Cut in switch boxes shall not be allowed unless explicit notes are on construction documents.

END OF SECTION
SECTION 260553

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

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. Buried cable warnings.
   2. Conductor color coding.
   3. Operational instructions and warnings.
   4. Danger signs.
   5. Equipment/system identification signs.

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. Plastic laminate shall be 1/16” thick up to 20 sq. in. and 1/8” for larger size. Letters shall be 1/2” high, black on white background.
   1. 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” wide x 4 mils thick. 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.

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. Comply with governing regulations and the requests of governing authorities for the identification of electrical work.

3.2 UNDERGROUND CABLE IDENTIFICATION

A. During backfilling/top-soiling of each exterior underground electrical and communication or duct bank conduit, install a continuous underground-type plastic line marker, located directly over the buried conduit at 6” to 8” below finished grade.

B. Install a single line marker where multiple small conduits are buried in a common trench and do not exceed an overall width of 16”.
C. Install line marker for every buried conduit.

3.3 CONDUCTOR COLOR CODING

A. Conductors #10 and Smaller: Insulation continuously colored throughout.

B. Conductors Larger than #10: Three continuous wraps of 1/2” wide 3M #191 tape at each end and at pull and junction boxes.

C. 208/120 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. 480/277 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.

3.4 DANGER SIGNS

A. Install danger signs required by governing regulations and authorities.

B. Install appropriate danger signs at locations of electrical work constituting similar dangers for persons in or about the project.

C. Install danger signs on switches and similar controls, regardless of whether concealed or locked up, where untimely or inadvertent operation (by anyone) could result in significant danger to persons, or damage to or loss of property.

3.5 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. Stick-on decals for field installation are not acceptable.
5. Each dry type transformer -- directly above nameplate and connection diagram.
6. Each safety switch -- on outside of cover.
7. Each relay cabinet -- on outside of cover.
8. Each exhaust fan switch -- custom engraved on outside of switch cover plate (high and low if required).
9. Each motor starter -- on outside of cover.
10. Outside light switches - custom engraved on outside of switch cover plate.
11. Switch for load that cannot be seen from the control point -- custom engraved on outside of switch cover plate.

B. Nameplates shall be securely attached with an approved mechanical fastener. Adhesive attachment shall not be permitted.

3.6 PAINTING

A. J-boxes shall be painted as follows:
   1. Emergency system - yellow.
   2. Fire alarm system - red.

3.7 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. 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” high, clear tape, and black lettering.

END OF SECTION
SECTION 262726
WIRING DEVICES AND FLOOR BOXES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Wiring Devices:
   1. Wall switches
   2. Receptacles
   3. Device plates and box covers
   4. Wall dimmers
   5. Floor mounted service fittings
   6. Occupancy sensors

B. Floor boxes

1.2 REFERENCES

A. NEMA WE1 – General-Purpose Wiring Devices
B. NEMA WD2 – Semiconductor Dimmers for Incandescent Lamps
C. NEMA WD5 – Specific-Purpose Wiring Devices

1.3 SUBMITTALS

A. Submit manufacturer’s product data for wiring devices and floor boxes

1.4 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. Where type and grade are not indicated, provide proper selection to correspond with branch circuit wiring and overcurrent protection. Attachment of wires to devices shall be by screw pressure under the head of binding screws. Arrangements depending on spring pressure or tension are not acceptable. All binding screws shall be brass or bronze.

2.2 ACCEPTABLE MANUFACTURERS - WALL SWITCHES

A. Bryan 5362
B. Hubbell
C. Leviton
D. Other manufacturers equal in design and function will be considered upon submittal of manufacturer's data.

2.3 WALL SWITCHES

A. Wall switches for lighting circuits and motor loads under 1/3 hp shall be AC general use snap switch with toggle handle, Ivory, 20 amperes and 120/277 volt AC with number of poles as required, equal to Arrow-Hart #1991.

B. Key operated switches shall be Gray, 20 amperes and 120/277 volt AC with number of poles as required, equal to Arrow-Hart #1991L. Furnish key equal to Arrow-Hart #2000.

C. Horsepower rated switch shall be 30 ampere, equal to Arrow-Hart #3999I (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. 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.

2.5 RECEPTACLES

A. Convenience duplex receptacles shall be Ivory, 20 amperes and 125 volt AC, equal to Arrow-Hart #5352I.

B. Dedicated circuit duplex receptacles shall be Ivory, 20 amperes, 125 volt AC, equal to Arrow-Hart #5352I.

C. GFCI receptacles shall be ivory 20 amperes, 120 volt with integral ground fault current interrupter, equal to Arrow-Hart #GF5342I. Do not use feed through feature.

D. Heat tape receptacles shall be Arrow-Hart #5262CRGRY with Crouse Hinds #WLRD-1 cover. Install round plug on heat tape cord to match weatherproof bushing on receptacle cover for watertight installation.

E. Specific-use receptacles shall have volts, amps, poles and NEMA configuration as noted on drawings.

F. Corridor receptacles shall be Hospital grade; Arrow-Hart #8200I.

G. Duplex and GFCI receptacles installed in wiremold type wire way shall be Decora type and gray.

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” thick, color ivory equal to Arrow-Hart #72071 Series with cutouts required for devices indicated on drawings. 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.
B. Telephone, computer and CCTV wall plates, single 5/8” hole equal to Arrow-Hart #71181 Series.
C. Jumbo plates are not permitted.
E. Weatherproof cover plate shall be gasketed cast aluminum or feraloy (by Crouse-Hinds) with hinged gasketed device covers.
F. Isolated ground wall plate shall be silk screened "ISOLATED GROUND".

2.8 ACCEPTABLE MANUFACTURERS - FLOOR MOUNTED SERVICE FITTINGS
A. Steel City
B. Walker
C. Wiremold
D. Other manufacturers equal in design and function will be considered upon submittal of manufacturer's data.

2.9 FLOOR MOUNTED SERVICE FITTINGS AND BOXES
A. Surface-type service fitting for convenience receptacle shall be brushed aluminum equal to Steel City #SFH-40-RG.
B. Flush covers for duplex convenience receptacles shall be brass with two hinged lift lids equal to Steel City #P-64-DS. Provide brass carpet plate where carpeting is installed.
C. Floor boxes for surface-type service fittings shall be cast iron, fully adjustable, watertight and concrete tight, equal to Steel City #602.

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. 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. These drawings, however, may not give complete and accurate information in regard to locations of such items. 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" and not more than 12" 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. Install floor boxes level and flush with finish flooring material.

END OF SECTION
SECTION 265100
LIGHTING FIXTURES

PART 1 - GENERAL

1. WORK INCLUDED

A. Interior lighting fixtures.
B. Exterior lighting fixtures.
C. Emergency lighting units.
D. Emergency exit signs.
E. Emergency fluorescent lamp power supplies.
F. Lamps.
G. Ballasts.

1.2 REFERENCES

B. NEMA WD1 - General-Purpose Wiring Devices.
C. ANSI C78.377 LED Standards.
D. ANSI C82.1 - Specification for Fluorescent Lamp Ballasts.
E. ANSI C82.4 - Specifications for High-Intensity-Discharge Lamp Ballasts (Multiple Supply Type).
F. NEMA LE - HID Lighting System Noise Criterion (LS-NC) Ratings.

1.3 SUBMITTALS

A. Submit manufacturer's data on interior and exterior lighting fixtures in booklet form, with separate sheet for each fixture, assembled by luminaire "type" in alphabetical order, with the proposed fixture and accessories clearly labeled. Ballast and lamp product data shall accompany fixture submittals.
B. Submit dimensioned drawings and performance data including coefficients of utilization, candela distribution, spacing to mounting height ration, efficiency and visual comfort probability.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver lighting fixtures individually wrapped in factory-fabricated fiberboard type containers. Parabolic louvers shall be shipped in thermally sealed polyethylene wrapper.
B. Handle lighting fixtures carefully to prevent breakage, denting and scoring the fixture finish. Do not install damaged lighting fixtures.
C. Store lighting fixtures in a clean, dry space and protected from the weather.

PART 2 - PRODUCTS

2.1 GENERAL
A. Lighting fixtures and accessories shall comply with the design and function requirements of the project. Design characteristics shall be as noted in manufacturer's submittal data.

B. Provide lighting fixtures of the size, type and rating as scheduled, complete with, but not limited to, lamps, lampholders, reflectors, ballasts, poles and wiring.

2.2 INTERIOR LIGHTING FIXTURES

A. Fluorescent and LED Fixtures:
   1. Lenses shall be 0.125 inch thick virgin acrylic. Provide a minimum of 8 hold-down lens retaining clips for troffers utilizing framed diffuser lenses.
   2. Parabolic louvers shall be semi-specular silver anodized aluminum, 3 inches deep.
   3. Frames shall be flush, steel hinged and equipped with rotary-action cam latches.

B. Incandescent fixtures shall be prewired equipped with integral thermal protection.

2.3 EXTERIOR LIGHTING FIXTURES

A. Enclosures shall be complete with gaskets to form weatherproof seal and UL approved for wet locations.

B. Provide low temperature ballasts with reliable starting to 0 degrees F.

2.4 ACCEPTABLE MANUFACTURERS - EMERGENCY LIGHTING UNITS

A. Dual Lite.

B. Lithonia.

C. Williams.

D. Other manufacturers of emergency lighting units equal in design and function will be considered upon submittal of manufacturer's data.

2.5 EMERGENCY LIGHTING UNITS

A. Provide emergency lighting units self-contained complete with batteries, charger, and lamps to provide automatic emergency lighting upon failure of normal power.

B. Battery shall be 12 volts, maintenance free, lead calcium type, with 1.5 hours minimum capacity to supply the connected lamp load.

C. Charger shall be solid state capable of maintaining the battery fully charged during normal conditions, and capable of recharging discharged battery to full charged within 12 hours.

D. Lamps shall be 12 watt minimum, sealed beam Tungsten Halogen type.

E. Unit housing shall be steel with beige finish.

F. Indicators: Provide lamps to indicate AC ON and RECHARGING.

G. Provide switch to manually transfer unit from normal supply to battery supply.

H. Unit shall be 277 volt or as indicated on plans.

2.6 ACCEPTABLE MANUFACTURERS - EMERGENCY EXIT SIGNS
A. Dual Lite  
B. Lithonia  
C. Williams  
D. Other manufacturers of emergency exit signs equal in design and function will be considered upon submittal of manufacturer's data.

2.7 EMERGENCY EXIT SIGNS

A. Provide exit signs with integral battery-operated emergency power supply, including power failure relay, test switch, AC ON pilot light, battery, and fully-automatic charger.  
B. Battery shall be maintenance free lead calcium 4 to 6 volts with 1.5 hour minimum capacity to supply connected lamp load.  
C. Exit signs shall have stencil face, 6 inch high red letters on white background directional arrows as indicated.

2.8 ACCEPTANCE MANUFACTURERS - EMERGENCY FLUORESCENT LAMP POWER SUPPLY

A. Lithonia  
B. Chloride  
C. Williams  
D. Other manufacturers equal in design and function will be considered upon submittal of manufacturer's data.

2.9 EMERGENCY FLUORESCENT LAMP POWER SUPPLY

A. Unit shall be self-contained, including test switch, AC ON pilot light, fully-automatic charger and battery, capable of operating one 32 watt, T8 lamp with a minimum output of 1200 lumens for 1.5 hours.  
B. Battery shall be maintenance free lead calcium, 4 to 6 volts.

2.10 ACCEPTABLE MANUFACTURERS - LAMPS

A. General Electric Company  
B. Philip Lighting Company  
C. Sylvania  
D. Other manufacturers of lamps equal in design and function will be considered upon submittal of manufacturer's data.

2.11 LAMPS

A. General use incandescent lamps shall be inside frosted type, 120 volts, extended service lamps, 2500 hour minimum.
2.12 ACCEPTABLE MANUFACTURERS - BALLASTS

A. Valmont
B. Advance
C. Magnetek
D. Other manufacturers of ballasts equal in design and function will be considered upon submittal of manufacturer's data.

2.13 BALLASTS

A. Fluorescent ballast shall be electronic high efficiency program start equal to Advance Optanium, rapid start, 430 MA: Class 'P', Sound Rating A, thermal protected, non-resetting, HPF, CBM, ETL.
B. Fluorescent ballasts for dimming applications shall be the electronic type, as recommended by the dimmer manufacturer.
C. HID ballast shall be of the constant wattage autotransformer type for mercury vapor lamps, lead-peak autotransformer type for metal halide lamps and regulating type for high pressure sodium lamps. Ballast shall start and operate the lamp at ambient temperatures ranging from minus 20°F to 105°F. All ballasts shall be encased and potted and shall have automatic thermal protection, and high power factor, minimum of 90%.

PART 3 - EXECUTION

3.1 INSPECTION

A. Installer shall examine the areas and conditions which light fixtures 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 LIGHTING FIXTURES

A. Install light fixtures in accordance with the manufacturer's written instructions, the applicable requirements of NEC and the National Electrical Contractors Association's "Standard of Installation".
B. If a fixture type designation is omitted, furnish fixture of the same type as shown for rooms of similar usage. Verify with Construction Inspector before purchase and installation.
C. Check the building electrical system requirements and architectural finishes, and regardless of the catalog number prefixes and suffixes shown, furnish fixtures with the proper trim, frames, supports, hangers,
ballasts, voltage rating, and other miscellaneous appurtenances to properly coordinate with said conditions. Verify with Construction Inspector prior to ordering.

D. Check the type of ceilings to be installed in each room and verify that the recessed light fixtures are proper for the type of ceiling to be installed before ordering fixtures.

E. Fasten fixtures securely to structural support members of the building; solid pendant fixtures shall be plumb.

F. Immediately before final observation, clean all fixtures, inside and out, including plastics and glassware, and adjust all trim to properly fit adjacent surface, replace broken or damaged parts, and lamp and test all fixtures for electrical as well as mechanical operation.

G. Protect installed fixtures from damage during the remainder of the construction period.

H. Upon completion of installation of interior lighting fixtures, and after circuitry has been energized; apply electrical energy to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

I. Incandescent lamps shall be new at time of final acceptance.

J. Fluorescent lamps may be used in the final finishing of the building. Those that have exceeded more than 1/3 of their rated life (as established by Construction Inspector records), or that have blackened ends shall be replaced with new lamps before final acceptance.

3.3 LIGHT FIXTURE SCHEDULE

A. Refer to Drawings for Light Fixture Schedule.

END OF SECTION
SECTION 270500
COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Sections. Not limited to:
1. Section 270526 - Grounding and Bonding for Communications Systems
2. Section 270528.15 - Floorboxes and Poke-thrus
3. Section 270528.19 - Zone boxes
4. Section 270528.29 - Hangers and Supports for Communications Systems
5. Section 270528.33 - Conduits and Backboxes Boxes for Communications Systems
6. Section 270528.36 - Cable Trays for Communications Systems
7. Section 270553 - Identification for Communications Systems
8. Section 270700 - Communications Testing
9. Section 271100 - Communications Room Fit-out
10. Section 271113 - Communications Entrance Protection
11. Section 271116 - Communications Cabinets, Racks, Frames and Enclosures
12. Section 271119 - Communications Termination Blocks and Patch Panels
13. Section 271123 - Communications Cable Management and Ladder Rack
14. Section 271126 - Communications Rack Mounted Power Protection and Power Strips
15. Section 271313 - Communications Copper Backbone Cabling
16. Section 271313.01 - Communications Copper Backbone Cabling, Exterior
17. Section 271313.13 - Communications Copper Cable Splicing and Terminations
18. Section 271323 - Communications Optical Fiber Backbone Cabling
19. Section 271323.13 - Communications Optical Fiber Splicing and Terminations
20. Section 271333 - Communications Coaxial Backbone Cabling
21. Section 271333.13 - Communications Coaxial Splicing and Terminations
22. Section 271343 - Communications Cabling, Exterior Cameras
23. Section 271513 - Communications Copper Horizontal Cabling
24. Section 271533 - Communications Coaxial Horizontal Cabling
25. Section 271543 - Communications Faceplates and Connectors
26. Section 271619 - Communications Patch Cords, Station Cords, and Cross Connect Wire
27. Section 274100 - Common Work Results for Audiovisual Systems & Equipment
28. Section 274113.13 - Front Projection Screens
29. Section 274116 - Integrated Audiovisual Systems and Equipment
30. Section 275113 - Paging Systems
31. Section 275114 - Television Distribution Equipment
32. Section 275223 - Nurse Call
33. Section 275313 - Clock Systems
34. Section 275316 - Wireless RTLS
35. Section 275317 - Wireless Temperature Monitoring System
36. Section 275318 - WLAN AP
37. Section 275319 - Internal Cellular, Paging, and Antenna Systems
38. Section 275320 - Radio system communications

B. Related Requirements: Comply with following:
1. Cutting and Patching: Section 017329 – Cutting and Patching.
2. Firestopping: Section 078400 – Firestopping.

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), IEEE 802.5 (Token Ring), TP-PMD (Copper-based FDDI), 52/155 Mbps ATM (asynchronous transfer mode, and 77 Channel Analog Broadband Video out to 550 MHz.
3. Gigabit Cable Performance: Capable of supporting applications including AES/EBU Digital Audio, 270 Mbps Digital video, IEEE 802.5z (Gigabit Token Ring), 622 Mbps 64-CAP ATM, 1000Base-T Gigabit Ethernet, and 1.2 Gigabit ATM.

D. 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. Acceptable solutions are:
   a. CommScope SYSTIMAX VisiPatch 360 System
3. For Single Mode cable, provide a zero water peak single mode solution
   a. CommScope SYSTIMAX TeraSPEED Solution
4. For multimode cable, provide an OM4 solution
   a. CommScope SYSTIMAX LazrSPEED Solution

E. 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).

F. Related Documents and Sections:
1. Section 002113 - Instructions to Bidders.
2. Section 002213 – Supplementary Instructions to Bidders.
3. Section 007200 - General Conditions.
4. Section 007300 - Supplementary Conditions.
5. Division 1 – General Requirements Sections.

1.2 REFERENCES
A. Reference Standards: See Section 014200 - References. In addition to requirements shown or specified, comply with applicable provisions of following for design, materials, fabrication, and installation of component parts:
1. AASHTO H-20 Load Rating
2. ANSI C80.1 - Specification for Rigid Steel Conduit, Zinc Coated
3. ANSI C80.3 - Electrical Metallic Tubing; Zinc Coated
4. ANSI C80.6 - Intermediate Metal Conduit; Zinc Coated
5. ANSI/NECA/BICSI-568 - Installing Commercial Building Telecommunications Cabling
6. ASTM A48/A48M-00 - Standard Specification for Gray Iron Castings
8. ASTM A475-98 - Standard Specification for Zinc-Coated Steel Wire Strand
10. ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel
11. ASTM C33-01a - Standard Specification for Concrete Aggregates
14. ASTM Test Method D1557-00 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³(2,700 kN-m/m³)
15. AWPA E12-94 - Standard Method of Determining Corrosion of Metal in Contact with Treated Wood
17. BICSI Telecommunications Distribution Methods Manual, 12th edition including all subsequent addenda/errata
18. City and State Ordinances, as applicable to location
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
24. NEMA-250
25. NEMA TC2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
26. NEMA TC3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing
27. NEMA TC8 - PVC Plastic Utilities Duct for Underground Installations
28. NEMA TC9 - Fittings for PVC Plastic Utilities Duct for Underground
29. NEMA VE-1 – Metal Cable Tray Systems
30. NEMA VE 2-2000 - Cable Tray Installation Guidelines
31. NFPA-70, National Electrical Code®, 2008 edition including all subsequent addenda/errata
32. NFPA-72, National Fire Alarm Code®, 2010 edition including all subsequent addenda/errata
34. NSTISSI No. 7003 – Protected Distribution Systems
35. NSTISSAM TEMPEST/2-95 – Red/Black Installation Guidance
37. TIA-526-14A – OFSTP-14: Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
38. TIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises
39. TIA-568-C.1 – Commercial Building Telecommunications Cabling Standard
40. TIA-568-C.2 – Balanced Twisted-Pair Telecommunications Cabling and Components Standards
41. TIA-568-C.3 – Optical Fiber Cabling Components Standard
42. TIA-569-B - Commercial Building Standard for Telecommunications Pathways and Spaces
43. TIA-569-B-1 - Commercial Building Standard for Telecommunications Pathways and Spaces, Addendum 1 – Temperature and Humidity Requirements for Telecommunications Spaces
44. TIA-570-B – Residential Telecommunications Infrastructure Standard
45. TIA-570-B-1 – Residential Telecommunications Infrastructure Standard, Addendum 1 – Additional Requirements for Broadband Coaxial Cabling
46. TIA-598-C - Optical Fiber Cable Color Coding
47. TIA-606-A - Administration Standard for Commercial Telecommunications Infrastructure
48. TIA-606-A-1 - Administration Standard for Commercial Telecommunications Infrastructure, Addendum 1 – Administration of Equipment Rooms and Data Center Computer Rooms
49. TIA J-STD-607-A - Commercial Building Grounding (Earthing) and Bonding Requirements For Telecommunications
50. TIA-758-A - Customer-Owned Outside Plant Telecommunications Infrastructure Standard
51. TIA/EIA-862 – Building Automation Systems Cabling Standard for Commercial Buildings
52. TIA-942 – Telecommunications Infrastructure Standard for Data Centers
53. TIA-942-1 – Data Center Coaxial Cabling Specifications and Application Distances
54. TIA-1005-1 – Telecommunications Infrastructure Standard for Industrial Premises, Addendum 1 – Industrial Pathways and Spaces
55. TIA-TSB-155-A – Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T
56. TIA-TSB-185 – Environmental Classification (MICE) Tutorial
57. Underwriters Laboratories Standard 6 – UL Standard for Safety for Electrical Rigid Metal Conduit – Steel
58. Underwriters Laboratories Standard 797 - Electrical Metallic Tubing- Steel
59. Underwriters Laboratories Standard 1242 - Type IMC threaded and unthreaded conduit, nipples, bends, and couplings in 1 to 4 inch trade size

1.3 DEFINITIONS
A. Definitions: See Section 014216 – References for additional definitions.
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.
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 Rick 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. NEC: | National Electrical Code, NFPA 70 |
| 52. NEMA: | National Electrical Manufacturers Association |
| 54. NFPA: | National Fire Protection Association |
| 55. NR: | Network Room |
| 56. OSHA: | Occupational Safety and Health Administration |
| 57. OSP: | Outside Cable Plant |
| 58. OTDR: | Optical Time Domain Reflectometer |
| 59. PIC: | Plastic Insulated Conductor |
| 60. POTS: | Plain Old Telephone Service |
| 61. PR: | Pair |
| 62. PVC: | Polyvinyl Chloride |
| 63. RCDD®, | Registered Communications Distribution Designer |
| 64. RFI: | Radio Frequency Interference |
| 65. RH: | Relative Humidity |
| 66. SCS: | Structured Cabling System |
| 67. SM: | Single-mode |
| 68. SMDF: | Strategic Main Distribution Frame |
| 69. SNR: | Signal-to-Noise Ratio |
10. **SONET**: Synchronous Optical Network
11. **SW**: Station Wire
12. **TB**: Terminal Block
13. **TBB**: Telecommunication Bonding Backbone
14. **TC**: Telecommunications Closet (replaced with Telecommunications Room ~[TR])
15. **TGB**: Telecommunications Grounding Busbar
16. **TIA**: Telecommunications Industry Association
17. **TMGB**: Telecommunications Main Grounding Busbar
18. **TO**: Telecommunications Outlet
19. **TR**: Technology room (replacing Telecommunications Closet (TC))
20. **UL**: Underwriters Laboratory
21. **µm**: Micron
22. **UPS**: Uninterruptible Power Supply
23. **USOC**: Universal Service Order Code
24. **WAO**: Work Area Outlet

1.4 **SUBMITTALS**

A. General: Comply with Section 013300 – Submittal Procedures and Section 016000 Product Requirements.

1. Submittal Schedule and Log: Comply with Section 013300.
2. Proposed Products List: Comply with Section 013300.
3. Product Data: Comply with Section 013300.
4. Shop Drawings: Comply with Section 013300.
5. Test Reports: Comply with Section 013300 and Section 270700.
6. Operation and Maintenance Data: Comply with Section 017800 – Closeout Submittals.
   a. Submit operation and maintenance manuals for communications systems and equipment.
   b. Use manuals during demonstrations and instruction of Owner’s personnel.
7. Warranty: Comply with Section 017800 – Closeout Submittals.

B. Project Record Documents: Comply with Section 017839 – 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 intrabuilding 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.

1.5 **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 five (5) years or longer. In addition, the Contractor shall have installation experience in a hospital or clinical environment.
3. The Contractor shall employee 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 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 day 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% 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% 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 waive 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 014100 – Regulatory Requirements. Comply with following:

7. Applicable rules and regulations of federal and state and local governmental agencies.

C. Project Meetings: Comply with Section 013119 – Project Meetings.
   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 013113 – Project 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 013113.
   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 013113 – Project 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.

1.6 DELIVERY, STORAGE, AND HANDLING
A. General: Comply with Section 016600.
   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.

1.7 PROJECT CONDITIONS
A. Use of Premises: Comply with Section 011400 – Work Restrictions.
   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 (historical facilities, power facilities, prisons, etc.). 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.

1.8 SEQUENCING AND SCHEDULING
A. General: Sequence and schedule work in accordance with Section 013213 – Scheduling of Work.
B. Progress Schedule: Prepare and submit in accordance with Section 013216 – Construction Progress Schedule.

1.9 WARRANTY
A. Special Warranty: Prepare and submit in accordance with Section 017836 - Warranties.
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 twenty (20) year CommScope Extended Product Warranty. Repair or replace elements of SCS as required to deliver specified performance of complete system. The Contractor, within ten (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 1 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 016000 – 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.

C. **Contract documents are prepared on basis of acceptable manufacturer(s).**
   1. If Contractor elects 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. **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.
   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 wenches.
   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.
      2. Cold-Formed Steel Tubing: ASTM A500.
      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 083100 - Access Doors and Panels.

PART 3 - EXECUTION
3.1 EXAMINATION
   A. General: Perform in accordance with Division 02 – Existing Conditions.
   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 083100 - Access Doors and Panels when necessary to provide proper access to communication system components.

3.4 INSTALLATION
A. General: Comply with Section 013113– Project Coordination and Section 016000 – 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 017329 – Cutting and Patching.

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 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 099100. 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.

3.6 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 079200 – Joint Sealants.
   2. All core holes passing through floors shall be sleeved. Sleeves shall extend 4” AFF and be sealed to prevent water intrusion from floor to floor. Sleeves shall be properly firestopped, per code.

B. Firestopping: Fire-stop openings and penetrations through fire and smoke rated wall and floor assemblies in accordance with Section 078400 - 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.
   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. Where conduits are required to extend pathway as indicated on drawings is 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.
   4. 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: Comply with Section 014523 – Testing and Inspection Services.
   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 017400 – Cleaning.
   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 coirings, caps, and tape shall leave clean, unmarked surfaces.

B. Housekeeping: 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: Provide in accordance with Section 017900 – Demonstration and Training.
   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
SECTION 270528.15
FLOORBOXES AND POKE-THRUS

PART 1 - GENERAL

1.1 SUMMARY
A. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
   1. Floor Box Assembly.
   2. Poke-thru Assembly.
B. Related Requirements: Comply with following:
   1. Section 078400 – Firestopping.
   2. Section 270500 – Common Work Results for Communications.
   3. Section 270526 – Grounding and Bonding for Communications.
   4. Section 270553 – Identification for Communications Systems.

1.2 REFERENCES
A. Reference Standards: See Section 014200 – References and Section 270500 - Common Work Results for Communications.

1.3 SUBMITTALS
A. General: Submit in accordance with Section 013300 – Submittal Procedures and Section 270500 – 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.

PART 2 - PRODUCTS

2.1 FLOOR BOX ASSEMBLY
A. On-grade applications: Manufactured from cast-iron.
B. Above-grade applications: Manufactured from stamped steel.
C. Provide two 1-1/4 inch conduit openings to feed cabling to the box. Box shall provide the means to reduce this opening to fit 1 inch, 3/4 inch and 1/2 inch conduit sizes. Each floorbox compartment, if divided, shall have a minimum of one conduit opening.
D. Covers and Flanges: Floor box options shall accept metallic cover plates and flanges.
   1. Flange shall provide 1/2 inch of adjustment to accommodate various floor coverings and concrete depths. Flanges shall accommodate connectivity outlets and modular inserts.
   2. Covers shall be available with options for tile or carpet inserts, blank covers, or covers with two 1 inch liquid tight openings for furniture feed applications.
   3. Covers shall be die-cast aluminum, die-cast zinc, brass, or nickel. Cover finish shall be:
      a. Textured, aluminum, brass, nickel finish.
      b. Powder coat finish, color shall be black.
      c. Confirm final finish/color and composition with architect prior to purchase and installation.
E. Device mounting plates shall accept both duplex power devices, as well as communications connectivity outlets and modular inserts.
F. Modular inserts shall snap directly into the faceplate through the use of a mounting bezel.
G. Permit a tunneling feature that will allow internal wiring to various compartments. The box shall provide various size conduit knockout openings.
H. Fully adjustable, providing a maximum of 1-7/8 inch pre-pour adjustment, and a maximum of 3/4 inch post-pour adjustment.
I. Double-gang compartment for data communications cabling. Double-gang compartment for power. Four-gang compartment for audiovisual cabling. Box shall accommodate typical 2-gang and 4-gang faceplates without the use of adapters or bezels.

J. Concrete Depth: The minimum concrete depth shall depend on the type of box used while accounting for the fire rating of the floor. Each box shall contain four locations to attach the box to the slab/concrete form. Each box shall accommodate leveling for pre-pour adjustment.

K. Floor Box shall be labeled as “COMMUNICATIONS”

L. Acceptable Manufacturers:
   1. FSR.
   2. No Substitution.

2.2 POKE-THRU ASSEMBLY

A. Classification and Use: Reference note: poke-thru device use is limited by the UL Fire Resistance Directory to a minimum spacing of 2 feet on center and not more than one device per 65 square feet of floor area in each span. Poke-thru device shall have been examined and tested by Underwriters Laboratories Inc. to comply with UL514A and/or UL514C, as applicable and tested to Canadian Standard C22.2 and bear the cULus mark. The poke-thru shall conform to the standards set in the National Electrical Code, Section 300-21.

B. For use in 2-hour rated, unprotected reinforced concrete floors and 2-hour rated floors employing unprotected steel floor units and concrete toppings, or concrete floors with suspended ceilings. Fire resistive designs with suspended ceilings shall have provisions for accessibility in the ceiling below the poke-thru device fittings.

C. Integrated intumescent firestop material to maintain the fire rating of the floor assembly. The intumescent material shall be held securely in place in the insert body.

D. Evaluated by UL to meet the applicable U.S. and Canadian safety standards for scrub water exclusion when used on tile, terrazzo, wood, and carpet covered floors.

E. Suitable for use in air handling spaces in accordance with Section 300-22C of the National Electrical Code.

F. Communication Modules Mounting Accessories: Facilitate mounting SCS UTP, STP, fiber optic, coaxial, and data/communications devices.

G. Flush Poke-Thru: Assembly shall consist of an insert and an activation service head cover for flush mounted installation.
   1. Insert Body:
      a. Channels to provide complete separation of power and communication services.
      b. Bracket that will accommodate up to four connectivity modular inserts. Bracket to also include a rubber grommet at the communication compartment opening to protect communication cables.
      c. Poke-Thru devices shall readily accept Systimax outlets without modification.
   2. One 3/4 inch conduit channel and two 1/2 inch conduit channels for communication and power cabling, respectively. Sizes are minimal.
   3. Activation Cover:
      a. Die-cast aluminum alloy powder coated or plated finish, black, gray, ivory.
      b. Solid brass forging.
      c. Brushed aluminum finish.
      d. Hinged covers.
      e. Confirm final finish/color and composition with architect prior to purchase and installation.

H. Flush Furniture Feed: Assembly shall consist of an insert and an activation service head cover for flush mounted installation.
   1. Insert Body:
      a. Channels to provide complete separation of power and communication services.
   2. One 3/4 inch conduit channel and two 1/2 inch conduit channels for communication and power cabling, respectively. Sizes are minimal.
   3. Activation Cover:
      a. Die-cast aluminum alloy powder coated or plated finish, black, gray, ivory.
      b. Solid brass forging.
      c. Brushed aluminum finish.
      d. Include three conduit openings to feed modular furniture applications and provide a flush appearance.
      e. Confirm final finish/color and composition with architect prior to purchase and installation.
I. Surface Mounted Furniture Feed: Assembly shall consist of an insert and an activation service head cover for surface mounted installation.
   1. Insert Body:
      a. Channels to provide complete separation of power and communication services.
   2. One 3/4 inch conduit channel and two 1/2 inch conduit channels for communication and power cabling, respectively. Sizes are minimal.
   3. Activation Cover:
      a. Die-cast aluminum alloy powder coated or plated finish, black, gray, ivory.
      b. Trim flange and a hexagonal service head.
      c. Confirm final finish/color and composition with architect prior to purchase and installation.

J. Acceptable Manufacturers:
   1. Hubbell.
   2. Thomas & Betts
   3. Wiremold.
   4. Accepted Substitute in accordance with Section 012500 – Substitution Procedures.

PART 3 - EXECUTION

3.1 FLOOR BOX/POKE THRU ASSEMBLY

A. Examine conditions under which boxes, distribution systems, accessories, and fittings are to be installed. Notify the Architect/Engineer [Construction Manager] in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Strictly comply with manufacturer's installation instructions, recommendations and approved shop drawings. Coordinate installation with adjacent work to ensure proper clearances and to prevent electrical hazards.

C. Mounting: Mount in either a 3 inch or 4 inch core hole as applicable.

END OF SECTION
SECTION 270528.29
HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY
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. Cable Tie.
B. Related Requirements: Comply with following:
   1. Section 078400 – Firestopping
   2. Section 270500 – Common Work Results for Communications.
   3. Section 270526 – Grounding and Bonding for Communications.
   4. Section 270548 - Vibration and Seismic Controls for Communications Systems.
   5. Section 270553 – Identification for Communications Systems.

1.2 REFERENCES
A. Reference Standards: See Section 014200 – References and Section 270500 - Common Work Results for Communications.

1.3 SUBMITTALS
A. General: Submit in accordance with Section 013300 – Submittal Procedures and Section 270500 – Common Work Results for Communications.
B. Product Data and Installation Instructions: Submit for products included within this specification section.
C. Product Samples: As required.

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 012500 – Substitution Procedures.

2.2 CABLE TIE
A. Plenum rated when used in plenum environment.
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.
   7. Accepted Substitute in accordance with Section 012500 – Substitution Procedures.

2.3 SUPPORTING DEVICE
A. Miscellaneous Support: Provide in accordance with Section 270500.

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 270528.36 - 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
SECTION 270528.33
CONDUITS AND BOXES FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY
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
C. Related Requirements: Comply with following:
1. Section 078400 – Firestopping
2. Section 270500 - Common Work Results for Communications.
3. Section 270526 - Grounding and Bonding for Communications.

1.2 REFERENCES
A. Reference Standards: See Section 014200 – References and Section 270500 - Common Work Results for Communications.

1.3 SUBMITTALS
A. General: Submit in accordance with Section 013300 – Submittal Procedures and Section 270500 – Common Work Results for Communications.
B. Product Data and Installation Instructions: Submit for products included within this specification section.
C. Product Samples: As required.

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 012500 – 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 012500 – 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 270528.36 - 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 270526 – Grounding and Bonding for Communications and Section 270500 – Common Work Results for Communications.

3.3 FIRESTOPPING
   A. Firestop conduit openings and penetrations through fire and smoke rated wall and floor assemblies in accordance with Section 078400 – Firestopping and Section 270500 – Common Work Results for Communications.

END OF SECTION
SECTION 270528.36
CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY
A. Cable Tray Systems: Provide cable tray system to route voice, data, video and other low voltage communications cable. Cable tray system shall consist of tray, bases, covers, connector assemblies, clamp assemblies, connector plates, splice plates, appropriate fittings, device mounting plates and splice bars as specified, for a complete installation.

B. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
1. Wire Mesh Type
2. Ladder Tray

C. Related Requirements: Comply with following:
1. Section 078400 - Firestopping.
2. Section 270500 - Common Work Results for Communications.
3. Section 270526 - Grounding and Bonding for Communications.
4. Section 270528.29 - Hangers and Supports for Communications Systems.
5. Section 270548 - Vibration and Seismic Controls for Communications Systems.
6. Section 270553 - Identification for Communications Systems.

1.2 REFERENCES
A. Reference Standards: See Section 014200 – References and Section 270500 - 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. Following Articles of NFPA 70 - National Electric Code:
   a. 376 - Metal Wireways
   b. 378 - Nonmetallic Wireways
   c. 392 – Cable Trays
   d. 770 - Optical Fiber Cables and Raceways
   e. 800 - Communications Circuits
2. NEMA VE-1 – Metal Cable Tray Systems.
3. NEMA VE-2 – Cable Tray Installation Guidelines.

1.3 SUBMITTALS
A. General: Submit in accordance with Section 013300 – Submittal Procedures and Section 270500 – Common Work Results for Communications.

B. Product Data and Installation Instructions: Submit for products included within this specification section.

C. Product Samples: As required.

PART 2 - PRODUCTS

2.1 WIRE MESH TYPE
A. Constructed of high strength steel wires and formed into a standard 2 inch by 4 inch wire mesh pattern with intersecting wires welded together. Wire ends along cable tray sides (flanges) shall be rounded or chamfered during manufacturing for safety of cables and installers.

B. Filled no more than 40 percent visual fill of cable tray’s maximum density.

C. Cable tray with proper support spacing shall be capable of carrying a uniformly distributed load at 100 percent maximum fill, with a safety factor of 1.5.

D. Constructed with rounded edges and smooth surfaces.

E. Materials and Finishes: Material and finish specifications for each wire mesh type cable tray are as follows:
1. Pre-Galvanized Zinc: Wall brackets and other pre-galvanized accessories shall be coated with zinc in accordance with ASTM A653.
2. Electro-Galvanized Zinc: Support accessories and miscellaneous hardware shall be coated in accordance with ASTM B633 SC3. Threaded components shall be coated in accordance with ASTM B633 SC1.

F. Fittings shall be pre-manufactured or field formed per manufacturer’s instructions.

G. Splicing assemblies shall be bolted type using serrated flange locknuts. Hardware shall be either yellow zinc dichromate in accordance with ASTM B633 SC2 or AISI Type 304 Stainless Steel.

H. Supports shall be center support hangers, trapeze hangers, wall brackets, or a combination of, as field conditions require.

I. Trapeze hangers or center support hangers shall be supported by 1/4 inch or 3/8 inch diameter rods, as required to support cable weight.

J. Special accessories shall be furnished as required to protect, support and install a wire mesh type cable tray support system.

K. Acceptable Manufacturers:
   1. B-Line.
   2. Cablofil.
   3. Cope.
   4. Flextray.
   5. Accepted Substitute in accordance with Section 012500 – Substitution Procedures.

2.2 LADDER TRAY

A. Consist of two longitudinal members (side rails) with transverse members (rungs) mechanically fastened to the side rails. Rungs shall be spaced 6-12 inches on center. Rung spacing in radiused fittings shall be industry standard 9 inch and measured at the center of the tray’s width. Each rung must be capable of supporting a 200 pound concentrated load at the center of a 24 inch wide cable tray with a safety factor of 1.5. Rungs shall be capable of easy removal, reinstallation, or replacement if necessary.

B. Type(s):
   1. Ladder Tray - Telco Style: Consist of two longitudinal steel tubing members (side rails) with rungs.

C. Filled no more that 40 percent visual fill of cable tray’s maximum density.

D. Cable tray with proper support spacing shall be capable of carrying a uniformly distributed load at 100 percent maximum fill, with a safety factor of 1.5.

E. Splice plates shall have 4 nuts and bolts per plate. The resistance of fixed splice connections between adjacent sections of tray shall not exceed 0.00033 ohms. Splice plates shall be furnished with straight sections and fittings.

F. Supports shall be trapeze hangers, wall brackets, or a combination of, as field conditions require.

G. Trapeze hangers or center support hangers shall be supported by 1/4 inch or 3/8 inch diameter rods, as required to support cable weight.

H. Accessories, as required:
   1. Splice plates.
   2. Support hardware.
   3. Cable retaining posts.
   4. 90-degree corner supports.
   5. Runway supports, 2” high, width as required.

I. Acceptable Manufacturers:
   1. B-Line.
   2. Cablofil.
   3. Chatsworth.
   4. Wiremold.
   5. Accepted Substitute in accordance with Section 012500 – Substitution Procedures.

2.3 SOLID-TYPE CABLE TRAY

A. Solid bottom trough type trays shall consist of two longitudinal members (side rails) with a solid bottom supported by ladder rung below the solid bottom.

B. Filled no more that 40 percent visual fill of cable tray’s maximum density.
C. Cable tray with proper support spacing shall be capable of carrying a uniformly distributed load at 100 percent maximum fill, with a safety factor of 1.5.

D. Splice plates shall have 4 nuts and bolts per plate. The resistance of fixed splice connections between adjacent sections of tray shall not exceed 0.00033 ohms. Splice plates shall be furnished with straight sections and fittings.

E. Supports shall be trapeze hangers, wall brackets, or a combination of, as field conditions require.

F. Trapeze hangers or center support hangers shall be supported by 1/4 inch or 3/8 inch diameter rods, as required to support cable weight.

G. Tray dimensions as indicated on trays.

H. Accessories: All accessories shall be by the cable tray manufacturer and shall be for the purpose intended by the manufacturer:
   1. Horizontal bends
   2. Splice plates
   3. Support brackets
   4. Bonding jumpers

I. Acceptable Manufacturers:
   1. B-Line: Redi-Rail System,
   2. Accepted Substitution in accordance with Section 012500 – Substitution Procedures

2.4 COMMUNICATIONS FIRESTOP PENETRATIONS

A. Mechanical firestop assembly

B. Size and quantity, as required.

C. Acceptable manufacturers:
   1. Hilti: CP 653 Speed Sleeve product line
   2. Legrand/Wiremold: FlameStopper Thru-Wall Fitting product line
   3. Specified Technology, Inc: EZ-Path product line

PART 3 - EXECUTION

3.1 CABLE TRAY

A. All cable tray on level one from the MMB to TR-1B (north side TR) shall be Solid-type Cable Tray with a solid bottom.

B. Provide vertical cable tray, as indicated by drawings, in TRs to support vertical backbone cables. Install ladder rack from 1’ AFF to 1’ below the overhead deck using 2” runway supports as wall stand-offs. Attach backbone cables every 3 ft max. with crossing cable ties.

C. Coordinate cable tray with other work (i.e. ductwork, electrical conduits, piping, plumbing, electrical devices, etc.) as necessary to properly integrate installation of cable tray.

D. Install cable trays as indicated: Installation shall be in accordance with equipment manufacturer's instructions, and with recognized industry practices to ensure that cable tray equipment complies with requirements of NEC and applicable portions of NFPA 70B. Reference NEMA VE-2 for general cable tray installation guidelines.

E. Provide minimal clearances around cable tray per referenced standards to permit access for installing cables, maintaining cables, and reducing the electromagnetic interference (EMI) onto cables.

F. Cable tray fitting supports shall be located such that they meet the strength requirements of straight sections. Install fitting supports per NEMA VE-2 guidelines, or in accordance with manufacturer's instructions.

G. Cut and install per manufacturer's recommendations. Angle cut cutters shall be used to alter wire mesh type cable tray in field.

H. Bond and ground to TMGB/TGB with properly sized Grounding conductor. Sections: Connected by bonding jumpers or tied together with Grounding conductor running entire length of cable tray system. Ladder tray and solid-type cable tray may be bonded together with splice plates.

I. Maintain bend radius for fiber optic and copper cables when transitioning to/from cable tray system. Provide waterfalls for any locations where cable leave through the bottom of the cable tray.

J. When cable tray changes direction, it shall do so with a device designed for this purpose from the same manufacturer as the cable tray.
K. Ladder rack: Provide cable retaining posts for ladder rack where cables are not held within the outer limits of the cable tray. Cables should not be placed so tight as to leave the outer limits of the tray when changing directions (e.g. bend and “T”s). Provide 90 degree corner supports at 90 degree junctions and at “T” junctions.

L. Secured from equipment racks, ceiling slab and/or wall supports.

M. Test cable tray support systems to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with specified maximum grounding resistance. See NFPA 70B, Chapter 18, for testing and test methods.

N. Provide manufacturer test reports witnessed by an independent testing laboratory of the “worst case” loading conditions outlined in this specification and performed in accordance with the latest revision of NEMA VE-1 or CSA C22.2 No. 126.

3.2 CABLE ROUTING

A. Install heavier, backbone cables in bottom of cable tray. Secure cables with hook-and-loop straps to prevent movement and damage to lighter cables.

B. Cables shall drop out of cable tray bottom by means of cable tray manufacturer’s cable drop waterfalls only. Cables may exit the top of cable tray by passing through a cable support (J-hook) defined by Section 270528.29 to support its weigh without resting on cable tray side rails. No cable shall rest on side rails of exit.

3.3 GROUNDING AND BONDING

A. Sections: Bolted together with continuous grounding conductor running entire length of cable support system. Provide grounding lug to connect grounding conductor to cable tray sections at both ends of section. Lug shall fit over/around continuous grounding conductor when bonded to cable tray.

B. Bond and ground to TMGB/TGB with electrically sized and approved grounding conductor. Grounding conductor shall be a minimum #6 AWG.

3.4 FIRESTOPPING

A. Firestop openings and penetrations through fire and smoke rated wall and floor assemblies in accordance with Section 078400 – Firestopping and Section 270500 – Common Work Results for Communications.

B. Cable tray sections shall penetrate fire-rated walls via HILTI firestop system W-L-4011.

C. Install cables through firestop assembly per UL approved methods for firestop assembly.

END OF SECTION
SECTION 270553
IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY
A. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
   1. Identification Products.
B. Related Requirements: Comply with following:
   1. Section 270500 - Common Work Results for Communications.

1.2 REFERENCES
A. Reference Standards: See Section 014200 – References and Section 270500 - Common Work Results for Communications.

1.3 SUBMITTALS
A. General: Submit in accordance with Section 013300 – Submittal Procedures and Section 270500 – 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: Submit following in accordance with Section 017800.
   1. Operation and Maintenance Data: for products.

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 012500 – Substitution Procedures.

PART 3 EXECUTION

3.1 IDENTIFICATION
A. Owner may have different preferred labeling scheme. Confirm specific labeling requirements with Owner’s Representative prior to cable installation or termination.
B. Workstation: Label cables within outlet boxes.

C. Distribution Racks and Frames: Label each unit and field within that unit.

D. Within Connector Fields, in Wiring Closets and Equipment Rooms: Label each connector and each discrete unit of cable-terminating and connecting hardware.

E. Cables, General: Label each cable within 4 inches of each termination and tap, where it is accessible in cabinet or junction or outlet box, and elsewhere as indicated.

F. Exposed Backbone Cables and Backbone Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 50 feet.

G. Cable Schedule: Post in prominent location in each wiring closet and equipment room. List incoming and outgoing cables and their designations, origins, and destinations. Provide electronic copy of final comprehensive schedules for Project, in software and format selected by Owner.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Testing methods for copper cable, optical fiber cable, coaxial cable and grounding and bonding.
   2. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
      a. Fiber Optic Cable Tester.
      b. Category 6A 100 Ohm UTP Tester.
      c. 75 Ohm Coax Tester.
      d. Grounding and Bonding Tester
      e. Spectrum Analyzer with Power Meter.
      f. Signal Generator.
      g. Wireless Network Optimization Platform

B. Related Requirements: Comply with following:
   1. Section 270500 - Common Work Results for Communications.

1.2 REFERENCES
A. Reference Standards: See Section 014200 – References and Section 270500 - Common Work Results for Communications.

1.3 SUBMITTALS
A. General: Submit in accordance with Section 013300 – Submittal Procedures and Section 270500 - Common Work Results for Communications.
B. Product Data: Submit following:
   1. Test equipment.
C. Test Reports: Submit electronic copies & hard copies.
   2. Hardcopy Summary Reports: Submit in labeled 3 ring binders with attached affidavit verifying passing execution of tests. Hardcopy Summary Reports: Contain following information on each row of report: Circuit ID, test specification used, length, date of test, and pass/fail result. Hand-written test reports not allowed.

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 012500 - Substitution Procedures.

2.2 CATEGORY 6A 100 OHM UTP TESTER
A. Physical Interface: Modular RJ-45 connector and serial port with DB-9 connector.
B. Injector for complete wire mapping and TDR for determining cable length.
C. Measure NEXT for six pair combinations and Attenuation on four pairs from 1.0 to 500 MHz.
D. Additional Measurement Capabilities: Include impedance, loop resistance, capacitance, impulse noise and peak to peak noise.
E. Acceptable Manufacturers:
   1. Fluke.
   2. Ideal.
   3. JDSU.
   4. Accepted Substitute in accordance with Section 012500 - 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 012500 - 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 012500 - 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: +13 dBm minimum.
E. Acceptable Manufacturers:
   1. Agilent.
   2. Anritsu.
   3. Rohde & Schwarz.
   5. dBm.
   6. Accepted Substitute in accordance with Section 012500 - Substitution Procedures.

2.7 WIRELESS NETWORK OPTIMIZATION PLATFORM
A. Frequency bands: 700 MHz, IDEN, Cellular, AWS, PCS, 2.5 GHz.
B. Technologies:
   1. IDEN.
   2. GSM/GPRS/EDGE.
   3. WCDMA/HSPA/HSDPA/HSUPA/HSPA+.
   4. CDMA2000/1xEVDO.
   5. LTE.
   6. WiMAX.
C. Software and PC connectivity for transferring test results.
D. Indoor mapping software with the following capabilities:
   1. Indoor navigation.
   2. Create/load floor plan image.
   3. Positional information by mouse click.
   4. Play back and plot data on indoor map as time progresses.
E. Acceptable Manufacturers:
   1. Agilent.
   2. Accepted Substitute in accordance with Section 012500 - 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 850 and 1300 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. (Allowable cable loss per km)(km of fiber in link) + (0.75 dB) (number of mated pairs of connectors) = 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.
3. Owner’s Representative may agree to allow certain cabling runs to exceed standardized performance criteria (e.g. length). In this Event, such Runs: Explicitly identified by contractor and excluded from requirements to pass standardized tests.

END OF SECTION
SECTION 27116
COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

PART 1 - GENERAL

1.1 SUMMARY
A. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
   1. Two Post Floor-Mount Rack.
   2. Floor-Mount Cabinet.
   3. Colocation Cabinet.
   4. Wall-Mount Cabinet.
   5. Hinged Wall Bracket.
   6. Accessories.
B. Related Requirements: Comply with following:
   1. Section 270500 - Common Work Results For Communications.
   2. Section 270526 - Grounding and Bonding for Communications.

1.2 REFERENCES
A. Reference Standards: See Section 014200 – References and Section 270500 - Common Work Results for Communications.

1.3 SUBMITTALS
A. General: Submit in accordance with Section 013300 – Submittal Procedures and Section 270500 – Common Work Results for Communications.
B. Product Data and Installation Instructions: Submit for products included within this specification section.
C. Product Samples: As required.

PART 2 - PRODUCTS

2.1 TWO POST FLOOR-MOUNT RACK
A. Standard 7 foot high by 19 inch wide aluminum/metallic self-supporting rack system to house Owner-provided equipment and Contractor provided termination bays for multiple cable types.
B. Support and organize electronic equipment, cross-connection and termination hardware for fiber optic cabling, station cabling, riser cabling, or building entrance cabling as required by design.
C. Designed for cable and jumper management and have hardware to organize and support cabling and patch cords in vertical and horizontal planes.
D. Provide with necessary hardware to assemble frame included.
E. Conventional equipment mounting width of 19 inches.
G. Fastening System for Equipment: Facilitate easy installation.
H. Finish: Not scratched, chipped or marred.
I. Rack Components: Charcoal black in color.
J. 3 inch wide channels at each side and with extruded aluminum top angles and base angles providing support.
K. Able to be mounted side by side and be secured to adjacent racks in line-up.
L. Base Angles: 0.3125 inch thick.
M. Top Angles: 0.1875 inch thick.
N. Frames: Capable of supporting 700 pounds, with uniform distribution of weight.
O. 0.19 inch thick channel flange and 0.13 inch web thickness.
P. Comply with following:
Dimensions

<table>
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<tr>
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<th>7 feet high by 20.31 inches wide by 3 inches deep with 19 inch center mounting.</th>
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<tbody>
<tr>
<td>Hole Pattern</td>
<td>EIA310-D 5/8 inch - 5/8 inch – 1/2 inch alternating.</td>
</tr>
<tr>
<td>RMU's</td>
<td>45 Rack Mounting Units.</td>
</tr>
<tr>
<td>Mounting Screws</td>
<td>No. 12-24 thread combination Phillips/straight heads and pilot points.</td>
</tr>
<tr>
<td>Flanges</td>
<td>Flange edge to edge internal measurement of 17.5 inches</td>
</tr>
</tbody>
</table>

Dimensions

<table>
<thead>
<tr>
<th></th>
<th>7 feet high by 30 inches (750mm) wide by 42 inches (1070mm) deep with 19 inch center mounting.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hole Pattern</td>
<td>EIA310-D 5/8 inch - 5/8 inch – 1/2 inch, alternating.</td>
</tr>
<tr>
<td>RMU’s</td>
<td>42 Rack Mounting Units.</td>
</tr>
<tr>
<td>Mounting Screws</td>
<td>No. 12-24 thread combination Phillips/straight heads and pilot points.</td>
</tr>
</tbody>
</table>

Q. Acceptable Manufacturers:
1. Chatsworth Standard Rack - Model # 55053503
2. No Substitutions.

2.2 FLOOR-MOUNT CABINET

A. Metallic self-supporting cabinet system to house Owner-provided equipment and Contractor provided termination panels.
B. Support and organize electronic equipment, cross-connection and termination hardware for fiber optic cabling and horizontal cabling required by design.
C. Designed for cable and jumper management and have hardware to organize and support cabling and patch cords in vertical and horizontal planes.
D. Provide with necessary hardware to assemble frame included.
E. Conventional equipment mounting width of 19 inches.

H. Independent adjustable front and rear mounting rails. Adjustable while cabinet secured to floor.
I. Rear rail construction with a clear ventilation path.
J. Finish: Not scratched, chipped or marred.
K. Cabinet Components: Charcoal black in color.
L. Able to be mounted side by side and be secured to adjacent cabinets in line-up.
M. Frames: Capable of supporting 700 pounds min. with uniform distribution of weight.
N. Front Door: Easily installed and removed. Vented. Lockable.
O. Side Panels: Only install on end cabinets. Easily installed and removed. Solid.
Q. Vertical Management: Built in. Designed to support quantity of cables specified on drawings.
R. Comply with following:

S. Acceptable Manufacturers:
1. APC - NetShelter SX 42U 750mm Wide x 1070mm Deep Networking Enclosure.
2. No substitutions.

2.3 CO-LOCATION CABINETS

A. Two compartment cabinet. Secure pathways to each compartment, isolating cables for other compartment. Minimal 20 rack units per compartment.
B. Front Door: Easily installed and removed. Separate doors per compartment. Vented.
C. Side Panels: Only install on end cabinets. Easily installed and removed. Separate doors per compartment. Solid
D. Rear Panel: Flush mount, easily installed and removed. Separate doors per compartment. Vented
E. Comply with following:

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>7 feet high by 23.6 inches (600mm) wide by 42 inches (1070mm) deep with 19 inch center mounting.</th>
</tr>
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<tbody>
<tr>
<td>Hole Pattern</td>
<td>EIA310-D 5/8 inch - 5/8 inch – 1/2 inch, alternating.</td>
</tr>
<tr>
<td>RMU’s</td>
<td>20 Rack Mounting Units per Compartment.</td>
</tr>
<tr>
<td>Mounting Screws</td>
<td>No. 12-24 thread combination Phillips/straight heads and pilot points.</td>
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</tbody>
</table>

F. Acceptable Manufacturers:
1. APC - NetShelter SX Colocation 2 x 20U 600mm Wide x 1070mm Deep Enclosure.
2. No substitutions.

2.4 WALL-MOUNT CABINET
A. 24 inches high by 20 inches wide by 20 inches deep, metallic wall-mount cabinet system to house Owner-provided equipment and Contractor provided termination panels.
B. Support and organize electronic equipment, cross-connection and termination hardware for fiber optic cabling and horizontal cabling required by design.
C. Designed for cable and jumper management and have hardware to organize and support cabling and patch cords in vertical and horizontal planes.
D. Provide with necessary hardware to assemble frame included.
E. Conventional equipment mounting width of 19 inches.
G. Fastening System for Equipment: Facilitate easy installation.
H. Independent adjustable front and rear mounting rails. Adjustable while cabinet secured to wall.
I. Finish: Not scratched, chipped or marred.
J. Cabinet Components: Charcoal black in color.
K. Frames: Capable of supporting 200 pounds with uniform distribution of weight.
M. Side Panels: Easily installed and removed. Vents.
N. Comply with following:

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>36 inches high by 24 inches wide by 24 inches deep with 19 inch center mounting.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24 inches usable vertical space.</td>
</tr>
<tr>
<td>Hole Pattern</td>
<td>EIA310-D 5/8 inch - 5/8 inch – 1/2 inch - alternating.</td>
</tr>
<tr>
<td>RMU’s</td>
<td>13 Rack Mounting Units.</td>
</tr>
<tr>
<td>Mounting Screws</td>
<td>No. 12-24 thread combination Phillips/straight heads and pilot points.</td>
</tr>
</tbody>
</table>

O. Acceptable Manufacturers:
1. Chatsworth.
2. Accepted Substitute in accordance with Section 012500 – Substitution Procedures.

2.5 HINGED WALL BRACKET
A. 5.25 inches high by 19 inches wide by 4-8 inches deep.
B. Wall-mountable and hinged.
C. Metallic construction.
D. Frames: Capable of supporting 30 pounds.
E. Include TIA-310 universal mounting holes.
F. Acceptable Manufacturers:
1. B-Line.
2. Chatsworth.
4. Accepted Substitute in accordance with Section 012500 – Substitution Procedures.

2.6 ACCESSORIES
A. Rack Mount Shelf:
   1. Dimensions: 1U.
B. Keyboard/Display Shelf:
   1. Slide out keyboard shelf.
   2. Integrated LCD monitor.
   3. Dimensions: 1U.
C. Acceptable Manufacturers:
   1. APC.
   2. Chatsworth.
   3. Hoffman.
   4. Middle Atlantic.
   5. Wright-Line.
   6. Accepted Substitute in accordance with Section 012500 – Substitution Procedures.

PART 3 - EXECUTION

3.1 FLOOR-MOUNT RACK/CABINET
A. Anchored to floor.
B. Provide vertical and horizontal cable management sized for no more than 40 percent fill.
C. Mount with minimum of 36 inches clear access behind and in front of rack/cabinet.
D. Ground rack/cabinet to TMGB/TGB with Grounding Wire.
E. Additional information: Swing-out rack:
   1. Orient swing to match drawings.
   2. Attached cable management to face of rack. Attach on hinged side of the rack. Do not obscure
      equipment mounting holes or interfere with the ability to mount hardware in rack.
   3. Provide 9” minimum distance from rear foot of rack to wall behind rack.
   4. Racks shall be “ganged” to increase stability.

3.2 WALL-MOUNT CABINET/HINGED WALL BRACKET
A. Secure to plywood backboard with appropriate type screws or fasteners.

3.3 GROUNDING AND BONDING
A. Bond to ground in accordance with Section 270526 – Grounding and Bonding for Communications and
   Section 270000 - Communications.

END OF SECTION
SECTION 271119
COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
B. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
   2. Voice Grade Backbone Patch Panel.
C. Related Requirements: Comply with following:
   1. Section 270500 – Common Work Results for Communications.
   2. Section 270526 – Grounding and Bonding for Communications.
   4. Section 271323.13 – Optical Fiber Splicing and Terminations

1.2 REFERENCES
A. Reference Standards: See Section 014200 – References and Section 270500 - Common Work Results for Communications.

1.3 SUBMITTALS
A. General: Submit in accordance with Section 013300 – Submittal Procedures and Section 270500 – 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.

PART 2 - PRODUCTS

2.1 CATEGORY 6A HORIZONTAL PATCH PANEL
A. Meet or exceed latest Category 6A standards.
   1. Termination Block: Systimax VisiPatch 360 System patch panel system
B. Accessories:
   1. 19” 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: Systimax VisiPatch System patch panel system
B. Accessories:
   1. 19” 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. Provide labels for each cable in accordance with Section 27.0553 – Identification for Communications Systems.
C. Provide 32-port termination blocks in side-by-side pairs so as to fill a 4U bracket. For VisiPatch 360 only.
D. Contractor may provide higher port count patch panels and bracketing, if preferred. For example, a single 12U VisiPatch kit in place of three 4U kits may be used. For VisiPatch 360 only.

END OF SECTION
SECTION 271123
COMMUNICATIONS CABLE MANAGEMENT

PART 1 - GENERAL

1.1 SUMMARY
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.
   3. D-Ring.
B. Related Requirements: Comply with following:
   1. Section 270500 – Common Work Results for Communications.
   2. Section 270528.29 – Hangers and Supports for Communications Systems.
   3. Section 270528.36 – Cable Trays for Communications Systems.
   4. Section 270553 – Identification for Communications Systems.

1.2 REFERENCES
A. Reference Standards: See Section 014200 – References and Section 270500 - Common Work Results for Communications.

1.3 SUBMITTALS
A. General: Submit in accordance with Section 013300 – Submittal Procedures and Section 270500 – Common Work Results for Communications.
B. Product Data and Installation Instructions: Submit for products included within this specification section.
C. Product Samples: As required.

PART 2 - PRODUCTS

2.1 RACK/CABINET/ZONE BOX MANAGEMENT: VERTICAL AND HORIZONTAL
A. Horizontal Cable Manager: Locate as indicated on drawings.
   1. Systimax Horizontal Trough Kit
   2. Single sided
   3. Rack-mountable to 19in rails.
   4. Height: 1U and 2U as indicated on drawings
B. Vertical Cable Manager: Locate as indicated on drawings.
   1. Systimax Vertical Cable Management Kit
   2. Width: 10in
   3. Double Sided, With Doors
   4. Black
   5. Same height as rack/cabinet.
C. Acceptable Manufacturers:
   1. CommScope Systimax
   2. No Substitutions.

2.2 WALL MOUNT DISTRIBUTING "D" RING
A. Composite or zinc-plated steel to resist corrosion.
B. Ring edges: Rolled to prevent nicks and scratches in the cable and wire insulation.
C. Acceptable Manufacturers:
   1. AMP.
   2. B-Line
   3. Chatsworth.
   4. Panduit.
   5. Siemon.
   6. Accepted Substitute in accordance with Section 012500 – Substitution Procedures.
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.
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.

3.2 WALL MOUNT DISTRIBUTING “D” RING
A. Rings: Install distribution rings for support of armored backbone cables vertically within TRs only.
B. Distribution rings shall not be used in place of vertical ladder rack in TRs. Rings may help contain cables in transition from ladder to tray or to support cable grips.

END OF SECTION
SECTION 271313  
COMMUNICATIONS COPPER BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Qualitative requirements for multipair backbone cables consisting of 22 AWG to 24 AWG thermoplastic insulated solid conductors that are formed into one or more units of balanced twisted pairs. For cables larger than 25 pairs, the units are assembled into binder groups of 25 pairs or part thereof following the industry color code. The groups are identified by distinctly colored binders and assembled to form the core. The core shall be covered by a protective sheath. The sheath consists of an overall thermoplastic jacket and may contain an underlying metallic shield and one or more layers of dielectric material applied over the core.
   2. Minimum requirements for cable installations for connecting TRs to the CD.

B. Backbone:
   1. Intrabuilding copper cables (indoor) between various TR/FDs and the MTR/CD when routed through the buildings.
   2. Inter-building copper cable (outdoor) between various EF or between an EF and an OSP device or termination point.
   3. Routes: Approved by Owner's Representative prior to installation.

C. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
   1. Category 3 Cable.

D. Related Requirements:
   1. Section 270500 – Common Work Results for Communications.
   2. Section 270526 – Grounding and Bonding for Communications.
   4. Section 270700 – Communications Testing
   5. Section 271113 – Communications Entrance Protection
   6. Section 271119 – Communications Termination Blocks and Patch Panels
   7. Section 271313.01 – Communications Copper Backbone Cabling, Exterior
   8. Section 271313.13 – Communications Copper Cable Splicing and Terminations

E. Contractor shall verify all spaces as plenum or non-plenum with the architect/mechanical engineer prior to purchasing or installing any cable. Contractor shall be aware of and comply with any owner or AHJ requirements for plenum cable or other cable types beyond code requirements.

1.2 REFERENCES

A. Reference Standards: See Section 014200 – References and Section 270500 - Common Work Results for Communications. In addition to requirements indicated or specified, comply with applicable provisions of the following for the design, materials, fabrication, and installation of component parts:
   2. ANSI/ICEA S-84-608.
   3. ISO/IEC 11801.

1.3 SUBMITTALS

A. General: Submit in accordance with Section 013300 – Submittal Procedures and Section 270500 – 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, Category 3 and 5e: 250 feet (76 m) of each size and type used for Project. Furnish on reels.
PART 2 - PRODUCTS

2.1 ALL CABLES

A. 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.
   2. Contractor shall verify all spaces as plenum or non-plenum with the architect/mechanical engineer prior to purchasing or installing any cable. Contractor shall be aware of and comply with any owner or AHJ requirements for plenum cable or other cable types beyond code requirements.

B. Cable rated as CMR, unless otherwise required as listed above.

2.2 CATEGORY 3 CABLE.

A. General: General requirements for category 3 cable.
   2. Category 3 copper cable recommended for use by the manufacturer for the specific application (i.e. aerial, direct burial, underground, etc.) and as required by the NEC Article 800.
   3. Conductor size: 22 AWG to 24 AWG.
   5. Shielding (all Category 3 cable): Corrugated armor.
   6. Jacket: The core shall be enclosed by a uniform, continuous thermoplastic jacket.

B. Transmission Characteristics:
   1. 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 Two Conductors of any Pair, ASTM D4566: Shall not exceed 5 percent at 20°C.
   3. Mutual Capacitance of any Backbone Cable Pair at 1 kHz, ASTM D4566: Shall not exceed 6.6 nF per 328 ft (100 m) at 20°C.
   4. Maximum Capacitance Unbalance of any Backbone Cable Pair at 1 kHz, ASTM D4566: Shall not exceed 330 pF per 328 ft (100 m) at 20°C.
   5. Characteristic Impedance, ASTM D4566: 100 ohms ±15%.

C. Acceptable Manufacturers:
   1. ADC Krone.
   2. Belden.
   4. General Cable.
   5. Mohawk.
   7. Accepted Substitute in accordance with Section 012500 - Substitution Procedures.

PART 3 - EXECUTION

3.1 BACKBONE CABLE INSTALLATION

A. Prior to installation, physically inspect cable for damage to the jacket. Inspect cable jacket as cable is removed from reel. Do not install cable with damaged jacket or shield.

B. Comply with the manufacturer’s installation instructions, BICSI Information Transport Systems Installation Manual and best industry practices.

C. Cables may be installed in conduit, cable support system, or in cable hangers spaced a maximum of 4 to 5 feet (1219 to 1524 mm) on center.

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. Do not exceed the maximum allowed pulling tension per the manufacturer’s installation instructions. Contractor is responsible for determining minimum bend radiiuses for cable being placed, using manufacturer's latest information. The following minimum bend radius information is provided only as general guidance:
   1. Short Term No Load: 10 times outer diameter
   2. During Installation: 20 times outer diameter
   3. At Rest After Installation: 10 times outer diameter
F. Bend radius for four-pair balanced twisted-pair cable shall be 4 times the outside diameter of the cable.

G. After installation, the cable should be free from tension over the entire length of each run.

H. Vertical Cable Runs: Use gravity to assist in cable placement.
   1. Start installation from top of run to bottom of run.
   2. Hand-pull if possible.
   3. If machine assistance is required, monitor tension and do not exceed manufacturer’s specified cable tension limits.

I. Ensure that existing conduits are clean and free of obstructions prior to pulling cable. Install ground bushings on conduits where required before pulling cable.

J. Maximum supportable distances for balanced twisted-pair cabling applications:
   1. Voice Transmissions: 2624 ft (800 m).
   2. Data Applications using Category 3, 5e, 6 or 6A: 328 ft (100 m).

K. If deviations from the drawings are required, they shall be approved by Owner’s Representative prior to placement of affected cables.

L. Take precautions during installation to prevent cable from being kinked, crushed, or being mishandled. Mechanical stress placed upon cable during installation shall be such that cable is not twisted or stretched.

M. Where copper backbone cable passes through vertical riser closet or TR secure fiber to wall vertically every 36 inches (915 mm). Review fasteners, strain relief and routing with Owner’s Representative.

N. OSP cabling shall be transitioned to ISP cabling within 50’ of entering building and exiting rigid metallic conduit.

3.2 TESTING
   A. Test all cables in accordance with Section 270700 – Communications Testing.

3.3 IDENTIFICATION
   A. Label all cables in accordance with Section 270553 – Identification for Communications Systems.

3.4 FIRESTOPPING
   A. Firestop openings and penetrations through fire and smoke rated wall and floor assemblies in accordance with Section 078400 – Firestopping and Section 270500 - Common Work Results for Communications.

3.5 BONDING AND GROUNDING
   A. Bond and ground shielded cables in accordance with Section 270526 – Grounding and Bonding for Communications.

END OF SECTION
SECTION 271313.13
COMMUNICATIONS COPPER CABLE SPLICING AND TERMINATIONS

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
1. 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.
C. Related Requirements: Comply with following:
1. Section 270500 - Common Work Results for Communications.
2. Section 270526 - Grounding and Bonding for Communications.
3. Section 271113 - Communications Entrance Protection.
4. Section 271119 - Communications Termination Blocks and Patch Panels.

1.2 REFERENCES
A. Reference Standards: See Section 014200 – References and Section 270500 - Common Work Results for Communications.

1.3 SUBMITTALS
A. General: Submit in accordance with Section 013300 – Submittal Procedures and Section 270500 – 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.

PART 2 - PRODUCTS

2.1 SPLICE CLOSURES
A. Complete pressure tight reenterable 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 012500 - 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 012500 - 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 012500 - Substitution Procedures.

PART 3 - EXECUTION

3.1 OSP SPICING
   A. See Section 271113 – Communications Entrance Protection for OSP copper cable termination information.
   B. See Section 271119 – 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.

3.2 ISP SPICING
   A. Intrabuilding copper cables shall not be spliced, but shall be continuous between communications rooms.

3.3 TESTING
   A. Test all cables in accordance with Section 270700 – 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.

3.4 IDENTIFICATION
   A. Label all cables in accordance with Section 270553 – Identification for Communications Systems.

3.5 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 270526 – Grounding and Bonding for Communications.

END OF SECTION
SECTION 271322
COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Qualitative requirements for installation of optical fiber backbone cables.
B. Backbone:
   1. Intrabuilding optical fiber cables (indoor) between various communications room (FDs and BDs).
   2. FDs for voice data service to be a single-mode based infrastructure. FDs for other low voltage systems to be single-mode/multimode based.
   3. Routes: Approved by Owner’s Representative prior to installation.
C. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
   1. 50/125 μm Multimode Optical Fiber Cable.
   2. Single Mode Optical Fiber Cable.
D. Related Requirements: Comply with following:
   1. Section 270500 - Common Work Results for Communications.
   2. Section 270526 - Grounding and Bonding for Communications.
   3. Section 270553 - Identification for Communications Systems.
   4. Section 270700 - Communications Testing
   5. Section 271119 - Communications Termination Blocks and Patch Panels
   6. Section 271323.13 - Communications Optical Fiber Splicing and Terminations

1.2 REFERENCES
A. Reference Standards: See Section 014200 – References [014219 – Reference Standards] and Section 270500 - Common Work Results for Communications. In addition to requirements indicated or specified, comply with applicable provisions of the following for the design, materials, fabrication, and installation of component parts:
   1. ANSI/ICEA S-83-596.
   2. ANSI/ICEA S-87-640.
   4. ISO/IEC 11801.

1.3 SUBMITTALS
A. General: Submit in accordance with Section 013300 – Submittal Procedures and Section 270500 - 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: 500 ft spare of each type of optical fiber cable used on the project.

PART 2 - PRODUCTS

2.1 ALL CABLES
A. Cables: Rated, listed and marked for use in plenum application.
   1. OFNP rated per NEC and comply with other applicable codes.
   2. Contractor shall verify all spaces as plenum or non-plenum with the architect/mechanical engineer prior to purchasing or installing any cable. Contractor shall be aware of and comply with any owner or AHJ requirements for plenum cable or other cable types beyond code requirements.
   5. Cable type: Distribution, gel-free.
B. Fiber in Cable Run: From same manufacturer and same type. Mix of fibers from different manufacturers not allowed.

2.2 SINGLE MODE / 50/125 µm MULTIMODE PREMISE HYBRID OPTICAL FIBER CABLE
A. Physical Characteristics:
   1. 24SM/24MM Plenum, armored, hybrid, OM3 optical fiber cable.
B. Acceptable Manufacturers:
   1. Systimax
      a. 24SM/24MM - Part number P-048-DZ-CM-FMUAQ/8W024/5L024
   2. No Substitutions.

2.3 SINGLE-MODE PREMISE OPTICAL FIBER CABLE
A. Physical Characteristics:
   1. 36SM Plenum, armored optical fiber cable.
   2. 72SM Plenum, armored optical fiber cable.
   3. 144SM Plenum, armored optical fiber cable
B. Acceptable Manufacturers:
   1. Systimax
      a. 36SM – Part number P-036-DZ-8W-FMUYL
      b. 72SM – Part number P-072-DZ-8W-FMUYL
      c. 144SM – Part number P-144-DZ-8W-FMUYL
   2. No Substitutions.

2.4 SINGLE-MODE INSIDE/OUTSIDE OPTICAL FIBER CABLE
A. Physical Characteristics:
   1. 36SM non-armored optical fiber cable.
   2. 72SM non-armored optical fiber cable.
B. Acceptable Manufacturers:
   1. Systimax
      a. 36SM – Part number P-036-OD-8W-FMUBK
      b. 72SM – Part number P-072-OD-8W-FMUBK
   2. No Substitutions.

PART 3 - EXECUTION

3.1 OPTICAL FIBER CABLE INSTALLATION
A. Prior to installation, physically inspect cable for damage to the jacket. Inspect cable jacket as cable is removed from reel. Do not install cable with damaged jacket or shield.

B. Comply with the manufacturer’s installation instructions, BICSI Information Transport Systems Installation Manual and best industry practices.

C. Cables may be installed in conduit, cable support system, or in cable hangers spaced a maximum of 4 to 5 feet on center.

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. Do not exceed the maximum allowed pulling tension per the manufacturer’s installation instructions. Contractor is responsible for determining minimum bend radiuses for cable being placed, using manufacturer's latest information. The following minimum bend radius information is provided only as general guidance:
   1. Cable During Installation: 20 times outer diameter
   2. At Rest After Installation: 10 times outer diameter
   3. Indoor cable with four or fewer fibers intended to be pulled through pathways during installation: 2 inch.

F. After installation, the cable should be free from tension over the entire length of each run.

G. Vertical Cable Runs: Use gravity to assist in cable placement.
   1. Start installation from top of run to bottom of run.
2. Hand-pull if possible.
3. If machine assistance is required, monitor tension and do not exceed manufacturer’s specified cable tension limits.

H. Ensure that existing conduits are clean and free of obstructions prior to pulling cable. Install ground bushings on conduits where required before pulling cable.

I. If deviations from the drawings are required, they shall be approved by customer’s representative prior to placement of affected cables.

J. Take precautions during installation to prevent cable from being kinked, crushed, or being mishandled. Mechanical stress placed upon cable during installation shall be such that cable is not twisted or stretched.

K. Cable shall be one continuous run of fiber unless otherwise specified. Splicing is limited to fiber termination within TRs unless otherwise noted.

L. For fiber runs, leave 10 ft minimum service loop at each FD along route.

M. Loose tube fiber cables shall be installed using fan out kits.

N. Contractor: Responsible for verifying actual footages and distances identified on attached prints (i.e. wall-to-wall, pullbox-to-pullbox and TR to TR).
1. Responsible for verifying that conduits and raceways are ready for occupancy before cable placement.
2. Assume responsibility for difficulties or damage to cable during placement.

O. Where fiber optic cable passes through vertical riser closet or TR secure fiber to wall vertically every 36 inch. Review fasteners, strain relief and routing with Owner’s Representative.

3.2 TESTING
A. Test all cables in accordance with Section 270700 – Communications Testing.

3.3 IDENTIFICATION
A. Label all cables in accordance with Section 270553 – Identification for Communications Systems.

3.4 FIRESTOPPING
A. Firestop openings and penetrations through fire and smoke rated wall and floor assemblies in accordance with Section 078400 – Firestopping and Section 270500 – Common Work Results for Communications.

3.5 BONDING AND GROUNDING
A. Bond and ground armored cables in accordance with section 270526 – Grounding and Bonding for Communications.

END OF SECTION
SECTION 271323
COMMUNICATIONS OPTICAL FIBER BACKBONE CABLEING, EXTERIOR

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Qualitative requirements for installation of optical fiber backbone cables.

B. Backbone:
   1. Inter-building optical fiber cable (outdoor) between various EF or between an EF and an OSP device or termination point.
   2. Routes: Approved by Owner’s Representative prior to installation.

C. Minimum composition requirements and/or installation methods for following materials and work are included in this section:

D. Related Requirements: Comply with following:
   1. Section 270500 - Common Work Results for Communications.
   2. Section 270526 - Grounding and Bonding for Communications.
   3. Section 270553 - Identification for Communications Systems.
   4. Section 270700 - Communications Testing
   5. Section 271119 - Communications Termination Blocks and Patch Panels
   6. Section 271323.13 - Communications Optical Fiber Splicing and Terminations

1.2 REFERENCES
A. Reference Standards: See Section 014200 – References [014219 – Reference Standards] and Section 270500 - Common Work Results for Communications. In addition to requirements indicated or specified, comply with applicable provisions of the following for the design, materials, fabrication, and installation of component parts:
   1. ANSI/ICEA S-83-596.
   2. ANSI/ICEA S-87-640.
   4. ISO/IEC 11801.

1.3 SUBMITTALS
A. General: Submit in accordance with Section 013300 – Submittal Procedures and Section 270500 - 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: 500 ft spare of each type of optical fiber cable used on the project.

PART 2 - PRODUCTS

2.1 ALL CABLES
A. Cables: Rated, listed and marked for use in plenum application.
   1. OFNP rated per NEC and comply with other applicable codes.
   2. Contractor shall verify all spaces as plenum or non-plenum with the architect/mechanical engineer prior to purchasing or installing any cable. Contractor shall be aware of and comply with any owner or AHJ requirements for plenum cable or other cable types beyond code requirements.
   4. Cable type: Distribution, gel-free.

B. Fiber in Cable Run: From same manufacturer and same type. Mix of fibers from different manufacturers not allowed.
2.2 SINGLE-MODE INSIDE/OUTSIDE OPTICAL FIBER CABLE

A. Physical Characteristics:
   1. 36SM non-armored optical fiber cable.
   2. 72SM non-armored optical fiber cable.

B. Acceptable Manufacturers:
   1. Systimax
      a. 36SM – Part number P-036-OD-8W-FMUBK
      b. 72SM – Part number P-072-OD-8W-FMUBK
   2. No Substitutions.

PART 3 - EXECUTION

3.1 OPTICAL FIBER CABLE INSTALLATION

A. Prior to installation, physically inspect cable for damage to the jacket. Inspect cable jacket as cable is removed from reel. Do not install cable with damaged jacket or shield.

B. Comply with the manufacturer’s installation instructions, BICSI Information Transport Systems Installation Manual and best industry practices.

C. Cables may be installed in conduit, cable support system, or in cable hangers spaced a maximum of 4 to 5 feet on center.

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. Do not exceed the maximum allowed pulling tension per the manufacturer’s installation instructions. Contractor is responsible for determining minimum bend radiiuses for cable being placed, using manufacturer’s latest information. The following minimum bend radius information is provided only as general guidance:
   1. Cable During Installation: 20 times outer diameter
   2. At Rest After Installation: 10 times outer diameter
   3. Indoor cable with four or fewer fibers intended to be pulled through pathways during installation: 2 inch.

F. After installation, the cable should be free from tension over the entire length of each run.

G. Vertical Cable Runs: Use gravity to assist in cable placement.
   1. Start installation from top of run to bottom of run.
   2. Hand-pull if possible.
   3. If machine assistance is required, monitor tension and do not exceed manufacturer’s specified cable tension limits.

H. Ensure that existing conduits are clean and free of obstructions prior to pulling cable. Install ground bushings on conduits where required before pulling cable.

I. If deviations from the drawings are required, they shall be approved by customer’s representative prior to placement of affected cables.

J. Take precautions during installation to prevent cable from being kinked, crushed, or being mishandled. Mechanical stress placed upon cable during installation shall be such that cable is not twisted or stretched.

K. Cable shall be one continuous run of fiber unless otherwise specified. Cables between the MMB, TEP, and Hospital shall be continuous and without splicing from TR to TR. Cables within buildings shall be continuous and without splicing from TR to TR. Splicing is limited to fiber termination within TRs unless otherwise noted.

L. For fiber runs, leave 10 ft minimum service loop at each FD along route.

M. Loose tube fiber cables shall be installed using fan out kits.

N. Contractor: Responsible for verifying actual footages and distances identified on attached prints (i.e. wall-to-wall, pullbox-to-pullbox and TR to TR).
   1. Responsible for verifying that conduits and raceways are ready for occupancy before cable placement.
   2. Assume responsibility for difficulties or damage to cable during placement.

O. Where fiber optic cable passes through vertical riser closet or TR secure fiber to wall vertically every 36 inch. Review fasteners, strain relief and routing with Owner’s Representative.
3.2 TESTING
A. Test all cables in accordance with Section 270700 – Communications Testing.

3.3 IDENTIFICATION
A. Label all cables in accordance with Section 270553 – Identification for Communications Systems.

3.4 FIRESTOPPING
A. Firestop openings and penetrations through fire and smoke rated wall and floor assemblies in accordance with Section 078400 – Firestopping and Section 270500 – Common Work Results for Communications.

3.5 BONDING AND GROUNDING
A. Bond and ground armored cables in accordance with section 270526 – Grounding and Bonding for Communications.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Qualitative requirements for splicing and termination of fiber backbone/tie cables.
B. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
   1. Optical Fiber Splice Closures.
   2. Optical Fiber Splice Hardware.
   3. Optical Fiber Housing/Shelf.
   4. Optical Fiber Housing/Shelf Connector Panels
C. Related Requirements: Comply with following:
   1. Section 270500 - Common Work Results for Communications.
   2. Section 270526 – Grounding and Bonding for Communications.
   3. Section 271119 – Communications Termination Blocks and Patch Panels.
   4. Section 271543 – Communications Faceplates and Connectors.

1.2 REFERENCES
A. Reference Standards: See Section 014200 and Section 270500.

1.3 SUBMITTALS
A. General: Submit in accordance with Section 013300 – Submittal Procedures and Section 270500 – Common Work Results for Communications.
B. Product Data and Installation Instructions: Submit for products included within this specification section.
C. Product Samples: As required.

PART 2 - PRODUCTS

2.1 OPTICAL FIBER SPLICE CLOSURES
A. Complete pressure tight reenterable 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. Corning.
   3. Preformed Line Products.
   4. Tyco Electronics.
   5. Accepted Substitute in accordance with Section 012500 - Substitution Procedures.

2.2 OPTICAL FIBER SPLICE HARDWARE
A. Fusion Splice Sleeves:
   1. Fusion splice sleeves shall be designed to prevent stress and protect fusion optical fiber splices in field.
B. Acceptable Manufacturers:
   1. 3M.
   2. Corning.
   3. Tyco Electronics.
   4. Accepted Substitute in accordance with Section 012500 - Substitution Procedures.
2.3 OPTICAL FIBER HOUSING/SHELF
   A. For Cross-connection, Interconnection, Splicing and Fiber Identification: Provide for designated racks.
   B. Meet or exceed all TIA/EIA-568-C.3 Optical Fiber Cabling Components Standard requirements.
   C. UL Listed.
   D. Rack-mountable. RU as indicated on drawings.
   E. Accessories (e.g. RoloSplice Kits) as required to accommodate fusion splicing.
   F. Shelf: Protect from mechanical stress on cable and fibers, and from macro-bending losses.
      1. Accessible from front and rear. Unit shall slide out to allow access from top.
   G. Acceptable Manufacturers:
      1. CommScope Systimax Modular 360G2 Shelves
      2. No Substitutions.

2.4 OPTICAL FIBER HOUSING/SHELF CONNECTOR PANELS
   A. Cartridges with pigtails.
   B. 12 LC connectors per cartridges.
   C. Compatible with CommScope 360G2 shelves
   D. Acceptable Manufacturers:
      1. CommScope Systimax 360G2 Modular Cartridges
      2. No Substitutions.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Outside plant optical fiber shall be continuous and without splice. The only optical fiber splice shall be the OSP optical fiber cables spliced to existing OSP backbone cables unless otherwise noted.
   B. Inside plant optical fiber shall be continuous and without splice unless otherwise noted.
   C. Terminate optical fiber backbone cables with LC-type pigtail to pre-terminated LC cartridges
   D. Coordinate polarity requirements for fiber with owner before purchasing cartridges.
   E. Field termination of fiber (e.g. field-polish connectors, mechanical-splice connectors, etc.) is prohibited.
   F. Route cables and fiber strands in a neat and orderly manner.
   G. Terminate and splice all fibers in accordance with industry standards and manufacturer’s written instructions.

3.2 TESTING
   A. Test all cables in accordance with Section 270700 – Communications Testing.
   B. Pressure test all OSP splice enclosures per manufacturer’s instructions.

3.3 IDENTIFICATION
   A. Label all cables in accordance with Section 270553 – Identification for Communications Systems.

3.4 BONDING AND GROUNDING
   A. Bond and ground armored cables in accordance with section 270526 – Grounding and Bonding for Communications.

END OF SECTION
SECTION 271333
COMMUNICATIONS COAXIAL BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
1. Qualitative requirements for installation of coaxial backbone/tie cables.
2. Minimum requirements for cable installations for connecting communications room (FD). Includes backbone transmission media between these locations. Installed in home run or trunk and tap topology with first-level backbone cables beginning at headend located at main cross-connect (MC) in CD.

B. Backbone:
1. Intrabuilding coaxial cables (indoor) between various communications room (FD).
2. Inter-building coaxial cable (outdoor) between various EF or between an EF and an OSP device or termination point.
3. Routes: Approved by Owner’s Representative prior to installation.

C. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
1. Series 6 Coaxial Cable.
2. Series 11 Coaxial Cable.
3. 1/2 inch Coaxial Cable.
4. 7/8 inch Coaxial Cable.
5. 1-5/8 inch Coaxial Cable.

D. Related Requirements: Comply with following:
1. Section 270500 - Common Work Results for Communications.
2. Section 270526 - Grounding and Bonding for Communications.
3. Section 271333.13 - Communications Coaxial Splicing and Terminations.

1.2 REFERENCES
1. Reference Standards: See Section 014200 – References and Section 270500 - Common Work Results for Communications.

1.3 SUBMITTALS
A. General: Submit in accordance with Section 013300 – Submittal Procedures and Section 270500 - Common Work Results for Communications.
B. Product Data: Submit product data for each type of coaxial 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: 1,000 ft spare Series 6 coaxial cable. 250 ft. spare Series 11, 1/2 inch, 7/8 inch and 1-5/8 inch coaxial cable.

PART 2 - PRODUCTS

2.1 ALL CABLES
A. 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.
2. Contractor shall verify all spaces as plenum or non-plenum with the architect/mechanical engineer prior to purchasing or installing any cable. Contractor shall be aware of and comply with any owner or AHJ requirements for plenum cable or other cable types beyond code requirements.
B. Cable rated as CMR, unless otherwise required as listed above.
2.2 SERIES 6 COAXIAL CABLE

A. Riser Rated:
1. Physical Characteristics:
   a. CMR rated, as required by the NEC Article 800.
   b. Conductor: 18 AWG, solid with foam dielectric of 0.180 inch.
   c. Shield: Aluminum foil and 60 percent Aluminum braid.
   d. Overall Diameter of Cable: Equal to or less than 0.272 inch.

2. Transmission Characteristics:
   a. Nominal Capacitance: Equal to or better than 16.2 pF/ft.
   b. Nominal Impedance: 75 ohm.
   c. Nominal Attenuation: Equal to or less than following:

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<th>RG-6 Frequency (MHz)</th>
<th>Max. Attenuation (dB/100m)</th>
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B. Plenum Rated:
1. Physical Characteristics:
   a. CMP rated, as required by the NEC Article 800.
   b. Conductor: 18 AWG, solid with foam FEP dielectric of 0.170 inches.
   c. Shield: Aluminum foil and 60 percent Aluminum braid.
   d. Overall Diameter of Cable: Equal to or less than 0.239 inches.

2. Transmission Characteristics:
   a. Nominal Capacitance: Equal to or better than 16.0 pF/ft.
   b. Nominal Impedance: 75 ohm.
   c. Nominal Attenuation: Equal to or less than following:

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</table>
3. Acceptable Manufacturers:
   a. CommScope.
   b. No substitutions.

2.3 SERIES 11 COAXIAL CABLE

A. Riser Rated:
   1. Physical Characteristics:
      a. CMR rated, as required by the NEC Article 800.
      b. Conductor: 14 AWG, solid with foam dielectric of 0.280 inches.
      c. Shield: Aluminum foil and 60 percent Aluminum braid.
      d. Overall Diameter of Cable: Equal to or less than 0.395 inches.

   2. Transmission Characteristics:
      a. Nominal Capacitance: Equal to or better than 16.0 pF/ft.
      b. Nominal Impedance: 75 ohm.
      c. Nominal Attenuation: Equal to or less than following:

      | Frequency (MHz) | Max. Attenuation (dB/100m) |
      |----------------|---------------------------|
      | 1              | 0.62                      |
      | 10             | 1.51                      |
      | 50             | 3.01                      |
      | 100            | 4.13                      |
      | 200            | 5.87                      |
      | 400            | 8.30                      |
      | 700            | 11.29                     |
      | 900            | 13.09                     |
      | 1000           | 13.88                     |

B. Plenum Rated:
   1. Physical Characteristics:
      a. CMP rated, as required by the NEC Article 800.
      b. Conductor: 14 AWG, solid with foam FEP dielectric of 0.280 inches.
      c. Shield: Aluminum foil and 60 percent Aluminum braid.
      d. Overall Diameter of Cable: Equal to or less than 0.351 inches.

   2. Transmission Characteristics:
      a. Nominal Capacitance: Equal to or better than 16.0 pF/ft.
      b. Nominal Impedance: 75 ohm.
      c. Nominal Attenuation: Equal to or less than following:

      | Frequency (MHz) | Max. Attenuation (dB/100m) |
      |----------------|---------------------------|
      | 1              | 0.49                      |
      | 10             | 1.54                      |
      | 50             | 3.58                      |
      | 100            | 5.22                      |
      | 200            | 7.71                      |
      | 400            | 11.55                     |
      | 700            | 16.21                     |
3. Acceptable Manufacturers:
   a. Commscope.
   b. No Substitutions.

2.4 1/2” COAXIAL CABLE

A. Riser Rated:
   1. Physical Characteristics:
      a. CMR rated, as required by the NEC Article 800.
      b. Outer conductor: copper.
      c. Inner conductor: copper.
      d. Overall Diameter of Cable: Equal to or less than 0.58 inches.
   2. Transmission Characteristics:
      a. Nominal Capacitance: Equal to or better than 22.2 pF/ft.
      b. Nominal Impedance: 50±1 ohm.
      c. Nominal Attenuation: Equal to or less than following:

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B. Plenum Rated:
   1. Physical Characteristics:
      a. CMP rated, as required by the NEC Article 800.
      b. Outer conductor: copper.
      c. Inner conductor: copper-clad aluminum.
      d. Overall Diameter of Cable: Equal to or less than 0.61 inches.
   2. Transmission Characteristics:
      a. Nominal Capacitance: Equal to or better than 23.0 pF/ft.
      b. Nominal Impedance: 50±2 ohm.
      c. Nominal Attenuation: Equal to or less than following:

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<th>1/2” Coaxial Frequency (MHz)</th>
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3. Acceptable Manufacturers:
   a. Andrew (Commscope).
   b. RFS.
   c. Trilogy Communications.
   d. Accepted Substitute in accordance with Section 012500 - Substitution Procedures.

2.5 7/8” COAXIAL CABLE

A. Riser Rated:
   1. Physical Characteristics:
      a. CMR rated, as required by the NEC Article 800.
      b. Outer conductor: copper.
      c. Inner conductor: copper.
      d. Overall Diameter of Cable: Equal to or less than 1.11 inches.
   2. Transmission Characteristics:
      a. Nominal Capacitance: Equal to or better than 22.2 pF/ft.
      b. Nominal Impedance: 50±0.5 ohm.
      c. Nominal Attenuation: Equal to or less than following:

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B. Plenum Rated:
1. Physical Characteristics:
   a. CMP rated, as required by the NEC Article 800.
   b. Outer conductor: copper.
   c. Inner conductor: copper.
   d. Overall Diameter of Cable: Equal to or less than 1.11 inches.

2. Transmission Characteristics:
   a. Nominal Capacitance: Equal to or better than 22.2 pF/ft.
   b. Nominal Impedance: 50±0.5 ohm.
   c. Nominal Attenuation: Equal to or less than following:

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3. Acceptable Manufacturers:
   a. Andrew (Commscope).
   b. RFS.
   c. Trilogy Communications.
   d. Accepted Substitute in accordance with Section 012500 - Substitution Procedures.

2.6 1-5/8" COAXIAL CABLE

A. Riser Rated:

1. Physical Characteristics:
   a. CMR rated, as required by the NEC Article 800.
   b. Outer conductor: copper.
   c. Inner conductor: copper.
   d. Overall Diameter of Cable: Equal to or less than 1.98 inches.

2. Transmission Characteristics:
   a. Nominal Capacitance: Equal to or better than 22.1 pF/ft.
   b. Nominal Impedance: 50±0.5 ohm.
   c. Nominal Attenuation: Equal to or less than following:

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B. Plenum Rated:
1. Physical Characteristics:
   a. CMP rated, as required by the NEC Article 800.
   b. Outer conductor: copper.
   c. Inner conductor: copper.
   d. Overall Diameter of Cable: Equal to or less than 1.98 inches.
2. Transmission Characteristics:
   a. Nominal Capacitance: Equal to or better than 22.1 pF/ft.
   b. Nominal Impedance: 50±0.5 ohm.
   c. Nominal Attenuation: Equal to or less than following:

PART 3 - EXECUTION

3.1 COAX COPPER CABLE
A. Prior to installation, physically inspect cable for damage to the jacket. Inspect cable jacket as cable is removed from reel. Do not install cable with damaged jacket or shield.
B. Comply with the manufacturer’s installation instructions, BICSI Information Transport Systems Installation Manual and best industry practices.

C. Cables may be installed in conduit, cable support system, or in cable hangers 4 to 5 feet on center.

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. Do not exceed the maximum allowed pulling tension per the manufacturer’s installation instructions. Contractor is responsible for determining minimum bend radiuses for cable being placed, using manufacturer's latest information.

F. After installation, the cable should be free from tension over the entire length of each run.

G. Ensure that existing conduits are clean and free of obstructions prior to pulling cable. Install ground bushings on conduits where required before pulling cable.

H. If deviations from the drawings are required, they shall be approved by Owner’s Representative prior to placement of affected cables.

I. Take precautions during installation to prevent cable from being kinked, crushed, or being mishandled. Mechanical stress placed upon cable during installation shall be such that cable is not twisted or stretched.

J. Where coaxial backbone cable passes through vertical riser secure fiber to wall vertically every 36 inch. Review fasteners, strain relief and routing with Owner’s Representative.

3.2 TESTING
A. Test all cables in accordance with Section 270700 – Communications Testing.

3.3 IDENTIFICATION
A. Label all cables in accordance with Section 270553 – Identification for Communications Systems.

3.4 FIRESTOPPING
A. Firestop openings and penetrations through fire and smoke rated wall and floor assemblies in accordance with Section 078400 – Firestopping and Section 270500 - Common Work Results for Communications.

3.5 BONDING AND GROUNDING
A. Bond and ground shielded cables in accordance with section 270526 – Grounding and Bonding for Communications.

END OF SECTION
SECTION 271513

COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Minimum requirements for horizontal copper twisted pair cabling.
B. Horizontal Cabling:
   1. Telecom:
      a. Telecom 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 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.
D. Related Requirements: Comply with following:
   1. Section 270500 - Common Work Results for Communications.
   2. Section 274100 - Common Work Results for Audiovisual Systems and Equipment.
   3. Section 270526 - Grounding and Bonding for Communications.
   4. Section 270553 - Identification for Communications Systems.
   5. Section 270700 - Communications Testing
   6. Section 271119 - Communications Termination Blocks and Patch Panels.

1.2 REFERENCES
A. Reference Standards: See Section 014200 – References and Section 270500 - Common Work Results for
   Communications.

1.3 SUBMITTALS
A. General: Submit in accordance with Section 013300 – Submittal Procedures and Section 270500 - 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 of each type used for project. Furnish on reels.

PART 2 - PRODUCTS

2.1 ALL CABLES
A. All cables shall be plenum rated.

2.2 CATEGORY 6A UTP CABLE
A. Physical Characteristics:
   1. Category 6A copper cable.
   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.


6. Maximum Cable Diameter: 0.354 in.


8. Cold Bend Radius, ASTM D4565: 4 times cable diameter minimum at -20ºC ± 1ºC without jacked or insulation cracking.


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 at 20ºC.

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 ft at 20ºC.

4. Capacitance Unbalance, Pair-To-Ground, at 1 kHz, ASTM D4566: Shall not exceed 330 pF per 328 ft at 20ºC.

C. Acceptable Manufacturers:

1. CommScope Systimax 2091 cable
2. No Substitutions.

2.3 #22 AWG SHIELDED TWISTED PAIR CABLE

A. Physical Characteristics:

1. #22 AWG conductors.
2. Twisted pair, stranded, color-coded conductors.
3. 100% overall shield with stranded copper or tinned-copper drain wire.
4. Insulation Thickness:
   a. 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. Belden.
2. Liberty.
3. West Penn.
4. Accepted Substitute in accordance with Section 012500 - 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. Accepted Substitute in accordance with Section 012500 - 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. Accepted Substitute in accordance with Section 012500 - 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 conductor, 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.
B. Transmission Characteristics:
   1. Data nominal capacitance: 12.5 pF/ft, 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. Accepted Substitute in accordance with Section 012500 - Substitution Procedures.

PART 3 - EXECUTION
3.1 CATEGORY CABLE
A. Cable distributions
   1. Copper Horizontal Cabling shall terminate in Voice/Data TRs, unless otherwise noted.
   2. One Copper Horizontal Cable for each television faceplates shall terminate in the Low Voltage TRs.
      Second Copper Horizontal Cable, if present, for each television faceplates shall terminate in the Voice/Data TRs.
   3. Copper Horizontal Cables for IP-based cameras shall terminate in the Low Voltage TRs.
   4. Copper Horizontal Cable for clinical faceplates shall terminate in Voice/Data 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.
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 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.
I. 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.

J. Each Run of Horizontal Copper Cable between Terminating Patch Panel and WAO: Continuous without any joints or splices.

K. Do not untwist horizontal copper cable pairs more than 0.5 inch when terminating.

L. Make use of raceways built into furniture for open office furnished work areas.

M. Do not install cable in common cable hangers with speaker cable.

N. 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.

O. Do not install Category 6A 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.

P. Replace cables with jackets that are chaffed or burned, exposing internal conductor insulation or have bare copper (shiners).

Q. 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. 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.

G. Maintain separation between varying cable types to avoid hum, crosstalk, and interference.

H. Maintain separation between cables and devices with a potential electromagnetic field to avoid interference.

I. Provide rubber or nylon grommets to protect cables passing through racks, panels, furniture, and junction boxes.

J. 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 270700 – Communications Testing.
3.4 IDENTIFICATION
   A. Label all cables in accordance with Section 270553 – 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 078400 – Firestopping and Section 270500 - Common Work Results for Communications.

3.6 BONDING AND GROUNDING
   A. Bond and ground shielded cables in accordance with Section 270526 – Grounding and Bonding for Communications.

END OF SECTION
SECTION 271533

COMMUNICATIONS COAXIAL HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Qualitative requirements for coaxial cables used in horizontal cabling. The cable shall consist of 18
      AWG center conductor that is surrounded by a foam dielectric, braid(s) and enclosed by an overall
      jacket.

B. Horizontal Cabling: That portion of telecommunication cabling system that extends from work area outlet
   (WAO) to communications room (FD).
   1. In addition to satisfying current telecommunications requirements, horizontal cabling system shall
      facilitate ongoing maintenance and relocation requirements, as well as readily accommodating future
      equipment and service changes.
   2. Horizontal coaxial cabling for project uses conventional hierarchical star topology that home runs
      coaxial cables, from communications room (FD) to WAO locations throughout facility.

C. Minimum composition requirements and/or installation methods for following materials and work are includ ed
   in this section:
   1. Series 6 Coaxial CATV Cable.
   2. Series 11 Coaxial CATV Cable.
   3. 1/2 inch Coaxial Cable.
   5. Series 59/U S-Video Coaxial Video Cable.
   7. Series 11/U Coaxial Video Cable.

D. Related Requirements: Comply with following:
   1. Section 270500 - Common Work Results for Communications.
   2. Section 270526 – Grounding and Bonding for Communications.
   4. Section 270700 – Communications Testing.
   5. Section 270548 - Communications Coaxial Splicing and Terminations.

1.2 REFERENCES

A. Reference Standards: See Section 014200 – References and Section 270500 - Common Work Results for
   Communications.

1.3 SUBMITTALS

A. General: Submit in accordance with Section 013300 – Submittal Procedures and Section 270500 - Common
   Work Results for Communications.

B. Product Data: Submit product data for each type of coaxial 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: 1,000 ft. spare Series 6 coaxial cable.

PART 2 - PRODUCTS

2.1 ALL CABLES

A. All cables shall be plenum rated.

2.2 SERIES 6 COAXIAL CATV CABLE

A. Plenum Rated:
   1. Physical Characteristics:
a. CMP rated, as required by the NEC Article 800.
b. Conductor: 18 AWG, solid with foam FEP dielectric of 0.170 inches.
c. Shield: Aluminum foil and 60 percent Aluminum braid.
d. Overall Diameter of Cable: Equal to or less than 0.239 inches.

2. Transmission Characteristics:
   a. Nominal Capacitance: Equal to or better than 16.0 pF/ft.
   b. Nominal Impedance: 75 ohm.
   c. Nominal Attenuation: Equal to or less than following:

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3. Acceptable Manufacturers:
   a. Commscope.
   b. No Substitutions.

2.3 SERIES 11 COAXIAL CATV CABLE

A. Plenum Rated:

1. Physical Characteristics:
   a. CMP rated, as required by the NEC Article 800.
   b. Conductor: 14 AWG, solid with foam FEP dielectric of 0.280 inches.
   c. Shield: Aluminum foil and 60 percent Aluminum braid.
   d. Overall Diameter of Cable: Equal to or less than 0.351 inches.

2. Transmission Characteristics:
   a. Nominal Capacitance: Equal to or better than 16.0 pF/ft.
   b. Nominal Impedance: 75 ohm.
   c. Nominal Attenuation: Equal to or less than following:

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3. Acceptable Manufacturers:
   a. CommScope.
   b. No Substitutions.

2.4 1/2 INCH COAXIAL CABLE

A. Plenum Rated:
   1. Physical Characteristics:
      a. CMP rated, as required by the NEC Article 800.
      b. Outer conductor: copper.
      c. Inner conductor: copper-clad aluminum.
      d. Overall Diameter of Cable: Equal to or less than 0.61 inches.
   2. Transmission Characteristics:
      a. Nominal Capacitance: Equal to or better than 23.0 pF/ft.
      b. Nominal Impedance: 50±2 ohm.
      c. Nominal Attenuation: Equal to or less than following:

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</table>

3. Acceptable Manufacturers:
   a. Andrew (CommScope).
   b. RFS.
   c. Trilogy Communications.
   d. Accepted Substitute in accordance with Section 012500 - Substitution Procedures.

2.5 SERIES 59/U – COAXIAL VIDEO CABLE

A. Physical Characteristics:
   1. Center conductors: #20 AWG solid bare copper, minimum.
   2. Shielding: double copper braid, 95% shield coverage, minimum.

B. Transmission Characteristics:
   1. Nominal DC resistance: 10 ohms/ 1000 feet.
   2. Nominal impedance: 75 ohms.
   4. Max attenuation, dB/100 feet: 0.80 at 10 MHz; 10.2 at 1000 MHz.

C. Acceptable manufacturers:
   1. Belden.
   2. Extron.
   3. Liberty.
4. West Penn.
5. Accepted Substitute in accordance with Section 012500 - Substitution Procedures.

2.6 SERIES 59/U – S-VIDEO COAXIAL VIDEO CABLE

A. Physical Characteristics:
1. Center conductors: #25 AWG solid bare copper, minimum.
2. Two individual video cables, color-coded, in overall jacket.
3. Shielding: double copper braid, 95% shield coverage, minimum.

B. Transmission Characteristics:
1. Nominal DC resistance: 41 ohms/1000 feet.
2. Nominal impedance: 75 ohms.
4. Max attenuation, dB/100 feet: 1.80 at 10 MHz; 14.5 at 1000 MHz.

C. Acceptable manufacturers:
1. Belden.
2. Extron.
3. Liberty.
4. West Penn.
5. Accepted Substitute in accordance with Section 012500 - Substitution Procedures.

2.7 SERIES 6/U – COAXIAL VIDEO CABLE

A. Physical Characteristics:
1. Center conductors: #18 AWG solid bare copper, minimum.
2. Shielding: double copper braid, 95% shield coverage, minimum.

B. Transmission Characteristics:
1. Nominal dc resistance: 6.4 ohms/1000 feet.
2. Nominal impedance: 75 ohms.
4. Max attenuation, dB/100 feet: 0.72 at 10 MHz; 7.75 at 1000 MHz.

C. Acceptable manufacturers:
1. Belden.
2. Extron.
3. Liberty.
4. West Penn.
5. Accepted Substitute in accordance with Section 012500 - Substitution Procedures.

2.8 SERIES 11/U – COAXIAL VIDEO CABLE

A. Physical Characteristics:
1. Center conductors: #14 AWG solid bare copper, minimum.
2. Shielding: double copper braid, 95% shield coverage, minimum.

B. Transmission Characteristics:
1. Nominal dc resistance: 2.5 ohms/1000 feet.
2. Nominal impedance: 75 ohms.
4. Max attenuation, dB/100 feet: 0.46 at 10 MHz; 4.8 at 1000 MHz.

C. Acceptable manufacturers:
1. Belden.
2. Extron.
3. Liberty.
4. West Penn.
5. Accepted Substitute in accordance with Section 012500 - Substitution Procedures.
PART 3 - EXECUTION

3.1 COAXIAL CABLE

A. Cable distributions
   1. Coaxial Horizontal Cabling for television faceplates shall terminate in Low Voltage TRs, unless otherwise noted.

B. Coaxial Horizontal Cabling for CATV shall not exceed 250 ft. Coaxial Horizontal Cabling for CATV exceeding 150ft shall be Series-11 and shall transition to Series-6 cable no further than 20-feet from drop outlet. Coaxial Horizontal Cabling for CATV below 150ft shall be Series-6. No Series-59 shall be acceptable for Coaxial Horizontal Cabling for CATV.

C. Comply with the manufacturer’s installation instructions, BICSI Information Transport Systems Installation Manual and best industry practices.

D. 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 open top cable supports (J-supports) out to WAO.

E. Schedule Work in manner to complete above ceiling work/below raised floor work prior to tile/panel installation. In event installer required to remove tiles/panels, coordinate with 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 cable support attached to floor pedestals.

F. Cables shall not lay on the ceiling or the ceiling support structure. Anchor cables to not interfere with other services or space access.

G. Replace coaxial cables that do not pass testing requirements.

H. No physical defects such as cuts, tears or bulges in outer jacket. Replace cables with defects.

I. Install cable in neat and workmanlike manner. Neatly bundle and tie cable in closets. Leave sufficient cable for 90 degree sweeps at vertical drops.

J. Each Run of coaxial cable between backbone cable and WAO or between equipment: Continuous without any joints or splices.

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 coaxial cabling with more than manufacturer’s recommended pull force. Utilize appropriate cable lubricant in sufficient quantity to reduce pulling friction to acceptable levels on; long pulls inside conduit, pulls of multiple cables into single small bore conduit, on conduit runs greater than 100 linear feet with bends of opposing directions, and in conduit runs that exceed 180 degrees of accumulated bends. 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 exposed shields.

3.2 TESTING

A. Test all cables in accordance with Section 270700 – Communications Testing.

3.3 IDENTIFICATION

A. Label all cables in accordance with Section 270553 – Identification for Communications Systems.
3.4 FIREFSTOPPING

A. Firestop openings and penetrations through fire and smoke rated wall and floor assemblies in accordance with Section 078400 – Firestopping and Section 270500 - Common Work Results for Communications.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
1. Category 6A Insert.
2. BNC-Type Connector.
3. BNC-Type Insert.
4. F-Type Connector.
5. F-Type Insert.
6. N-Type Connector.
7. Wall/Modular Furniture Faceplate.
8. Wall Phone Jack Assembly.
10. Recessed Table Box.
11. Surface Mount Box (Biscuit Box).
B. Related Requirements: Comply with following:
1. Section 270500 – Common Work Results for Communications.
2. Section 270526 – Grounding and Bonding for Communications.

1.2 REFERENCES
A. Reference Standards: See Section 014200 – References and Section 270500 - Common Work Results for Communications.

1.3 SUBMITTALS
A. General: Submit in accordance with Section 013300 – Submittal Procedures and Section 270500 – 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.

1.4 EXTRA MATERIALS
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 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. Spring Wire Contacts: Phosphor bronze, plated with 50 microinches of gold and over 100 microinches of nickel for lowest contact resistance.
F. 110 IDC, RJ45 type suitable for eight 22-26 AWG wires and certified Category 6A compliant.
G. System Components as defined by: TIA/EIA-568-C.2 channel performance.
H. 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 6A Compliance, Connector: Ability to support high megabit and shared sheath applications.
3. Termination of Connectors: 110-type insulation displacement connectors (IDC).
4. Provide ledge directly adjacent to 110 style termination against which wires can be directly terminated and cut in one action by installation craftsperson.
5. Connector Wiring Label: Provide installation color codes for both T568A and T568B wiring schemes.

I. Modular Connector: Consult with owner on termination scheme.
   1. Fit other installed telecommunications wallplates, outlets and field-configurable patch panels and patch blocks.

J. Acceptable Manufacturers:
   1. CommScope Systimax 360 GigaSPEED X10D MGS600
   2. No Substitutions.

2.2 BNC-TYPE CONNECTOR
   A. Crimp-type, male BNC-type connector.
      1. Terminate 75ohm coaxial cable.
      2. Meet SCTE and Bellcore specifications.
   B. Acceptable Manufacturers:
      1. AMP Netconnect.
      2. Hubbell.
      3. Leviton.
      4. Ortronics.
      5. Panduit.
      7. Siemon.
      8. Accepted Substitute in accordance with Section 012500 – Substitution Procedures.

2.3 BNC-TYPE INSERT
   A. Connector Body: High-impact, fire-retardant plastic rated UL 94V-0.
   B. BNC-type Bulkhead: Designed for Series 6 applications.
   D. Connectors: UL listed; and independently UL Certified.
   E. Modular Connector: Fit other installed telecommunications wallplates, outlets and field-configurable patch panels and patch blocks.
   F. Acceptable Manufacturers:
      1. AMP Netconnect.
      2. Hubbell.
      3. Leviton.
      4. Ortronics.
      5. Panduit.
      7. Siemon.
      8. Accepted Substitute in accordance with Section 012500 – Substitution Procedures.

2.4 F-TYPE CONNECTOR
   A. Series 6, Series 11 - crimp-type, male F-type connector.
      1. Terminate 75ohm coaxial cable.
      2. Meet SCTE and Bellcore specifications.
   B. Acceptable Manufacturers:
      1. Hubbell.
      2. Leviton.
      3. Ortronics.
      4. Panduit.
      5. Pass & Seymour.
      7. Accepted Substitute in accordance with Section 012500 – Substitution Procedures.
2.5 F-TYPE INSERT
   A. Connector Body: High-impact, fire-retardant plastic rated UL 94V-0.
   B. F-type Bulkhead: Designed for Series 6/Series 11 applications.
   D. Connectors: Comply with National Electrical Code; comply with FCC Part 68; UL listed; and independently UL Certified.
   E. Modular Connector: Fit other installed telecommunications wallplates, outlets and field-configurable patch panels and patch blocks.
   F. Acceptable Manufacturers:
      1. AMP Netconnect.
      2. Hubbell.
      3. Leviton.
      4. Ortronics.
      5. Panduit.
      7. Siemon.
      8. Accepted Substitute in accordance with Section 012500 – Substitution Procedures.

2.6 N-TYPE CONNECTOR
   A. Impedance: 50 Ohms.
   B. Style: straight female.
   C. Connector shall be same manufacturer as 50 ohm coaxial cable.
   D. Connector shall be for same size as 50 ohm coaxial cable.
   E. Acceptable Manufacturers:
      1. Andrew (Commscope).
      2. RFS.
      3. Trilogy Communications.
      4. Accepted Substitute in accordance with Section 012500 – Substitution Procedures.

2.7 WALL/MODULAR FURNITURE FACEPLATE
   A. Wall-mounted Faceplates: High impact, thermoplastic or stainless, flush-mounted design. Thermoplastic shall be white in color and installed everywhere except patient rooms. Stainless steel shall be installed only within patient rooms.
      1. Capable of accepting mixed multimedia.
      2. Rear-loading inserts.
      3. Single gang – Systimax LE Type Flush Mounted Faceplate,
      4. Double gang – Systimax L Type Flush Mounted Double Gang Faceplate
      5. Readily accept Systimax outlets without modification to device.
   B. Modular Furniture Faceplates: Snap-in type accepted by furniture manufacturer.
      1. Capable of accepting mixed multimedia.
      2. Rear-loading inserts.
      3. Contain at least one designation ID window for labeling.
      4. Readily accept Systimax outlets without modification to device.
   C. Faceplates: UL listed.
   D. Accessories:
      1. Blank inserts
   E. Acceptable Manufacturers:
      1. CommScope Systimax
      2. Manufacturer of modular furniture
      3. Accepted Substitute in accordance with Section 012500 – Substitution Procedures.

2.8 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.

2.9 FLOOR BOX ASSEMBLY MOUNTING PLATE
A. Floor Box Type and Manufacturer:
   1. Accept snap-in type inserts.
   2. Same manufacturer as floorbox or designed to fit with floorbox manufacturer.
   3. Mount permanently into floor box while maintaining proper cable bend radius.
   4. UL listed.
   5. Readily accept Systimax outlets without modification to device.
B. Acceptable Manufacturers:
   1. FSR
   2. Hubbell
   3. Wiremold.

2.10 RECESSED TABLE BOX
A. Flush-mount recessed table box to house SCS communications inserts and power receptacles.
B. Colors and Finishes: Black, Brass, Bronze, Nickel. Confirm finish with architect.
C. Flip up cover, Pop up box. Confirm type with architect.
D. Readily accept Systimax outlets without modification to device.
E. Acceptable Manufacturers:
   1. FSR
   2. Hubbell
   3. Mockett
   4. Wiremold
   5. No Substitutions.

2.11 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 BNC/F-TYPE CONNECTOR
A. Stray Strands of Shield: Clipped or moved away from center conductor.
B. White Center Conductor of Cable: Even with shoulder of attachment nut.
C. BNC/F-type Connector: Completely cover exposed braid.
D. Use proper crimp tool to do termination.

3.3 BNC/F-TYPE INSERT
A. Horizontal Cable: Screw onto backside of bulkhead.
B. Bulkhead Module: Snap into adapter plate.
C. Adapter Plate: Rear-loaded into faceplate.
D. Fill extra openings with blank inserts.

3.4 N-TYPE CONNECTOR
A. Comply with manufacturer installation recommendations.

3.5 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.

3.6 RECESSED TABLE BOX
A. Coordinate exact location with Architect.
B. Install per manufacturers’ recommendations.

3.7 TESTING
A. Test all connectors and inserts in accordance with Section 270700 – Communications Testing.

3.8 IDENTIFICATION
A. Label all faceplates in accordance with Section 270553 – Identification for Communications Systems.

END OF SECTION
SECTION 271619

COMMUNICATIONS PATCH CORDS, STATION CORDS, AND CROSS CONNECT WIRE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Qualitative requirements for Patch Cords, Station Cords and Cross Connect Wire.
   2. Minimum composition requirements and/or installation methods for following materials and work are included in this section:
      b. RG-6 Coaxial Patch Cord/Station Cord.
      c. Fiber Optic Patch Cord/Station Cord.
      d. Single-Pair Patch Cords.
      e. RG142 Coaxial Jumper.

B. 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.

C. Systimax Single-Pair Jumpers: One pair of insulated conductors used to connect circuits/links between multipair backbone cables at the cross-connect.

D. Related Requirements: Comply with following:
   1. Section 270500 - Common Work Results for Communications.
   2. Section 271513 – Communications Copper Horizontal Cabling.
   3. Section 271523 – Communications Optical Fiber Horizontal Cabling.
   4. Section 271533 – Communications Coaxial Horizontal Cabling.
   5. Section 271543 – Communications Faceplates and Connectors.

1.2 REFERENCES

A. Reference Standards: See Section 014200 – References and Section 270500 - Common Work Results for Communications.

1.3 SUBMITTALS

A. General: Submit in accordance with Section 013300 – Submittal Procedures and Section 270500 - 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.

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. 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.
   3. Cross Connect Wire: 250 ft, provide on a spool.

PART 2 - PRODUCTS

2.1 CATEGORY 6A UTP PATCH CORD/STATION CORD

A. Physical Characteristics:
   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 one patch cord for every Category 6A outlet.
   1. Systimax 360 GigaSPEED X10D
2. Confirm cord type and length with owner.

D. Provide one station cable for every Category 6A outlet.
   1. Systimax 360 GigaSPEED X10D 360GS10E, 15 ft

E. Acceptable Manufacturers:
   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 012500 - 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 271543 – Communications Faceplates and Connectors.
   3. Lengths: Coordinate with Owner prior to ordering.

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:
   2. No Substitutions.

2.4 SINGLE-PAIR PATCH CORDS

A. Physical Characteristics:
   2. Lengths: Coordinate with Owner prior to ordering.
   3. Color: Coordinate with Owner prior to ordering.

B. For horizontal 360 patch panel to voice backbone patch panel.
   1. Systimax VisiPatch 360 to VisiPatch 1-pair patch cord.
   2. Confirm cord type and length with owner.
   3. Provide one patch cord for every analog phone.

C. For voice backbone to voice backbone patch panel.
   1. Systimax VisiPatch to VisiPatch 1-pair patch cord.
   2. Confirm cord type and length with owner.
   3. Provide one patch cord for every analog phone.

D. Acceptable Manufacturers:
   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. Coordinate with Owner’s Representative exact lengths and colors of patch cords.
B. Deliver patch cords to site or location designated by Owner’s Representative.

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
SECTION 283100

ADDRESSABLE FIRE ALARM SYSTEM

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 this Section.
B. Related Sections:
   1. Division 01 General Requirements
   2. Division 07 Thermal and Moisture Protection, Section 078400 Firestopping
   3. Division 08 Doors and Windows, Section 087100 Door Hardware
   4. Division 14 Conveying Systems
   5. Division 21 Fire Suppression
   6. Division 23 Heating, Ventilating and Air Conditioning
   7. Division 26 Electrical
   8. Division 27 Communications

1.2 SUMMARY
A. Section Includes:
   1. This specification describes an addressable Fire Detection and alarm signaling system. The
      control panel shall be intelligent device addressable, analog detecting, low voltage and modular,
      with digital communication techniques, in full compliance with all applicable codes and standards.
      The features and capacities described in this specification are required as a minimum for this
      project and shall be furnished by the successful contractor. The complete system will be inclusive
      of the Materials Management Building, Thermal Energy Plant/Support Services Building and the
      New University Hospital. The Hospital main control panel shall be capable of displaying alarms
      from any and all buildings and transmit these alarms to the dashboard in the MMB building. Each
      building shall be provided with a system that is capable of being operated as a stand-alone system
      in the event of loss of communications.
   2. The system shall be in full compliance with National and Local Codes.
   3. 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.
   4. All equipment furnished shall be new and the latest state of the art products of a single
      manufacturer, engaged in the manufacturing and sale of analog fire detection devices for over ten
      years.
   5. The system as specified shall be supplied, installed, tested and turned over to the owner in an
      operational condition.
   6. 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.
   7. 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 for each building.
   8. 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.

1.3 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. Horn
   6. Horn/Strobe (any candela rating)
   7. Strobe (any candela rating)
   8. Speaker
   9. Speaker/Strobe (any candela rating)
   10. Addressable Monitor Module
11. Addressable Control Module
12. Remote Power Supply
13. Audio Amplifier
14. Remote Alphanumeric Annunciator
15. Magnetic Door Hold Open Device
16. Remote Indicator/Test Station
17. Desktop Printer
18. Remote Microphone
19. Vandal Resistant Speaker

1.5 DEFINITIONS
A. ASME: American Society of Mechanical Engineers
B. FACP: Fire alarm control panel.
C. FM: FM Global (Factory Mutual)
D. Furnish: To supply the stated equipment or materials.
E. Install: To set in position and connect or adjust for use.
F. LED: Light-emitting diode.
G. NFPA: National Fire Protection Association. Definitions in NFPA 72 apply to fire alarm terms used in this Section.
I. Provide: To furnish and install the stated equipment or materials.
J. UL: Underwriters Laboratories

1.6 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.
B. FACP with Digital Voice Evacuation - The system shall be complete, electrically supervised fire detection and evacuation system using one way communication and smoke control systems with microprocessor based operating system having the following capabilities, features and capacities:
1. Voice amplification shall be supervised.
2. Amplifiers shall be rated for 25V or 70.7V RMS.
3. Amplifiers shall be sized as minimum, to accommodate speakers in corridors at 2 watt and other locations 1 watt.
4. The system shall have the capability to support Peer-to-Peer network and voice configuration.
5. Multiple nodes shall provide Peer-to-Peer voice capability in order to eliminate a single point of failure.
6. Audio shall be synchronized between nodes in order to take into account common areas.
7. The network and audio risers between nodes shall be copper and shall be Class A loop configuration to allow communication to continue in the event of a fault.
8. Speakers shall have the ability to play coded audio tones.
9. The local system shall provide status indicators and control switches for all of the following functions:
   a. The system shall provide inputs to the firefighters smoke management panel furnished under Division 23.
   b. Audible and visual notification alarm circuit zone control.
   c. Speaker circuit zone control.
   d. Status indicators for sprinkler system waterflow and valve supervisory devices.
   e. 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.

C. FACP with Clean Agent Suppression Releasing.
   1. The system shall be listed by Underwriters Laboratories for configuration as an approved NFPA13 fire sprinkler deluge and pre-action and Clean Agent extinguishing agent release system.
   2. Any additional status or control functions as indicated on the drawings, including but not limited to: HVAC shut down, doors closing, Clean Agent discharge.
   3. The fire suppression system shall be listed by Underwriters Laboratories and Factory Mutual for use as a Clean Agent fire extinguishing agent system.
   4. The fire suppression system and the fire alarm releasing system shall be compatibility listed by UL and FM for use with each other.
   5. Any clean agent requirements shall be provided by division 283100, Fire Alarm Contractor.

D. Special Smoke Detection Requirements – must be provided for Atrium Smoke Detector Coverage and Smoke Control initiation.
   1. A very early smoke detection system (VESDA) that is listed for 20,000 sq. ft. shall be installed throughout the areas indicated on the floor plans (Atrium Coverage).
   2. The system shall consist of a highly sensitive laser based smoke detector using aspirated air sampling connected to sampling tubes.
   3. An optional display unit shall be provided to monitor each detector and a programmer shall be supplied to configure the system.

1.7 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.
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.
   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 and elevator recall. System shall have the capacity to provide 40 bypass function buttons.
   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 on the system printer and 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. Aspiration smoke detector alarm
   6. Automatic sprinkler system water flow switch

I. Activation of any system fire, security, supervisory, trouble or status initiating devices shall cause the following actions and indications at all fire alarm control panels.
   1. Fire alarm condition: Refer to the matrix on the drawings for sequence.
      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. Print alarm condition on system printer.
      d. Audible and visual signals shall be silenced from the fire alarm control panel by an alarm silence switch in accordance with NFPA 72, 2007 Edition.
      e. 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.
      f. The alarm information shall be displayed on a graphic dashboard located in the MMB building and the remote annunciator in the ED nurse station.
      g. Notify EHS personnel through page or cell phone text indicating the specific condition. System shall be capable of notifying a minimum of 5 different pagers or cell phones.
      h. Notification of University Police and CDAS through the EMS system.
      i. Notification of the outside monitoring agency.

   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 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 or tone evacuation signal 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: Refer to matrix on the drawings for sequence.
      a. Record within system history the initiating device and time of occurrence of the event.
      b. Print supervisory condition to system printer.
      c. Send the event information to the dashboard in the MMB building and the remote annunciator in the ED nurse station.
      d. Create a dry contact output to the Energy Management System (EMS).
      e. Notify EHS personnel through page or cell phone text indicating the specific condition. System shall be capable of notifying a minimum of 5 different pagers or cell phones.
      f. Notification of the outside monitoring agency.

   4. Trouble Condition: Refer to matrix on the drawings for sequence.
      a. Audible signals shall be silenced from the fire alarm control panel by a trouble acknowledge switch.
      b. Trouble conditions that have been restored to normal shall be automatically removed from 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.
      c. Trouble reports for primary system power failure to the master control shall be automatically delayed for a period of time equal to 25% of the system standby battery capacity to eliminate spurious reports as a result or power fluctuations.
      d. Record within system history, the occurrence of the event, the time of occurrence and the device initiating the event.
      e. Print trouble conditions to system printers.
      f. Send the event information to the dashboard in the MMB building and the remote annunciator in the ED nurse station.
      g. Create a dry contact output to the Energy Management System (EMS).
      h. Notification of the outside monitoring agency.

J. Aspiration Detection System Performance Requirements (VESDA)
1. Shall consist of a highly sensitive Laser based smoke detector, aspirator and filter.
2. It shall be modular, with each detector optionally monitored by a display featuring LED’s and a sounder. The system shall be configured by a programmer that is either integral to the system, portable or PC based.
3. The system shall allow programming of:
   a. Four smoke threshold alarm levels per pipe (sector).
   b. Time delays
   c. Faults including airflow, detector, power, filter and network as well as an indication of the urgency of the fault.
   d. Twelve configurable relay outputs for remote indication of alarm and fault conditions.
4. It shall consist of an air sampling pipe network to transport air to the detection system, supported by calculation from a computer based design modeling tool.
5. Performance Requirements
   a. Shall be tested and approved to cover up to 20,000 sq. ft.
   b. Shall be approved to provide very early smoke detection and provide four output levels corresponding to Alert, Action, Fire 1 and Fire 2 per pipe (sector). These levels shall be programmable and able to be set at sensitivities ranging from 0.0015-6% obscft.
   c. Shall report any faults on the unit by using configurable fault output relays.
   d. Shall be self monitored for filter contamination.
   e. Shall incorporate a flow sensor in each pipe and provide staged airflow faults.

K. Thermal Movement – Allow for thermal movements from ambient and surface temperature changes.

1.8 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 by the engineer, Aon Fire Protection Engineering Corporation and EH&S at UTSW.

B. Power calculations. Battery capacity calculations. Battery size shall be a minimum of 125% 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% spare capacity by zone.
   2. NAC circuit design shall incorporate a 20% 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”=1'-0” 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. Incomplete submittals shall be returned without review.

E. Aspiration Smoke Detection System
   1. Product data for detector, piping, supports and accessories.
   2. Piping layout showing sampling point locations, pipe routing and detector unit locations.
3. Air sampling pipe network calculations shall be provided by a sampling pipe air sampling modeling program. Pipework calculations shall be supplied with the proposed pipe layout design to indicate the following performance criteria:
   a. Transport time
      (1) The manufacturers recommended transport time (time taken for the smoke to enter the pipe and reach the detector) for the least favorable sampling point is 60 seconds or less.
      (2) The maximum transport time must never exceed the local codes or 120 seconds, whichever is lower.
   b. Balance %
      (1) The sampling point balance for the pipe shall not be less than 70% as indicated by calculation. That is, the volume of air drawn from the last sampling point shall not be less than 70% or the average volume of air through the other holes.
   c. Share %
      (1) The sampling hole share for the pipe shall not be less than 70% as indicated by calculation. That is, the sum volume of air drawn through the sampling holes must always be greater than 70% of the total volume of air entering the pipe (i.e. End Vent must not exceed 30% of the total flow).

F. 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

G. Qualification Data: For qualified Texas licensed Installer, Applicator, manufacturer, fabricator, professional engineer, testing agency, and factory-authorized service representative.

H. Source quality-control reports.
I. Field quality-control reports.
J. Operation and Maintenance Data: For all fire alarm equipment, to include in operation and maintenance manuals.
K. Software and firmware operational documentation
   1. Software operating and upgrade manuals
   2. Program software backup – On magnetic media or compact disk, complete with data files.
   3. Device address list
   4. Printout of software application and graphic screens
L. Warranty: Sample of special warranty.

1.9 QUALITY ASSURANCE
A. Manufacturer Qualifications: The publications listed below form a part of this publication to the extent referenced. The publications are referenced in the text by the basic designation only. The latest version of each listed publication shall be used as a guide unless the authority having jurisdiction has adopted an earlier version.
   1. FM Global (Factory Mutual (FM)): FM Approval Guide
   2. National Fire Protection Association (NFPA)
      a. NFPA 70 National Electrical Code
      b. NFPA 72 National Fire Alarm Code
      c. NFPA 90A Standard For The Installation of Air Conditioning and Ventilating Systems
      d. NFPA 92A Recommended Practice for Smoke Control Systems
      e. NFPA 101 Life Safety Code
      a. UL Fire Protection Equipment Directory
      b. UL Electrical Construction Materials Directory
      c. UL 38 – Manually Actuated Signaling Boxes for Use With Fire Protection Signaling Systems
      d. UL 228 – Door Holding Devices
      e. UL 268 - Smoke Detectors for Fire Protective Signaling Systems
      f. UL 268A - Smoke Detectors for Duct Application
      g. UL 464 - Audible Signal Appliances
      h. UL 497A – Secondary Protectors for Communications Circuits
      i. UL 521 - Heat Detectors for Fire Protective Signaling Systems
      j. UL 864 - Control Units for Fire Protective Signaling Systems
      k. UL 1076 – Security
      l. UL 1283 – Electromagnetic Interference Filters
      m. UL 1449 - Transient Voltage Surge Suppressors
n. UL 1480 - Speakers for Fire Protective Signaling Systems
o. UL 1971 - Signaling Devices for the Hearing Impaired

4. Underwriters Laboratories Canada (ULC)

5. International Code Council
   a. International Building Code

6. State and Local Building Codes as adopted and/or amended by The Authority Having Jurisdiction, ADA, and/or State and local equivalency standards as adopted by The Authority Having Jurisdiction.

7. The manufacturer shall have a minimum of 15 years production experience in the manufacture and design of high sensitivity aspiration-type smoke detection systems.

8. ISO 9002

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 provided. The representative shall be licensed in the State if required by law.
   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.
   3. The supplier 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 in the State having jurisdiction.
   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 E 84 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.

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.

1.10 DELIVERY, STORAGE, AND HANDLING
A. Deliver products to project site in original. Unopened packages with intact and legible manufacturers labels indentifying 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.

1.11 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.
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.

1.12 WARRANTY
A. Warranty for parts and labor shall be for a period of one year from the date of substantial completion.
1.13 EXTRA MATERIALS
A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Ten (10) smoke detector heads
   2. Two (2) heat detector heads
   3. One (1) pull station
   4. Ten (10) speaker strobes
   5. Ten (10) strobes
   6. Ten (10) speakers
   7. Five (5) monitor modules
   8. Five (5) control relays

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Edward Systems Technology (EST)
B. Siemens
C. Notifier

2.2 CONTROL PANEL
A. The fire alarm control panel shall be microprocessor based using multiple microprocessors throughout the system providing rapid processing of smoke detector and other initiation device information to control system output functions.
B. There shall be a watchdog circuit, which shall verify the system processors and the software program. Problems with either the processors or the system program the panel shall activate a trouble signal, and reset the panel.
C. The system modules shall communicate with an RS 485 network communications protocol. All module wiring shall be to terminal blocks, which will plug into the system card cage. The control panel shall be capable of expansion via up to 100 SLCs. Maximum system capacity shall be a minimum of 2500 intelligent initiation devices.
D. System Components:
   1. The Device Loop Card shall be capable of 252 intelligent devices distributed between two SLC circuits. Any trouble on one circuit shall not affect the other circuit. This module controls the signaling from the initiation devices reporting alarms and troubles to the control panel. This module shall also provide the signaling to the field devices for the controlling the output of specific initiation devices. The on board microprocessor provides the device loop card with the ability to function even if the main microprocessor fails. LED’s on the board shall provide annunciation for the following; Power, Card Failure, Network Failure, Gnd. Fault, Alarm, Trouble, Short Zone 1, Short Zone 2, Style 6 Open Zone 1, Style 6 Open Zone 2. This card shall plug into the system card cage. Circuit shall be capable of either input or output devices on any address without limitations. You can split the SLC in any ration while maintaining short circuit isolation between the two legs of the circuit.
   2. The signal line circuits shall be tested for opens, shorts and communications with all addressable devices installed before connection to the control panel.
   3. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, monitor, trouble and component status messages and control menu.
      a. The common control switches and with corresponding LEDs provided as minimum will be; Reset Alarm Silence, Panel Silence, and Drill. It shall be able to add additional switches/LEDs as required.
      b. The main control panel shall have a graphic LCD display that is backlit when active.
      c. Each point shall have custom event message.
      d. Provide a minimum of 6 simultaneous events to be displayed. The first five (5) highest priority events in addition to the most recent event. The events shall be automatically placed in event types (Alarm, Supervisory, Monitor & Trouble) for easy access and shall be possible to view the specific event type separately.
      e. Provide an internal audible signal with different programmable patterns to distinguish between alarm, supervisory, trouble and monitor conditions.
   4. The LCD shall have a keyboard screen to allow the technician ability to enter test and numbers for passwords or text changes. The interface screen module shall also have a Context Sensitive Help button. The interface screen module shall have the ability to view events, acknowledge, silence and reset networked systems. The interface screen module shall also have the ability to arm and disarm input and output points on FACP’s. The interface screen module shall have the ability to be configured for control of the entire network, control of the local FACP, or annunciation only. In a
5. The Network Interface Card (NIC-C) shall provide either intranode (HNET) communication or internode (XNET) communication between enclosures. HNET and XNET communication shall support Class A Style 7 wiring. NIC-C shall have the ability to be configured as an electrical repeater in order to increase communication distances. In addition, the NIC-C shall support CAN network communication. This card shall plug into the system card cage.

6. The network ring card shall provide the ability to network systems in a Class A Style 7 Ring configuration. A single card per system (node) shall provide peer-to-peer communication between systems allowing a total of 59 systems to be networked together. The card shall reside in the same enclosure as the interface screen module. The network ring card shall supervise the ring network to ensure proper operation. The card shall also isolate a short-circuit fault to each individual segment of the network and perform ground fault detection on its outgoing ring port. Any faults that are detected by the card shall be reported to the panel for annunciation. The card shall isolate faults only to the individual node in trouble allowing communication on the network ring to continue. The card shall act as an electrical repeater for each network pair.

7. The System Status Display shall provide a remote LED/LCD display that shows the local status of a system. An LED shall illuminate when alarm, supervisory, trouble and security events occur on the system. The display shall consist of a LCD display that has four lines of forty characters each that provides details of the event in alphanumeric form. The display shall have three additional control buttons for acknowledging events, silencing audible circuits, and resetting the system. The display shall have an integral keyswitch that enables these control buttons to operate. The display shall have the ability to be located within a locked cabinet, so no additional keyswitch is required for enabling the control buttons. The display shall be mountable in a 2-gang electrical box or 4-inch square electrical box.

8. The Zone Indicating Card shall contain 4 NAC circuits rated at 4 amps each with power-limited outputs. The zone inputs for the card shall be isolated and independently supervised. There shall be at least 3 unique codes/signals for each circuit based on system logic. These signals shall be a notification tone prior to voice instructing notification, Steady (Such as “Recall”), and Alert (Such as “Tornado Alert”). The card shall be listed for notification appliances, horns, bells, strobes, and speakers. The card shall be listed for NFPA 13 pre-action release, Clean agent. The card shall have the ability to wire the circuits Style Y with outputs synchronized. The card shall have the following LED’s to provide trouble shooting and annunciation: Power, Card Failure, Network Failure, Gnd. Fault, Zone Activation or Trouble. This card shall plug into the system card cage.

9. The Control Relay Card shall contain 6 fully programmable relays each rated at 4A, 30VDC/120VAC resistive and 3.5A, 120VAC 0.6 PF inductive. The card shall have the following LED’s to provide trouble shooting and annunciation; Power, Card Fail, Network Fail, Relay 1 Active, Relay 2 Active, Relay 3 Active, Relay 4 Active, Relay 5 Active, Relay 6 Active.

10. The system card cage shall provide the mounting of all system cards, field wiring, and panel’s inter-card wiring. All power limited field wiring shall connect to the top of the card cage. All non-power limited internal wiring shall be connected to the bottom of the card cage. The card cage shall hold the systems cards and have capability of connecting multiple card cages to meet system demands. All terminal blocks are removable.

11. The Remote Printer Module shall provide a means for connecting the FACP system to a serial or parallel printer for creating a hard copy of system status and configuration reports. The printer module shall also provide a Foreign System Interface output port that can be configured to communicate with external systems, such as Building Management Systems. The printer module shall consist of two RS-232 (serial) ports and a single parallel port allowing connection to a parallel printer. The serial port shall have the ability to be configured as RS-232 or RS-485.

12. The Supervised Input Module shall provide sixteen input circuits for remote system monitoring. Each input shall have the ability to be individually programmed as supervised (dry contact only) or unsupervised (general purpose input). The input module shall provide two programmable Form C relays. The input module shall be mountable in an enclosure that is remotely located from the main control panel. The input module shall be capable of supervising inputs 500 feet away.

13. The Output Control Module shall provide sixteen open collector outputs to drive LEDs, incandescent lamps or external relays. There shall also be an additional output for a local audible and two inputs for momentary lamp test as well as local audible silence switches. The module shall be mountable in an enclosure that is remotely located from the main control panel.

14. The switch control module shall be a supervised module with 8 switches and two LED’s per switch for controlling such items as speaker/strobe circuits. The switches shall also be used as generic inputs into the system. The module shall be mounted in the door for easy access. These modules shall be connected to the control area network, and have a maximum distance of 1000 ft.
15. The LED Control Module shall contain eight groups of 2 LED’s that shall be programmable. Eight LED’s shall be dual color capable that can be lighted either RED or GREEN flashing or steady. The remaining LED’s shall be AMBER flashing or steady. A space shall be provided for labeling of LED functions. The label shall slide behind a clear protective membrane. The module shall be mounted in the door for easy access. These modules shall be connected to the control area network, and have a maximum distance of 1000 ft.

16. The Live Voice Module shall have the supervised Microphone and pre-amplifier. The module shall contain 6 programmable switches. The module shall connect to the control area network, and also connect to the interface screen module. The module shall have remote capability using a Remote Network Interface. The module requires a Local Page Board to convert the audio to a digital signal. The module shall contain a Local Speaker w/control, Ready to Page LED, and a Pre-Announcement tone LED. The module shall be mounted in the door for easy access and viewing.

17. The Digital Audio Card shall provide Single channel of digital audio and control of all voice functions including Background Music or Conventional Paging. This module communicates with the interface screen module and to all other audio modules via the control area network. The module also contains an async serial interface buss to distribute the audio signals between the zone amplifiers and the Audio Input Card. The Local Page Board shall plug into this card converting the audio to a digital signal. The audio card shall plug in to the system card cage.

18. The zone amplifier module shall support Class A or B speaker zone wiring configurations. The module shall be able to reproduce signals from 200 hertz to 12,000 hertz for improved intelligibility of voice communication. Audio amplifiers shall be power limited.

19. The Audio Input Card (AIC) allows up to 2 external audio sources for any source such as CD, and tape player. There are two relays on the module to control the inputs. The system shall support multiple AIC cards. This card shall plug into the system card cage. The card shall be model number AIC. Output amplifiers and audio zone cards shall perform dynamic supervision, meaning, they can supervise the speaker circuit during operation, meeting UL requirements for the use of fire speakers with background music/paging.

20. An audio level conversion card shall provide the capability of conducting a global-emergency page (All Call) over copper across multiple, remote nodes with each audio riser holding a maximum of 63 nodes. The emergency page originates at a global-paging station, where it is broadcast at 70VRMS over an audio riser by an amplifier. A single, remote node containing one card, steps the incoming speaker-level audio down to line-level audio that is compatible with the audio input (0.775VRMS, independently adjustable to ±6dBu).

21. The audio level conversion card shall provide the ability to output line-level audio messages originating from the fire alarm system to other compatible 3rd party audio systems for enhanced integration

E. System response time from alarm to output shall not exceed three (3) seconds. To expedite troubleshooting, the system cards shall have ground fault and diagnostics LED’s on the cards. All system cards and modules shall have flash memory for downloading the latest module firmware.

F. Passwords:

1. Maintenance/Control Password - There shall be a 5 character password that a user must enter into the control panel in order to perform such maintenance- and control-related functions at the panel as:
   a. Arming and disarming devices.
   b. Activating, deactivating or modifying detector ASD and sensitivity settings.
   c. Activating and deactivating the History Log function, and deleting obsolete entries.
   d. Changing the system time and date.

2. Function Key Password - There shall be a 5 character password that a user must enter into the control panel in order to perform the panel’s Function Keys: touch screen buttons which perform custom-programmed system functions.

3. Reports Password - There shall be a 5 character password that a user must enter into the control panel in order to access the panel's reporting functions.

4. Walk test Password - There shall be a 5 character password that a user must enter into the control panel in order to perform the panel's walk testing functions.

5. Acknowledge Silenceable Reset Password - There shall be a 5 character password that a system user must enter into the control panel in order to acknowledge events, turn silenceable audibles and visuals on and off, and perform panel resets.

G. Networking:

1. Digital communication capabilities supporting Style 4 (Class B) or Style 7 (Class A) communications using either DC digital or fiber optics technologies or combinations of both as required for the control panel to communicate with at least 50 remote transponders.

2. Digital communication capabilities supporting Style 4 (Class B) or Style 7 (Class A) communications using either DC digital or fiber optics technologies or combinations of both as required for the control panel to communicate with at least 50 network nodes.
3. Capability shall exist within the system to extend the network at any node. The system shall support a maximum of two network extension circuits in series on any system branch, extending the inherent distance limitations for network communications.

4. Communication protocol shall be of the CSMA/CD (carrier sense, multiple access, collision detect) type, eliminating delays incorporated into other protocols. Communication techniques using token passing and requiring sensing of delays and re-generation of the token to re-establish network communications in the event of a fault shall not be acceptable.

H. Degrade Mode Alarm Activation:
1. Each data gathering panel shall support the ability to have its corresponding zone indicating card and output devices on an SLC loop activate when the SLC or conventional detector card is in Degrade Mode (has lost communication with the FACP). For example, if the device loop includes detectors with relay bases and lamps, the relays and lamps will activate upon any system alarm when the SLC is in Degrade Mode.
2. Degrade Mode Alarm Activation with Voice: Each data gathering panel shall support the ability to have its corresponding DAC-NET turn on audio when the SLC or conventional detector card is in Degrade Mode (has lost communication with the FACP).

I. Smoke Control: The fire alarm panels shall have the ability to be configured as a smoke control station that complies with UL/UUKL (UL 864) and NFPA 92A and ULC/ORD-C100 requirements. The system shall have the capability to monitor and override smoke control systems and equipment provided at designated locations within the same building. Graphical Smoke Control Panel shall be provided for Atrium Smoke Control System and shall incorporate all systems associated with smoke control.

J. Digital Voice Command:
1. The Digital Voice Command Center located with the FACP, shall contain all equipment required for all audio control, signaling and supervisory functions. This shall include speaker zone indication and control, digital voice units and microphone.
2. Up to 5 digital voice command centers shall be supported per system with the ability to limit control to one digital voice command center via a Request/Grant/Deny mechanism.
3. Function: The Voice Command Center equipment shall perform the following functions:
   a. Operate as a supervised multi-channel emergency voice communication system.
   b. Audibly and visually annunciate the active or trouble condition of every speaker circuit.
   c. Audibly and visually annunciate any trouble condition for digital tone and voice units required for normal operation of the system.
   d. Provide all-call Emergency Paging activities through activation of a single control switch.
   e. As required, provide vectored paging control to specific audio zones via dedicated control switches.
   f. Provide a factory recorded "library" of voice messages and tones in standard WAV. File format, which may be edited and saved on a PC.
   g. Provide a software utility capable of off-line programming for the VCC operation and the audio message files. This utility shall support the creation of new programs as well as editing and saving existing program files. Uploading or downloading the VCC shall not inhibit the emergency operation of other nodes on the fire alarm network.
   h. The Digital Voice Command shall be modular in construction, and shall be capable of being field programmable without requiring the return of any components to the manufacturer and without requiring use of any external computers or other programming equipment.
   i. The Digital Voice Command and associated equipment shall be protected against unusually high voltage surges or line transients.

K. Software Modifications: The system structure and software shall place no limit on the type or extent of software modifications on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being made. Systems that require the use of external programmers or change of EPROMs are not acceptable.

L. Computer Interface: The fire alarm control panel shall network to the computer.

M. Logic: The fire alarm system shall support generic functions that deal with binary states (True/False, high/low), and produce desired outputs from one or more binary inputs (for example, alarm outputs from detector or manual station inputs). AND, OR, NOT, Any N, D Latch, RS Latch, Time Base Control, Start Timer, Restart Timer are generic functions. Generic functions can be used as inputs to other function. The system shall support 1500 logic functions.

N. History – The system shall store 5000 events in history while in straight mode and 4500 in circular mode. In straight mode, trouble warnings will occur at 4000 and 4500 events. In circular mode, the control panels shall maintain a 2000 event alarm history, which consists of 2000 most recent alarm events from the 4500 event history file.

O. Reports:
1. The system shall have the ability to provide configuration, status, queue and history reports.
2. Configuration reports shall provide the following information:
a. Custom Messages  
b. Entity Type  
c. Device Usage  
d. Device Category  
e. Firmware revision  

3. Status reports shall provide the following information:  
a. Disarmed cards and devices  
b. ASD settings  
c. Sensitivity in %/foot  
d. Alarm threshold in %/foot  
e. Temperature in degrees C  
f. Walktest  

4. Queue reports shall provide the following information:  
a. Alarm events with custom message and event time  
b. Supervisory events with custom message and event time  
c. Security events with custom message and event time  
d. Trouble events with custom message and event time  

5. History reports shall provide Address, History Type, Description, Time & Date and Custom Message. The following event types shall be reported:  
a. Alarm events  
b. Supervisory events  
c. Security events  
d. Status changes  
e. Alarm verification  
f. Output activation from logic  
g. System Reset  
h. Event Acknowledgements  
i. Block Acknowledgements  
j. Audible Silence System Flag Changes  
k. Sensitivity Changes  
l. Arm / Disarm Commands  
m. Arm / Disarm By Logic  
n. Manual Output Overrides  
o. Output Overrides By Logic  
p. Time Changes  
q. Menu Logins  
r. ASD Changes  
s. Walktest  
t. Device Input to Logic Activations/Deactivations  

2.3 POWER SUPPLY  
A. The system Power Supply/Charger shall be a 12-amp supply with battery charger. The power supply shall be filtered and regulated. The power supply shall have a minimum of 1 power limited output rated at 4 amps, and a minimum of 1 output rated at 12 amps. The system power supply can be expanded up to 48 amps. The auxiliary power supply module shall share common batteries with the primary power supply. The system power supply shall have 4 relays, 1 for common alarm, one for common trouble and two programmable relays. The power supply shall be rated for 120/240 VAC 50/60 Hz.  
B. The battery charger shall be able to charge the system batteries up to 100 AH batteries. Battery charging shall be microprocessor controlled and programmed with a special software package to select charging rates and battery sizes. Thermistor for monitoring battery temperature to control charging rate shall be available.  
C. The power supply shall have a plug for an AC adapter cable, which allows a technician to plug in a laptop computer for up or down loading program information or test equipment.  
D. Transfer from AC to battery power shall be instantaneous when AC voltage drops to a point where it is not sufficient for normal operation.  

2.4 SYSTEM ENCLOSURE  
A. Provide the enclosure needed to hold all the cards and modules as specified with at least spare capacity for two cards. The enclosure outer door shall be either black or red. Provide the color as to the local AHJ requirements. The outer doors shall be capable of being a left hand open or a right hand open. The inner door shall have a left hand opening. System enclosure doors shall provide where required ventilation for the modules or cards in the enclosure.  
B. Provide system enclosure for all amplifiers. Where required by the manufacturer, provide means for venting heat from the enclosure either by having enclosure sides and top vented or the doors vented.
2.5 SYSTEM PRINTERS
A. The system printer shall be operated from a Remote Printer Module which shall be mounted under a table or behind desk. This module shall provide a parallel port and 2 serial ports for RS 232 protocol. One of the serial ports shall be able to be programmed for RS485 protocol.
B. The logging printer shall be supervised for: On/Off line, out of paper, paper jam, power off, and connection the system. The printer shall be a high speed, 24 dot matrix, wide carriage, and capable of using tractor or friction fed paper. Supervised network connection shall be either Style 4 or 7 as required by local requirements. The printer shall contain diagnostic LED’s for ease in maintenance.

2.6 INTELLIGENT INITIATING DEVICES
A. Intelligent Initiation Devices – General
1. All initiation devices shall be insensitive to initiating loop polarity. Specifically, the devices shall be insensitive to plus/minus voltage connections on either Style 4 or Style 6 circuits.
B. Smoke Detectors – Addressable
1. The detector shall have an LED to identify normal operation, maintenance required and alarm.
2. Provide intelligent analog addressable multi-sensor smoke detectors at the locations shown on the drawings. The intelligent detector gathers analog information from each of its two fire sensing elements and converts it into digital signals. The detectors on-board microprocessor measures and analyzes these signals separately with respect to a third element – Time. It compares the information to historical readings, time patterns and known fire characteristics to make an alarm decision. Digital filters remove signal patterns that are not typical of fires.
3. Devices ceiling mounted shall be installed within 1" of the center of the ceiling tiles.
4. All ceiling and wall mounted devices shall have backboxes. All ceiling backboxes must be supported from the structure or the ceiling grid, not the ceiling tile.
C. Heat Detectors – Addressable
1. Thermal detectors shall be rated at 135 degrees fixed temperature and 15 degrees per minute rate of rise. Detectors shall be constructed to compensate for the thermal lag inherent in conventional type detectors due to the thermal mass, and alarm at the set point of 135 degrees Fahrenheit. The choice of alarm reporting as a fixed temperature detector or a combination of fixed and rate of rise shall be made in system software and be changeable at any time without the necessity of hardware replacement.
2. The detectors furnished shall have a listed spacing for coverage up to 2,500 square feet and shall be installed according to the requirements of NFPA 72 for open area coverage.
3. Devices ceiling mounted shall be installed within 1" of the center of the ceiling tiles.
4. All ceiling and wall mounted devices shall have backboxes. All ceiling backboxes must be supported from the structure or the ceiling grid, not the ceiling tile.
D. Duct Smoke Detectors – Addressable
1. The detector shall have an LED to identify normal operation, maintenance required and alarm.
2. Provide intelligent analog addressable multi-sensor smoke detectors at the locations shown on the drawings. The intelligent detector gathers analog information from each of its two fire sensing elements and converts it into digital signals. The detectors on-board microprocessor measures and analyzes these signals separately with respect to a third element – Time. It compares the information to historical readings, time patterns and known fire characteristics to make an alarm decision. Digital filters remove signal patterns that are not typical of fires.
3. Duct Detectors are to be supplied the fire alarm contractor, installed by the mechanical contractor. AHU shutdown is to be wired by the Division 26 contractor and tested by both the mechanical and fire alarm contractor. Fire Smoke Damper Operation is the responsibility of the Mechanical Contractor.
4. If associated remote indicators are required by code, they will be ceiling mounted +/- 1" f center of tile with back box and supports.
E. Detector Bases – Addressable
1. Detector bases shall be low profile twist lock type with screw clamp terminals and self-wiping contacts. Bases shall be installed on an industry standard, 4" square or octagonal electrical outlet box.
2. Where selective localized control of electrical devices is required for system operation, furnish and install detector base with software programmed addressable relay integral to the base. The relay shall switch electrical loads within relay ratings, as indicated on the drawings. Operation of the addressable control circuit shall be independent of the number of detectors and relays on the circuit or the number in an alarm state. Relay bases shall be rated for resistive or inductive load (120VAC or 30VDC) 3 amps.
F. Manual Pull Stations – Addressable
1. Provide addressable manual stations where shown on the drawings, to be flush or surface mounted as required. Manual stations shall contain the intelligence for reporting address, identity, alarm and
trouble to the fire alarm control panel. The manual station communications shall allow the station to provide alarm input to the system and alarm output from the system within less than four (4) seconds.

2. The manual station shall be equipped with terminal strip and pressure style screw terminals for the connection of field wiring. Surface mounted stations where indicated on the drawings shall be mounted using a manufacturer's prescribed matching red enamel outlet box.

3. Provide double action pull station (keyswitch operated). Key shall be identical to the keys for the control panel.

4. All pull stations shall be mounted to a backbox mounted in the wall.

G. Addressable Interface Devices

1. Addressable interface devices shall be provided to monitor contacts for such items as water-flow, tamper, and PIV switches connected to the fire alarm system. These interface devices shall be able to monitor a single or dual contacts. An address will be provided for each contact. Where remote supervised relay is required the interface shall be equipped with a SPDT relay rated for 4 amps resistive and 3.5 amps inductive.

2. Where needed a conventional zone module shall connect to the signal line circuit, which will allow the use of conventional initiation devices. This module shall have the ability to support up to 15 convention smoke detectors and an unlimited number of contact devices. This module shall also be capable of monitoring linear beam detectors and conventional Flame detectors. Where required, there shall be an intrinsically safe detection solution for NEMA defined intrinsically safe installations compatible with the conventional zone module.

3. Single device damper monitoring and control: When connected to the FACP, a single switch input shall be able to monitor all 3 states of a damper – open, closed, and in transit. When connected to a FACP, a single relay shall be able to fully control a damper (through the relay connected to the motor control) while also using its switch input for monitoring all 3 states of the damper.

2.7 DEVICE PROGRAMMING UNIT

A. The programming tool shall program the intelligent devices with addresses. The unit shall test the device to respond to its address. Dipswitches and rotary switches shall not be acceptable. The programmer shall have carrying case.

2.8 ASPIRATION SMOKE DETECTION (Atrium Smoke Detection)

A. Single zone laser detection for 20,000 square feet coverage

1. Manufactured Units(s)
   a. Air Sampling smoke detection system.
   b. Many configurations are possible; Provide configurations:
      1) Detector with integral display

2. Detector Assembly
   a. The detector, filter, aspirator and relay outputs shall be housed in a mounting box and shall be arranged in such a way that air is drawn from the fire risk and a sample passed through the dual stage filter and detector by the aspirator.
   b. The detector shall be LASER-based type and shall have an obscuration sensitivity range of 0.0015 – 6% obsc/ft.
   c. The detector shall have four independent field programmable smoke alarm thresholds across its sensitivity range with adjustable time delays for each threshold between 0-60 seconds.
   d. The detector shall also incorporate facilities to transmit the following faults
      1) Detector
      2) Air flow
      3) Filter
      4) System
      5) Zone
      6) Network
      7) Power
      8) Urgent and minor faults. Minor faults shall be considered as servicing or maintenance signals. Urgent faults indicate the unit may not be able to detect smoke.
   e. The detector shall have four in-line sample pipe inlets and must contain a flow sensor for each pipe inlet. Both minor and urgent flow faults can be reported.
   f. The filter must be a two-stage disposable filter cartridge. The first stage shall be capable of filtering particles in excess of 20 microns from the air sample. The second stage shall be ultra-fine, removing more than 99% of contaminant particles of 0.3microns or larger, to provide a clean air barrier around the detector's optics to prevent contamination and increase service life.
g. The aspirator shall be a purpose-designed rotary vane air pump. It shall be capable of allowing for multiple sampling pipe runs up to 600 ft. in total, (4 pipe runs per detector) with a transport time of less than 120 seconds or as appropriate codes dictate.

h. The assembly must contain relays for alarm and fault conditions. The relays shall be software programmable to the required functions. The relays must be rated at 2 AMP at 30 VDC.

i. The assembly shall be able to be surface mounted to a wall or recessed in the wall cavity (the unit may be inverted in either option).

j. The assembly shall have built-in event and smoke logging. It shall store smoke levels, alarm conditions, operator actions and faults. The date and time of each event shall be recorded. Each detector (zone) shall be capable of storing up to 18,000 events and does not require the presence of a display in order to do so.

3. Displays
a. Each detector will incorporate a Display module.
b. Each display shall provide the following features at a minimum:
   1) A 20 segment bargraph display.
   2) Four independent high intensity alarm indicators, Alert, Action, Fire 1 and Fire 2, corresponding to the four alarm thresholds of the detector.
   3) Alarm threshold indicators for Alert, Action and Fire 1.
   4) Detector fault and airflow fault indicators.
   5) Faults originating in the particular zone (Zone Fault) shall be distinguished from those produced by the overall smoke detection system and from those resulting from network wiring errors (Network Fault). LED indicators shall be provided for each fault category.
   6) Minor and urgent fault LED indicators.
   7) A remotely mounted Display may be optionally equipped with 7 or 12 configurable relays for signaling alarm and fault conditions.
   8) Four buttons supporting the following features:
      a) Mode/Test - Scrolls through the information on the Display's digital display: Sensitivity (Fire 1 Threshold setting), current smoke level and Zone number. When pressed and held initiates a lamp test on the individual display module.
      b) Silence - Silences all devices on the system
      c) Reset - Unlatches all latched alarm conditions on the assigned zone.
      d) Isolate - Isolates the individual zone (inhibits Alarm and Fault relays and initiates Isolate relay).

4. Programmers
a. When required, a Programmer module may be located within the detector, a remote mounting box, a 19 inch remote rack, or in a portable hand-held unit. Alternatively, programming may be performed using a Windows® application running on a PC connected through a High Level Interfacing unit.
b. Each Programmer shall support the following features at a minimum:
   1) Programming of any device on the system.
   2) Viewing of the status of any device in the system.
   3) Adjustment of the alarm thresholds of a nominated detector.
   4) Setting of day/night, weekend and holiday sensitivity threshold settings.
   5) Initiation of an automated environmental compensation system to automatically configure the detector's alarm threshold settings to suit the current environment.
   6) Multi-level password control.
   7) Programmable latching or non-latching relay operation.
   8) Programmable energized or de-energized relays.
   9) Programmable high and low flow settings for airflow supervision.
   10) Programmable aspirator speed control.
   11) Programmable maintenance intervals.
   12) Facilities for referencing with time dilution compensation.
   13) Testing of relays assigned to a specific zone to aid commissioning.

5. Device Networking Requirements
a. The devices in the smoke detection system shall be capable of communicating with each other via twisted pair RS485 cable. The network shall be able to support up to 250 devices (detectors, displays and programmers), of which at least 100 detectors can be supported.
b. The network shall be capable of being configured in a fault tolerant loop for both short circuit and open circuit. Any communication faults shall be reported unambiguously and shall be clearly attributable to an individual device or wire link in the fault messages.
PC based configuration tools shall be available to configure and manage the network of detectors.

Digital Communication Port

Application
a. Detection alarm levels: The laser based air sampling detection system shall have four (4) independently programmable alarm thresholds. The four alarm levels may be used as follows:
   1) Alarm Level 1 (Alert)
      a) Activate a visual and audible alarm in the fire risk area.
   2) Alarm Level 2 (Action)
      a) Activate the electrical/electronic equipment shutdown relay and activate visual and audible alarms in the security office or other appropriate location.
   3) Alarm Level 3 (Fire 1) initiates an alarm condition in the fire alarm control panel to call the Fire Brigade and activate all warning systems.
   4) Alarm Level 4 (Fire 2)
      a) Activate a suppression system and/or other suitable countermeasures.

b. Initial Detection Alarm Settings: Initial settings for the alarm levels shall be determined by the requirements of the fire zone. However, the setting for Fire 1 (Alarm Level 3) shall always appear as 100% on the bargraph scale. Default settings of the unit shall be:
   1) Alarm Level 1 (Alert) .025% Obsc/ft
   2) Alarm Level 2 (Action) 0.044% Obsc/ft
   3) Alarm Level 3 (Fire 1) 0.062% Obsc/ft
   4) Alarm Level 4 (Fire 2) 0.61% Obsc/ft

c. Initial (factory default) Alarm Delay Thresholds: Initial (factory default) settings for the alarm delay threshold shall be:
   1) Alarm Level 1 (Alert) 10 seconds
   2) Alarm Level 2 (Action) 10 seconds
   3) Alarm Level 3 (Fire 1) 10 seconds
   4) Alarm Level 4 (Fire 2) 10 seconds
   5) Fault Alarm 5 seconds

d. Fault Alarms: The detector fault relay shall be connected to the appropriate alarm zone on the fire alarm control panel in such a way that a Detector Fault would register a fault condition on the FACP. The Minor Fault and Isolate relays shall also be connected to the appropriate control system.

e. Power Supply and Batteries: The system shall be powered from a regulated supply of nominally 24V DC. The battery charger and battery shall comply with the relevant Codes, Standards or Regulations. Typically 24 hours standby battery backup is required followed by 30 minutes in an alarm condition.
   1) Local Power Supply Standards that may apply:
      a) UL 1481 Listed (provided the power supply and standby batteries have been appropriately sized/rated to accommodate the system’s power requirements).

8. Sampling Pipe Design
a. Sampling Pipe
   1) The sampling pipe shall be smooth bore with an internal diameter between ¾ to 1 inch. Normally, pipe with an outside diameter of 1 inch and internal diameter of ¾” should be used.
   2) The pipe material should be suitable for the environment in which it is installed, or should be the material as required by the specifying body.
   3) All joints in the sampling pipe must be air tight and made by using solvent cement, except at entry to the detector.
   4) The pipe shall be identified as Air Sampling Smoke Detector Pipe (or similar wording) along its entire length at regular intervals not exceeding the manufacturers’ recommendation or that of local codes and standards.
   5) All pipes should be supported at not less than 5ft centers, or that of the local codes or standards.
   6) The far end of each trunk or branch pipe shall be fitted with an end cap and drilled with a hole appropriately sized to achieve the performance as specified and as calculated by the system design.

b. Sampling Holes
   1) Sampling holes of 5/64”, or otherwise appropriately sized holes (see Section 3.05), shall not be separated by more than the maximum distance allowable for
conventional point detectors as specified in the local code or standard. Intervals may vary according to calculations.

2) Per N.F.P.A. 72 the maximum allowable distance between sample points is 30 feet.
3) Each sampling point shall be identified in accordance with Codes or Standards.
4) Consideration shall be given to the manufacturers’ recommendations and standards in relation to the number of Sampling Points and the distance of the Sampling Points from the ceiling or roof structure and forced ventilation systems.

2.9 NOTIFICATION APPLIANCES

A. Strobes
1. The strobes shall meet and be listed for UL Standard 1971 (Emergency Devices for the Hearing-Impaired) for Indoor Fire Protection Service
2. Strobe shall be listed for indoor use, and shall meet the requirements of FCC Part 15 Class B
3. Strobe appliances shall produce a flash rate of one (1) flash per second over the Regulated Voltage Range, and shall incorporate a Xenon flash tube enclosed in a rugged Lexan® lens
4. All inputs shall be compatible with standard, reverse polarity supervision of circuit wiring by a Fire-Alarm Control Panel (FACP)
5. The Strobe shall be of low-current design
6. The strobe intensity shall have field-selectable settings, and shall be rated per UL Standard 1971 for 15/30/75/95 cd or 115/177 cd for ceiling mount where Multi-Candela appliances are specified
7. The selector switch for selecting the candela shall be tamper resistant
8. The appliance shall be compatible with power supplies with built-in sync protocol when synchronization is required
9. The strobes shall not drift out of synchronization at any time during operation
10. 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
11. The strobes shall be designed for indoor surface of flush mounting
12. 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
13. 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
14. All notification appliances shall be backward compatible
15. Devices ceiling mounted shall be installed within 1" of the center of the ceiling tiles.
16. All ceiling and wall mounted devices shall have backboxes. All ceiling backboxes must be supported from the structure or the ceiling grid, not the ceiling tile.

B. Speaker and Speaker Strobes
1. 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
2. Speaker with strobes shall be certified to meet the requirements of FCC Part 15, Class B
3. 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
4. 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
5. Speaker shall incorporate a sealed-back construction
6. All inputs shall employ terminals that accept #12 to #18 AWG wire sizes
7. Strobe intensity, where Multi-Candela appliances are specified, shall have field-selectable settings, and shall be rated per UL Standard 1971 for:
   a. 15/30/75/110 cd (ceiling mounting)
   b. 135/185 cd (ceiling mounting)
8. Selector switch for selecting the candela shall be tamper resistant
9. The strobe portion, when synchronization is required, shall be compatible with power supply with built-in protocol.
10. The strobes shall not drift out of synchronization at any time during operation
11. 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)
12. Wall-mount speaker and speaker-strobe appliances shall be designed for indoor-flush mounting to 4” x 2-1/8” electrical boxes without need for an extension ring or surface mounting
13. Ceiling-mount, speaker-strobe appliances shall be designed for indoor-flush mounting
14. Speaker and speaker strobe shall incorporate a speaker-mounting plate with a snap-on grille cover
15. The finish of the speakers and speaker strobes shall be red.
16. All speaker and speaker-strobe appliances shall be listed for Special Applications: Strobes are
designed to flash at 1-flash-per-second minimum over their “Regulated Input Voltage Range”
17. Devices ceiling mounted shall be installed within 1” of the center of the ceiling tiles.
18. All ceiling and wall mounted devices shall have backboxes. All ceiling backboxes must be
supported from the structure or the ceiling grid, not the ceiling tile.
19. Speakers in the stairwells and elevator cabs shall be set up for paging only from the fire alarm
control panel.

C. Vandal-Resistant Speakers
1. 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
2. Speaker with strobes shall be certified to meet the requirements of FCC Part 15, Class B
3. Models shall be listed for outdoor use under UL Standard 1480
4. All models shall have listed sound output of up to 87 dB at 10 feet and a listed frequency response
of 400 to 4000 Hz
5. All speakers shall include both 25 and 70 volt VRMS inputs with field-selectable power taps from
1/8 to 8 watts, with listed sound output up to 94 dB for speakers or speaker strobes
6. All models have provisions for standard NAC supervision and IN / OUT field wiring using
terminals that accept #12 to #18 AWG wiring
7. Combination speaker strobe appliances shall incorporate a Xenon flash tube enclosed in a rugged
Lexan® lens or equivalent with solid-state circuitry
8. Strobes shall meet UL Standard 1971, and produce a flash rate of one (1) flash per second
minimum over the listed input voltage (16VDC-33VDC) range
9. Multi-candela strobe intensity shall be rated per UL Standard 1971 at 15/30/75/110cd
10. All strobe versions shall incorporate circuitry for synchronized strobe flash, and shall be designed
for compatibility with power supply.
11. All UL Standard 1971 Listed strobe appliances shall be verified to meet FCC Part 15, Class “B”
12. Strobe activation shall be via independent input from the speaker notification appliance circuit
13. Speaker and speaker-strobe appliances shall be designed for indoor surface or flush mounting
14. All speaker and speaker-strobe appliances shall be listed for Special Applications: Strobes are
designed to flash at 1-flash-per-second minimum over their “Regulated Input Voltage Range”
15. Devices ceiling mounted shall be installed within 1” of the center of the ceiling tiles.
16. All ceiling and wall mounted devices shall have backboxes. All ceiling backboxes must be
supported from the structure or the ceiling grid, not the ceiling tile.

D. Horn Strobes and Horns
1. Appliances shall meet and be listed for UL Standard 1971(Emergency Devices for the Hearing-
Impaired for Indoor Fire Protection Service)
2. Horn shall be UL Listed under Standard 464 (Fire Protective Signaling)
3. Horn strobe shall be listed for indoor use, and shall meet the requirements of FCC Part 15 - Class B
4. All inputs shall be compatible with standard reverse polarity supervision of circuit wiring by the Fire
Alarm Control Panel (FACP)
5. 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
6. 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 flash tube enclosed in a rugged
Lexan® lens
7. Horn shall be of low-current design
8. 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
9. The selector switch for selecting the candela setting shall be tamper resistant
10. The appliance, when synchronization is required, shall be compatible with Power Supplies.
11. The strobes shall not drift out of synchronization at any time during operation
12. 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)
13. The appliance shall also be designed so that the audible signal may be silenced while maintaining
strobe activation
14. 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.
15. If required, an NATP (Notification Appliance Trim Plate) shall be provided
16. 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”

17. All candela ratings represent minimum-effective Strobe intensity, based on UL Standard 1971.
18. 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% (± 2%)
19. Horns shall be listed under UL Standard 464 for audible signal appliances (Indoor use only)
20. Devices ceiling mounted shall be installed within 1” of the center of the ceiling tiles.
21. All ceiling and wall mounted devices shall have backboxes. All ceiling backboxes must be supported from the structure or the ceiling grid, not the ceiling tile.

2.10 ACCESSORIES

A. Door Holders
1. Door holders shall be semi recessed, 24 volt. The unit shall operate in conjunction with the fire alarm system to provide automatic release of the door as indicated in the sequence of operation. The unit shall be UL listed. The door holder shall be wired to the fire alarm system in accordance with the National Electrical Code wiring practice.

B. Remote Annunciator
1. Remote LCD Alphanumeric Annunciator: Shall have LCD display functions for alarm, supervisory, and trouble indications as well as event location information.

2.10 DIGITAL COMMUNICATOR

A. The Multi-Point Digital Alarm Communicator shall be UL864 listed to provide point identification of alarm, supervisory, security and trouble events to a Central or Remove Receiving Station. The Communicator shall support the following:
1. Ademco Contact ID or SIA protocol
2. Ademco Contact ID selection shall provide the ability to transmit events for up to 999 individual points
3. SIA selection shall provide the ability to transmit events for up to 2040 individual points
4. Programming of accounts and phone numbers
5. Dual phone line interface
7. Automatic 24-hour test

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 1-2006, Standard of Good Workmanship in Electrical Contracting.
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. Provide primary power for each panel from normal/emergency panels as indicated on the Electrical Power Plans. Power shall be 120 VAC service, transformed through a two-winding, isolation type transformer and rectified to low voltage DC for operation of all circuits and devices.

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 system" decal or silk-screened label shall be applied to all junction box covers.

3.4 CONDUCTORS
A. Each conductor shall be identified as shown on the drawings at each with wire markers at terminal points.
A. 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,
B. 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
C. shielded, speaker circuits; 16 AWG twisted.
D. All splices shall be made using solderless connectors. All connectors shall be installed in conformance with
D. the manufacturer recommendations.
E. The installation contractor shall submit for approval prior to installation of wire, a proposed color code for
E. 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
F. maintenance.
G. Wiring for notification appliance circuits and associated circuits required to activate the notification appliance
G. circuits shall be installed in a 2 hour enclosure or rated for 2 hour survivability until the circuit enters the
G. 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
A. 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
B. 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
A. 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.
D. 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,
A. 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 engineer 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 Aon Fire Protection Engineering Corporation and witnessed by EH&S at UTSW. Aon Fire Protection Engineering will be responsible for signoff of the system.

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 by the owner 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: Notify the owner in writing when the system is ready for final acceptance testing. Submit request for test at least 14 calendar days prior to the test date. Test the system in accordance with the procedures outlined in NFPA 72.
   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 acceptance inspector 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 acceptance inspector 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% 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
   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.

H. Aspiration Smoke Detector System Tests
1. The contractor shall allow for the manufacturer’s representative to attend commissioning of the entire installation in the presence of the owner and/or its representative.

2. All necessary instrumentation, equipment, materials and labor shall be provided by the Contractor.

3. The Contractor shall record all tests and system calibrations and a copy of these results shall be retained on site in the System Log Book.

4. System Checks
   a. Visually check all pipes to ensure that all joints, fittings, bends, sampling points, etc., comply with the Specification.
   b. Check the system to ensure the following features are operational and programmed in accordance with the specification.
      1) Alarm threshold levels
      2) Detector address
      3) Time and date
      4) Time delays
      5) Air flow fault thresholds
      6) External button operable (Reset/Isolate)
      7) Referencing
   c. Units set to U.S./S.I.
   d. Check to ensure that all ancillary warning devices operate as specified.
   e. Check interconnection with Fire Alarm Control Panel to ensure correct operation.

5. Tests
   a. Introduce Smoke into the Detector Assembly to provide a basic functional test.
   b. Introduce smoke to the least favorable Sampling Point in each Sampling Pipe. Transport time is not to exceed two minutes.
   c. Activate the appropriate Fire Alarm zones and advise all concerned that the system is fully operational. Fill out the log book and commissioning report accordingly.
   d. If more than two bargraph divisions illuminate under normal conditions (no smoke), review event log for two (2) weeks from date of commissioning and make appropriate adjustments to the alarm and delay thresholds.

3.9 DOCUMENTATION
   A. System documentation shall be furnished to the owner 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.

3.10 PROTECTION
   A. Remove and replace devices and panel components that are wet, moisture damaged, or mold damaged.

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. The instruction may be divided into two or more periods at the discretion of the owner. One training session shall be videotaped by the contractor. Videotapes shall be delivered to the owner.
   D. Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame. Install the frame in a conspicuous location observable from the FACP. The card shall show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, supervisory and trouble. The instructions shall be approved by the owner.
   E. 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.
F. 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.

G. 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.

END OF SECTION