



Missouri State
U N I V E R S I T Y

PLANNING, DESIGN & CONSTRUCTION

901 South National Avenue
Springfield, Missouri 65897

Phone: (417) 836-5101

Fax: (417) 836-6884

www.design.missouristate.edu

designandconstruction@missouristate.edu

HOOD-RICH ARCHITECTURE

400 South Ave, Suite 300

Springfield, Missouri 65806

Phone: (417) 862-4483

hoodrich.com

**Renovate Football Locker Room,
Forsythe Athletics Center**

PROJECT NUMBER: 240913-017

August 05, 2024

TECHNICAL SPECIFICATION INDEX

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 011000 – SUMMARY
SECTION 012500 – CONTRACT MODIFICATION PROCEDURES
SECTION 013100 – PROJECT MANAGEMENT AND COORDINATION
SECTION 013200 – CONSTRUCTION PROGRESS DOCUMENTATION
SECTION 013300 – SUBMITTAL PROCEDURES
SECTION 013300.1 – SECOND PARTY USER AGREEMENT FOR DRAWINGS
SECTION 014000 – QUALITY REQUIREMENTS
SECTION 014200 – REFERENCES
SECTION 015000 – TEMPORARY FACILITIES AND CONTROLS
SECTION 016000 – PRODUCT REQUIREMENTS
SECTION 016350 – SUBSTITUTION PROCEDURES
SECTION 017000 – EXECUTION REQUIREMENTS
SECTION 017320 – SELECTIVE DEMOLITION
SECTION 017700 – CLOSEOUT PROCEDURES
SECTION 019113 – GENERAL COMMISSIONING REQUIREMENTS

DIVISION 03 - CONCRETE

SECTION 033000 – CAST-IN-PLACE CONCRETE

DIVISION 04 - MASONRY

SECTION 042200 - CONCRETE UNIT MASONRY

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

SECTION 061600 - SHEATHING
SECTION 064116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS
SECTION 068300 – COMPOSITE PANELING

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 078413 - PENETRATION FIRESTOPPING
SECTION 078443 - JOINT FIRESTOPPING
SECTION 079200 - JOINT SEALANTS

DIVISION 08 - OPENINGS

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES
SECTION 08211 – FLUSH WOOD DOORS
SECTION 087100 - DOOR HARDWARE

DIVISION 09 - FINISHES

SECTION 092216 - NON-STRUCTURAL METAL FRAMING
SECTION 092900 - GYPSUM BOARD
SECTION 093013 - CERAMIC TILING
SECTION 095113 - ACOUSTICAL PANEL CEILINGS
SECTION 096513 - RESILIENT BASE AND ACCESSORIES
SECTION 096516 - RESILIENT SHEET FLOORING
SECTION 096519 - RESILIENT TILE FLOORING
SECTION 099124 - INTERIOR PAINTING (MPI STANDARDS)

DIVISION 10 - SPECIALTIES

SECTION 101400 - SIGNAGE
SECTION 102113.17 – PHENOLIC-CORE TOILET COMPARTMENTS
SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES
SECTION 105123 – PLASTIC-LAMINATE-CLAD LOCKERS
SECTION 105200 – FIRE PROTECTION SPECIALTIES

DIVISION 12 - FURNISHINGS

SECTION 123661.16 - SOLID SURFACING COUNTERTOPS

DIVISION 21 – FIRE SUPPRESSION

SECTION 210500 – COMMON WORK RESULTS FOR FIRE SUPPRESSION
SECTION 211310 – FIRE SUPPRESSION SPRINKLER SYSTEMS

DIVISION 22 – PLUMBING

SECTION 220500 – COMMON WORK RESULTS FOR PLUMBING
SECTION 221523 – VALVES FOR PLUMBING PIPING
SECTION 220529 – HANGERS, SUPPORT, AND VIBRATION ISOLATION FOR PLUMBING PIPING AND EQUIPMENT
SECTION 220553 – IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
SECTION 220700 – PLUMBING INSULATION
SECTION 220800 – COMMISSIONING OF PLUMBING SYSTEMS
SECTION 221100 – FACILITY PIPING AND SPECIALTIES
SECTION 224000 – PLUMBING FIXTURES

DIVISION 23 – HEATING, VENTILATION, AND AIR CONDITIONING

SECTION 230500 – COMMON WORK RESULTS FOR HVAC
SECTION 230514 – VARIABLE FREQUENCY DRIVES
SECTION 230519 – METERS AND GAUGES
SECTION 230523 – VALVES FOR HVAC PIPING
SECTION 230529 – HANGERS, SUPPORTS, AND VIBRATION ISOLATION FOR HVAC PIPING AND EQUIPMENT
SECTION 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
SECTION 230593 – TESTING AND BALANCING
SECTION 230700 – HVAC INSULATION
SECTION 230701 – HVAC PIPING INSULATION
SECTION 230800 – COMMISSIONING OF HVAC SYSTEMS
SECTION 230902 – BUILDING MANAGEMENT CONTROLS SYSTEM
SECTION 232113 – HVAC PIPING AND SPECIALTIES
SECTION 232123 – HVAC PUMPS
SECTION 233113 – HVAC DUCTWORK
SECTION 233300 – AIR DUCT ACCESSORIES
SECTION 233600 – AIR TERMINAL UNITS
SECTION 233713 – GRILLES, REGISTERS, AND DIFFUSERS
SECTION 237200 – ENERGY RECOVERY UNIT

DIVISION 26 – ELECTRICAL

SECTION 260500 – COMMON WORK RESULTS FOR ELECTRICAL
SECTION 260519 – CONDUCTORS AND CABLES
SECTION 260533 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
SECTION 260553 – IDENTIFICATION FOR ELECTRICAL EQUIPMENT AND WIRING
SECTION 260800 – COMMISSIONING OF ELECTRICAL SYSTEMS
SECTION 260923 – LIGHTING CONTROL DEVICES
SECTION 262416 – PANELBOARDS
SECTION 262726 – WIRING DEVICES
SECTION 265100 – LIGHT FIXTURES

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

SECTION 280500 – COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY
SECTION 283111 – ADDRESSABLE FIRE ALARM SYSTEM

END OF TENCHINCAL SPECIFICATIONS INDEX

(ARCHITECTURAL SEAL)

(MEP SEAL)

SECTION 011000 - SUMMARY

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. Access to site.
 - 4. Coordination with occupants.
 - 5. Work restrictions.
 - 6. Specification and drawing conventions.

- B. RELATED DOCUMENTS

- 1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

- A. Project Identification: Renovate Football Locker Room, Forsythe Athletics Center

- 1. Project Location: 827 S. Kings St. - Missouri State University, Springfield, Missouri.

- B. Owner: Missouri State University.

Owner's Representative:

Planning Design & Construction,
901 S. National Avenue,
Springfield, Missouri, 65897
(417) 836-5101

- C. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:

MEP Consultant:

Interpres Building Solutions
1201 South Campbell Ave.
Springfield, MO 65807
(417) 631-4895

Commissioning Consultant:

Entegrity Partners
288 S School Ave, Suite 110
Fayetteville, AR 72701
(305) 393-2308

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. This renovation work includes partial interior renovations to the existing football locker room facilities, support spaces and corridor finish upgrades along with minor interior updates to the existing main entrance area. This work also includes strategic upgrades to the the mechanical, electrical, fire alarm and plumbing systems.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.5 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. 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.

1.6 COORDINATION WITH OCCUPANTS

A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, except for 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.

1.7 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Work hours shall be unrestricted during the construction period starting on or around October 7, 2024 and ending on or before August 1, 2025.

- 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. Refer to General Conditions and Request for Utility Interruption in Appendix B – Contracting forms.
 - 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 on the campus of Missouri State University.
- F. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

1.8 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 Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - 2. Abbreviations: Materials and products are identified by abbreviations 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.

END OF SECTION 01100

SECTION 012500 - CONTRACT MODIFICATION PROCEDURES

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 handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 01635 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

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

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Architect.

- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include costs of labor and supervision directly attributable to the change.
 - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - 6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 - 7. Proposal Request Form: Use form acceptable to Architect.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

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

END OF SECTION **01250**

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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. Requests for Information (RFIs).
 - 4. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Section 01320 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 01770 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, 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.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. 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.
 - 8. Startup and adjustment of systems.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
 - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

- a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
- b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
- c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
- d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
- e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
- f. Indicate required installation sequences.
- g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

1.7 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 1. Project name.
 2. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
 1. Attachments shall be electronic files in Adobe Acrobat PDF format.

- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

1.8 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
1. Conduct the conference to review responsibilities and personnel assignments.
 2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Lines of communications.
 - f. Procedures for processing field decisions and Change Orders.

- g. Procedures for RFIs.
 - h. Procedures for testing and inspecting.
 - i. Procedures for processing Applications for Payment.
 - j. Submittal procedures.
 - k. Preparation of record documents.
 - l. Use of the premises and existing building.
 - m. Work restrictions.
 - n. Working hours.
 - o. Owner's occupancy requirements.
 - p. Responsibility for temporary facilities and controls.
 - q. Procedures for moisture and mold control.
 - r. Procedures for disruptions and shutdowns.
 - s. Construction waste management and recycling.
 - t. Parking availability.
 - u. Office, work, and storage areas.
 - v. Equipment deliveries and priorities.
 - w. First aid.
 - x. Security.
 - y. Progress cleaning.
 - 4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity 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, and Owner's Commissioning Authority of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility requirements.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written instructions.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.

- u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
 - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 30 days prior to the scheduled date of Substantial Completion.
- 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 - 2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of record documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. Requirements for preparing operations and maintenance data.
 - e. Requirements for delivery of material samples, attic stock, and spare parts.
 - f. Requirements for demonstration and training.
 - g. Preparation of Contractor's punch list.
 - h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - i. Submittal procedures.
 - j. Owner's partial occupancy requirements.
 - k. Installation of Owner's furniture, fixtures, and equipment.
 - l. Responsibility for removing temporary facilities and controls.
 - 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at biweekly intervals.
- 1. Coordinate dates of meetings with preparation of payment requests.
 - 2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Progress cleaning.
 - 10) Quality and work standards.
 - 11) Status of correction of deficient items.
 - 12) Field observations.
 - 13) Status of RFIs.
 - 14) Status of proposal requests.
 - 15) Pending changes.
 - 16) Status of Change Orders.
 - 17) Pending claims and disputes.
 - 18) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- F. Coordination Meetings: Conduct Project coordination meetings at appropriate intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
 1. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority 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 meetings shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined 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. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor 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) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Change Orders.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

END OF SECTION **01310**

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

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 documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's construction schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily construction reports.
 - 5. Special reports.
- B. Related Requirements:
 - 1. Section 01330 "Submittal Procedures" for submitting schedules and reports.
 - 2. Section 01400 "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

- G. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file, where indicated.
2. PDF electronic file.
3. Two paper copies.

- B. Startup construction schedule.

1. Approval of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.

- E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of all activities sorted in ascending order of total float.
4. Earnings Report: Compilation of Contractor's total earnings from the Notice to Proceed until most recent Application for Payment.

- F. Construction Schedule Updating Reports: Submit with Applications for Payment.

- G. Daily Construction Reports: Submit at weekly intervals.

- H. Special Reports: Submit at time of unusual event.

- I. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.
- B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01310 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
 - 1. Review software limitations and content and format for reports.
 - 2. Verify availability of qualified personnel needed to develop and update schedule.
 - 3. Discuss constraints, including phasing, work stages, interim milestones, and partial Owner occupancy.
 - 4. Review delivery dates for Owner-furnished products.
 - 5. Review schedule for work of Owner's separate contracts.
 - 6. Review submittal requirements and procedures.
 - 7. Review time required for review of submittals and resubmittals.
 - 8. Review requirements for tests and inspections by independent testing and inspecting agencies.
 - 9. Review time required for Project closeout and Owner startup procedures.
 - 10. Review and finalize list of construction activities to be included in schedule.
 - 11. Review procedures for updating schedule.

1.6 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice of Award to date of Substantial Completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.

2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Section 01330 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
 2. Work under More Than One Contract: Include a separate activity for each contract.
 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 01100 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01100 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 6. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Uninterruptible services.
 - b. Partial occupancy before Substantial Completion.
 - c. Use of premises restrictions.
 7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Startup and placement into final use and operation.
 8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

a. Substantial Completion.

- D. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.
 2. Unanswered Requests for Information.
 3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
 5. Pending modifications affecting the Work and Contract Time.
- E. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

2.2 STARTUP CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule within seven days of date established for the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 30 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 30 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's construction schedule using a time-scaled CPM network analysis diagram for the Work.
1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for the Notice to Proceed.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.

- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing.
 - j. Punch list and final completion.
 - k. Activities occurring following final completion.
 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
 5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.
 - a. Each activity cost shall reflect an appropriate value subject to approval by Architect.
 - b. Total cost assigned to activities shall equal the total Contract Sum.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.

8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the schedule of values).

G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.

1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
 - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
 - b. Submit value summary printouts one week before each regularly scheduled progress meeting.

2.4 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (see special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.

19. Substantial Completions authorized.

2.5 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At Bi-Weekly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate final completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION **013200**

SECTION 013300 - SUBMITTAL PROCEDURES

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.
- B. Related Requirements:
 - 1. **General Conditions, Article 38 –Shop Drawings, Product Data, and Samples**
 - 2. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.

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. 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.
- C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

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 revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
 - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 - 2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 - 3. Final Submittal: 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 date of fabrication.
 - h. Scheduled dates for purchasing.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Limited Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
- B. Architect will furnish base plan and reflected ceiling plan. Contractor must fill out second party agreement form 013300.1, following this specification before files will be provided.
- C. 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.
- D. 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.
- E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 - 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. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:
 - 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. Names of subcontractor, manufacturer, and supplier.
 - g. Category and type of submittal.
 - h. Submittal purpose and description.
 - i. Specification Section number and title.
 - j. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - k. Drawing number and detail references, as appropriate.
 - l. Location(s) where product is to be installed, as appropriate.
 - m. Related physical samples submitted directly.
 - n. Indication of full or partial submittal.
 - o. Transmittal number, numbered consecutively.
 - p. Submittal and transmittal distribution record.
 - q. Other necessary identification.
 - r. Remarks.
- F. Options: Identify options requiring selection by Architect.
- G. Deviations and Additional Information: 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.
- H. 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.

- I. 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.
- J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. **Refer to the General Conditions, Article 38 – Shop Drawings, Product Data, and Samples for specific requirements from the Owner.** General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Web-Based Project Software as hosted by the General Contractor: Prepare submittals and other project-related information and documents (Change Order, RFIs, etc.) in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
 - a. This Project requirement will be Contractor-provided.
 - b. Owner prefers PLANGRID software, but is not a Project requirement.
- 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.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
- 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 - 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches.
 - 3. Submit Shop Drawings in the following format:
 - a. PDF electronic file.
- 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.
 - e. Specification paragraph number and generic name of each item.
 - 3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
 - 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 - 5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
 - 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 or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
 5. Submit product schedule in the following format:
 - a. PDF electronic file.
- F. Coordination Drawing Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."
- G. Contractor's Construction Schedule: Comply with requirements specified in Section 01320 "Construction Progress Documentation."
- H. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01400 "Quality Requirements."
- I. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."
- J. 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.
- K. 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.

- L. 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.
- M. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- N. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- O. 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.
- P. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- Q. 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.
- 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 written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- 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 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: See requirements in Section 017700 "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. 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.
- B. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- D. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION **013300**

SECTION 013300.1 - SECOND PARTY USER AGREEMENT FOR DRAWINGS

SECOND PARTY USER AGREEMENT FOR CAD GENERATED DRAWINGS

NOTICE. By using this computer-generated drawing, you indicate your acceptance of the following terms and conditions. The purpose of this Agreement is to set forth the conditions for the use by a Second Party (User) of computer-generated drawings prepared by Hood-Rich, Inc. Hood-Rich, Inc. retains ownership of the information contained on the drawings; permission to use these materials is given only subject to the terms of this Agreement. The cost for electronic files is \$0.00 per sheet (not per file, not per CD).

ARTICLE 1. The information recorded on computer-generated drawings represents a portion of the services performed by Hood-Rich, Inc. No representation is made by Hood-Rich, Inc. that the electronic data is suitable or accurate for the purpose of bidding and/or as a direct tool used for construction. Hood-Rich, Inc. grants permission to use its computer-generated drawings with this understanding and with no liabilities either expressed or implied for accuracy or completeness. The User agrees to hold harmless and defend Hood-Rich, Inc. in the event of any action against or by the User for the preparation of information generated through the use of computer-generated drawings prepared by Hood-Rich, Inc. Further, in the event of such legal action, the User agrees to pay reasonable attorney's fees and expenses incurred by Hood-Rich, Inc. in resolving the matter.

ARTICLE 2. Computer-generated drawings are made available solely for the facilitation of the User's work on the specific project identified below and no permission is granted herein for copying or reuse. The User's acceptance of these terms, which is communicated by opening or using this drawing, constitutes acceptance of liability and the acceptance of responsibilities for the coordination of any revisions and computer-generated interlineations made to the information transmitted.

ARTICLE 3. Utilization of computer-generated drawings not in accordance with the terms of this Agreement shall constitute a breach of this Agreement; Hood-Rich, Inc. will at such time demand return of its property and may seek legal recourse and the cost of reasonable fees.

Acceptance of these terms may have legal implications that should be reviewed with the User's legal counsel.

Project:

Printed Name and Title of Second Party User:

Signature:

Date:

SECTION 014000 - QUALITY REQUIREMENTS

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 quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
 - 1. Laboratory Mockups: Full-size physical assemblies constructed at testing facility to verify performance characteristics.
 - 2. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
 - 3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.

- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

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

1.5 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.

6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.
- 1.6 QUALITY ASSURANCE
- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or products that are similar in material, design, and extent to those indicated for this Project.
- F. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- G. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.7 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 - 2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
 - 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

- a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01330 "Submittal Procedures."
- D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 1. Notify Architect, Commissioning Authority, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.

6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.8 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
- B. Special Tests and Inspections: Conducted by a qualified testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect, Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's, reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION **014000**

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.

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: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.
- C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.
- D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.
- E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

END OF SECTION **014200**

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

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.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

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, Architect, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. 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- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
 - 1. Locations of dust-control partitions at each phase of work.
 - 2. HVAC system isolation schematic drawing.
 - 3. Location of proposed air-filtration system discharge.
 - 4. Waste handling procedures.
 - 5. Other dust-control measures.

1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

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-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.
- 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 TEMPORARY FACILITIES

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

2.3 EQUIPMENT

- A. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction.
- B. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

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 Section 011000 "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: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. 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. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- E. 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 according to 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.
- F. 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.
- G. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 2. Install lighting for Project identification sign.
- I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.
1. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.
- 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. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."
- C. 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.
- D. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
 - 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- C. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- D. 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 two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches 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.
 - 2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 - 3. Insulate partitions to control noise transmission to occupied areas.
 - 4. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 - 5. Protect air-handling equipment.

6. Provide walk-off mats at each entrance through temporary partition.

3.5 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. 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.

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. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.

3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION **015000**

SECTION 016000 - PRODUCT REQUIREMENTS

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.
- B. Related Requirements:
 - 1. Section 01635 "Substitution Procedures" for requests for substitutions.
 - 2. Section 01420 "References" for applicable industry standards for products specified.

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 Section 01330 "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 Section 01330 "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. Protect 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. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01770 "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.
 - 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 - 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 not be considered.
 - b. Nonrestricted 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 not be considered.
 - b. Nonrestricted 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 Section 01635 "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.

END OF SECTION **016000**

SECTION 016350 - SUBSTITUTION PROCEDURES

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 substitutions.
- B. Related Requirements:
 - 1. Section 012100 "Allowances" for products selected under an allowance.
 - 2. Section 012300 "Alternates" for products selected under an alternate.
 - 3. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.

1.4 ACTION SUBMITTALS

- A.
 - 1. Substitution Request Form: **Refer to Appendix A -Contracting Forms, Request For Substitution.**
 - 2. Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 3. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from applicable code organization.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
4. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

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

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Not allowed unless otherwise indicated.

END OF SECTION **016350**

SECTION 017000 – EXECUTION REQUIREMENTS

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:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.

- B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
4. Section 017320 "Selective Demolition" for demolition and removal of selected portions of the building.
5. Section 078410 "Through-Penetration Firestop Systems" for patching penetrations in fire-rated construction.

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 INFORMATIONAL SUBMITTALS

- A. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.

2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

- B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. 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. Fire-detection and -alarm systems.
 - i. Conveying systems.
 - j. Electrical wiring systems.
 - k. 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. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. 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.
- C. 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.
- D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to 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 Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- C. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 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.
 - 4. Maintain minimum headroom clearance of **96 inches** in occupied spaces and **90 inches** in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 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. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."
- F. 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.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. 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 and ensures thermal and moisture integrity of building enclosure.
 - I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.
- 3.6 OWNER-INSTALLED PRODUCTS
- A. Site Access: Provide access to Project site for Owner's construction personnel.
 - B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.
- 3.7 PROGRESS CLEANING
- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

- a. Use containers intended for holding waste materials of type to be stored.
- 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces 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 Section 01500 "Temporary Facilities and Controls."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "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 Section 014000 "Quality Requirements."

3.9 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.

END OF SECTION **017000**

SECTION 017320 - 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.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.
 - 2. Section 017000 "Execution Requirements" for cutting and patching procedures.

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. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. 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 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.6 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.
- 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.

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. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.

1. 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.
2. 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 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.
- B. Reuse of Building Elements: Project has been designed to result in end-of-Project rates for reuse of building elements as follows. Do not demolish building elements beyond what is indicated on Drawings without Architect's approval.
- C. 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.
- D. 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.
- E. 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.

3.3 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.
 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.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.4 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 **017320**

SECTION 017700 - CLOSEOUT PROCEDURES

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 contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Requirements:
 - 1. Section 017300 "Execution" for progress cleaning of Project site.

1.3 ACTION SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

1.5 MAINTENANCE MATERIAL SUBMITTALS

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

1.6 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
 5. Submit test/adjust/balance records.
 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 6. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 7. Complete final cleaning requirements, including touchup painting.
 8. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

2. Results of completed inspection will form the basis of requirements for final completion.

1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
 1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
 1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 1. Organize list of spaces in sequential order, starting with exterior areas first.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in the following format:
 - a. PDF electronic file. Architect will return annotated file.
 - b. Three paper copies. Architect will return two copies.

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
 - 4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - c. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

- c. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
- d. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
- e. Sweep concrete floors broom clean in unoccupied spaces.
- f. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
- g. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
- h. Remove labels that are not permanent.
- i. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- j. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- k. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- l. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
- m. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
- n. Leave Project clean and ready for occupancy.

- C. Construction Waste Disposal: Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
 - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION **017700**

SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes general requirements that apply to the implementation of the commissioning process without regard to specific systems, assemblies, and components.

1.2 RELATED REQUIREMENTS

- A. Section 220800 – Commissioning of Plumbing Systems
- B. Section 230800 – Commissioning of HVAC Systems
- C. Section 260800 – Commissioning of Electrical Systems

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASSOCIATED AIR BALANCE COUNCIL (AABC)

ACG Commissioning Guideline (2005) Commissioning Guideline

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB Commissioning Standard

(2009) Procedural Standards for Whole Building Systems Commissioning of New Construction; 3rd Edition

SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA)

SMACNA 1429 (1994) HVAC Systems
Commissioning Manual, 1st Edition

1.4 DEFINITIONS

- A. Acceptance Phase: Phase of construction after startup and initial checkout when functional performance tests, O&M documentation review and training occurs.
- B. Commissioning Agent (CxA): An independent party, not otherwise associated with the A/E team members or the Contractor, oversees, though he/she may be hired as a subcontractor to them. The CxA directs the day-to-day commissioning activities.
- C. Commissioning Plan: An overall plan that provides the structure, schedule, and coordination planning for the commissioning process.
- D. Construction Phase: Phase of construction at the beginning of construction when submittal review, commissioning plan, documentation of system verification checks of commissioned systems are completed, and TAB and Controls completes work.
- E. Data Logging: Monitoring flows, currents, status, pressures, etc. of equipment using stand-alone data loggers separate from the control system.
- F. Deferred Functional Tests: FPT's that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions that disallow the test from being performed.
- G. Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents (that is, does not perform properly or is not complying with the design intent).
- H. Functional Completion: All TAB and commissioning responsibilities of the Contractor, (except for seasonal or approved deferred testing and controls training), must be completed.
- I. Functional Performance Test (FPT): Test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional testing. TAB's primary work is setting up the system flows and pressures as specified, while functional testing is verifying that which has already been set up. The CxA develops the functional test procedures in a sequential written form, coordinates, oversees, and documents the actual testing, which is usually performed by the installing contractor or vendor. FPT's are performed after pre-functional checklists, startup, T&B, controls are complete. The subcontractor is responsible for reviewing, understanding, and performing the FPTs.

- J. Indirect Indicators: Indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed.
- K. Issues log: A formal and ongoing record of problems or concerns and their resolution that have been raised by members of the Commissioning Team during the course of the commissioning Process.
- L. Manual Test: Using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").
- M. Monitoring: The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or the trending capabilities of control systems.
- N. Over-written Value: Writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 50 F to 75 F to verify economizer operation). See also "Simulated Signal".
- O. Phased Commissioning: Commissioning that is completed in phases due to the size of the structure or other scheduling issues, in order to minimize the total construction time.
- P. Post-Acceptance Phase: Phase of the project after the Acceptance Phase. During this phase, commissioning requirements are to correct any deficiencies, carry out any required re-testing and off-season testing, O&M and close-out documentation review.
- Q. Pre-functional Checklist (PFC): A list of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided and completed by the CxA . Pre-functional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operations (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.).
- R. Sampling: Functionally testing only, a fraction of the total number of identical or nearidentical pieces of equipment.
- S. Seasonal Performance Tests: FPT that are deferred until the system(s) will experience conditions closer to their design conditions.
- T. Simulated Condition: Condition that is created for the purpose of testing the response of a system.
- U. Simulated Signal: Disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure to the transducer and DDC system to simulate a sensor value.
- V. Start up: The initial starting or activating of dynamic equipment, including executing pre-functional checklists.
- W. Test Procedures: The step-by-step process which must be executed to fulfill the test

requirements. The test procedures are developed by the CxA with assistance and coordination from GC and subcontractors.

- X. Test Requirements: Requirements specifying what modes and functions, etc. shall be tested. The test procedures are not the detailed test procedures. The test requirements are specified in the Contract Documents.
- Y. Trending: Monitoring using the building control system.

1.5 ABBREVIATIONS

- A. The following are common abbreviations used in the Specifications and in the Commissioning Plan.

- 1. A/E - Architect and Design Engineers
- 2. CxA - Commissioning Agent
- 3. CC - Controls Contractor
- 4. EC - Electrical Contractor
- 5. ES - Electronic Security Contractor
- 6. FPT - Functional Performance Test
- 7. GC - General Contractor (prime)
- 8. MC - Mechanical Contractor
- 9. PFC - Pre-functional Checklist
- 10. PM - Project Manager (of the Owner)
- 11. Subs - Subcontractors to General
- 12. TAB - Test and Balance Contractor

1.6 SYSTEM DESCRIPTION

- A. Commissioning:
 - 1. Perform Commissioning in accordance with the requirements of the standard under which the Commissioning Firm's qualifications are approved, i.e., ACG Commissioning Guideline, NEBB Commissioning Standard, or SMACNA 1429 unless otherwise stated herein. Use the Commissioning Standard for all aspects of Commissioning, including qualifications for the Commissioning Firm and Commissioning Agent. All quality assurance provisions of the Commissioning Standard such as performance guarantees shall be part of this contract. Commissioning procedures shall be developed by the Commissioning Agent and be in accordance with Commissioning Scope of Work provided by Missouri State University. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the

body responsible for the Commissioning Standard used (ACG, NEBB, or TABB), the requirements and recommendations in these procedures and requirements shall be considered mandatory.

2. This project will have the following selected building systems commissioned:
 - i. HVAC Systems
 - ii. Domestic Water Heating Systems (where applicable)
 - iii. Lighting Control Systems
3. The commissioning process encompasses and coordinates the functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents.
 - i. Verify that applicable equipment and systems are installed according to the contract specifications, manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
 - ii. Verify and document proper performance of equipment and systems.
 - iii. Provide a Commissioning Final Report.
 - iv. Verify that the Owner's operating personnel are adequately trained.
 - v. Set-up and review trending on all commissioned systems.

- B. The commissioning process does not reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product in accordance with the Contract Documents.

1.7 COMMISSIONING TEAM

- A. Members appointed by Owner:
 1. CxA - An entity identified by the owner who leads, plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the contracted commissioning agents under a separate contract.
 2. Representatives of the facility user and operation and maintenance personnel.
- B. Assistance/Documentation may be requested from the following team members:
 1. General Contractor Superintendent
 2. General Contractor Project Manager

3. Contractor Quality Control Manager
 4. Mechanical Subcontractor Representative
 5. Electrical Subcontractor Representative
 6. Testing, Balancing, and Adjusting Subcontractor Representative
 7. Instrumentation and Controls Subcontractor Representative
 8. Owner Furnished Equipment Manufacturer's Representatives
 9. Owner's Representative
- C. Provision of a fully commissioned system of all materials required under the construction contract is the responsibility of the General Contractor. Therefore, Contractor Group members of the Systems Commissioning Team, through participation in the planning, management, and oversight of all construction activities related to equipment approvals, performance testing, and commissioning of the systems identified herein must be able to assure the Owner that all systems have been properly tested and commissioned. The Owner is intended to participate fully as adjuncts to the Contractor Group Team members. It is intended that through this participation, the Contractor Group Team members will be provided timely access to all design information necessary to resolve questions as to intended performance of the systems specified. In addition, the Owner will be sufficiently involved in the development of commissioning and performance testing programs to assure timely review of plans and procedures submitted by the Contractor. The purpose of this process will be to provide fully functional systems which interact to meet all contract performance requirements. The participation of the Commissioning Team members shall not relieve the General Contractor of any responsibility for compliance with the requirements of the contract.

1.8 SCHEDULING

- A. The CxA will work with GC according to established protocols to schedule the commissioning activities. The CxA will review the Construction Schedule and verify that pre-functional and functional testing is properly scheduled. The GC will integrate all commissioning activities into the master schedule.
- B. Commissioning inspections and testing will be accomplished in the presence of a representative of the General Contractor, and the Owner with the CxA overseeing the process.

1.9 OVERVIEW OF THE COMMISSIONING PROCESS

- A. Commissioning Plan: The CxA will develop the commissioning plan which shall be included in the project schedule. The commissioning plan provides guidance and further details the requirements in the execution of the commissioning process. The Specifications take precedence over the Commissioning Plan in the event of a conflict.
- B. Commissioning Process: The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur.
 - 1. Commissioning during construction begins with a meeting conducted by the CxA where the commissioning process is reviewed with the commissioning team members during a scheduled monthly/biweekly contractors' meeting. This meeting will occur prior to the completion of the first Pre-functional Checklist.
 - 2. Additional meetings will be required throughout construction, scheduled by the CxA with necessary parties attending, to plan, scope, coordinate, schedule future commissioning related activities, and resolve problems.
 - 3. Equipment documentation, including Shop Drawings, installation instructions, detailed start up procedures are submitted to the CxA during the normal submittals process.
 - 4. In general, performance verification proceeds from component level to systems and intersystem levels with pre-functional checklists being completed before functional testing.
 - 5. The Subs, under their own direction, execute and document the pre-functional checklists before and during the start-up process with the GC and the CxA monitoring conformance.
 - 6. Prior to commencement of functional testing, the Commissioning Team shall perform a systems activation inspection to ensure the systems are ready to be functionally tested.
 - a. The GC will ensure all Pre-functional Checklists are completed. The contractor shall identify any missing checklists and provide as necessary.
 - b. The CxA will verify all Pre-functional Checklists, TAB and startup are complete for systems to be Functionally Tested.
 - 7. The CxA will prepare the Functional Testing protocols for execution by the GC and Subs.

8. The GC will schedule the Functional Testing after the Pre-Functional Checklists, TAB and startup are complete and the Functional Testing protocols have been reviewed by the GC and Subs.
9. The CxA will witness and document the Functional Testing process.
10. The GC will witness the Functional Testing process to insure completed by the Subs.
11. Items of non-compliance in material, installation or setup are noted for the Contractor to correct. Non-complying systems will then be retested, and functional performance verified by the GC and the CxA.
12. All functional performance tests are completed before Substantial Completion Date.
13. If applicable, the CxA will review the Closeout and O&M documentation for completeness.
14. The GC will review the training plan provided by the Subs. The GC and CxA will witness training session(s) to verify that acceptable training was provided. The GC shall video all training for the Owner.

1.10 RESPONSIBILITIES

- A. The general responsibilities of various parties in the commissioning process are provided in this subsection. The specific responsibilities will be included in the commissioning plan.
- B. Owner's Responsibilities:
 1. Provide the OPR documentation to the CxA for information and use.
 2. Attend initial commissioning meeting and additional meetings as necessary.
 3. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
 4. Assist the GC in coordinating the training of owner's personnel.
- C. Architect/Engineer Responsibilities:
 1. Provide the Basis of Design documents approved by the Owner to the CxA for use in developing the commissioning plan, operating and maintenance training plan, and final commissioning report.
 2. Attend commissioning team meetings as needed.
 3. Provide copies of all project documents including plans, specifications,

addenda, ASI, PR's, etc.

4. Provide any design narrative and sequences documentation requested by the CxA. The designers shall assist in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
5. Coordinate resolution of system deficiencies identified during commissioning, according to the contract documents.
6. Participate in the resolution of system deficiencies identified during commissioning, according to the contract documents.
7. Provide required Closeout documentation for the Systems Manual in accordance with contract documents.

D. Contractors Responsibilities:

1. Facilitate the coordination of the commissioning process and incorporate commissioning activities into the Master Project Schedule (MPS).
2. Ensure that all subcontractors and vendors execute their commissioning responsibilities according to the contract documents and the MPS.
3. Incorporate Cx Milestones into the Construction Schedule.
4. Provide copies of all submittals including all changes thereto to the CxA .
5. Attend and participate in commissioning team meetings.
6. Cooperate with the CxA for timely resolution of issues recorded in the issueslog.
7. Complete Pre-functional Checklists as work is completed and provide to the CxA for review and verification.
8. Schedule and conduct Owners Training.
9. Facilitate and ensure all Systems Manual documentation is provided to the owner according to the owner's requirements.

E. Commissioning Authority (CxA) Responsibilities - In general, the Commissioning Authority shall:

1. Organize and lead the commissioning team.
 2. Coordinate the commissioning work and with the GC and owner, help integrate commissioning activities into the Master Project Schedule.
- F. Specifically, the CxA shall complete all these responsibilities during the following phases of construction:
1. Pre-Construction Phase
 - i. Attend Pre-Construction Meeting
 - ii. Develop Commissioning Activities Schedule and Incorporate into Construction Schedule
 - iii. Lead Commissioning Kick-Off Meeting
 2. Construction Phase
 - i. Develop Pre-Functional Checklists
 - ii. Perform Ongoing Construction Observations
 - iii. Coordinate Completion of Pre-Functional Checklists
 - iv. Pre-Functional Checklist Verification
 - v. Maintain Commissioning Issues Log
 - vi. Verify Start-Up
 - vii. Develop Functional Performance Tests
 - viii. Lead Controls Coordination Meeting
 - ix. Review Test and Balance Report
 - x. Participate in MEP Above-Ceiling Inspections
 - xi. Complete Functional Testing
 - xii. Complete TAB Verification
 - xiii. Verify Owner Training
 3. Occupancy Phase

- i. Publish Initial Commissioning Report
 - ii. Review Commissioning Report with Owner Staff
- 4. Post-Occupancy Phase
 - i. Perform Seasonal/Deferred Commissioning
 - ii. Update Commissioning Issues Log
 - iii. Publish Final Commissioning Report

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. All testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the construction contractor for the equipment being tested.
- B. Special equipment, tools, and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and shall be left on site for use by the Owner.
- C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerance specified in the Specifications.

2.2 UTILITIES AND ACCESSORIES

- A. Provide utilities necessary to execute testing and commissioning, including water, fuels, chemicals, batteries, and other similar expendable items.
- B. Provide any equipment or device required for access, such as ladders, and platforms.

PART 3 - EXECUTION

3.1 SUBMITTALS

- A. Pre-Construction Phase
 - i. Commissioning Activities Schedule
- B. Construction Phase

- i. Commissioning Plan
 - ii. Pre-functional Checklists
 - iii. Functional Performance Test Procedures
- C. Occupancy Phase
 - i. Initial Commissioning Report
- D. Post-Occupancy Phase
 - i. Final Commissioning Report

3.2 START-UP AND PRE-FUNCTIONAL CHECKLISTS

- A. General: Pre-Functional checklists ensure that the equipment and systems are properly installed and operational. They ensure that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full pre-functional checkout. The pre-functional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
 - i. Execution of Start-Up and Pre-Functional Checklists
 - 1. The Subs and vendors shall execute startup and provide the GC with the signed and dated copy of the completed start-up documentation and pre-functional checklist. The CxA will verify 10 percent of the pre-function checklist.
 - 2. Only individuals that have direct knowledge and witnessed that a line-item task on the pre-functional checklist was actually performed shall initial or check that item off.
 - 3. The GC and CxA shall witness the Start-up.
- B. Deficiencies: The subcontractor shall list any outstanding items of the initial start-up and pre-functional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies shall be provided to the GC and the CxA within 2 days of test completion. The GC and CxA will review and monitor outstanding deficiencies. The GC and the subcontractor shall correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.
- C. PHASED COMMISSIONING: When startup and initial checkout are required to be executed in phases, this phasing will be planned and scheduled in a coordination meeting of the CxA, mechanical, plumbing, TAB, and controls contractor, and the GC. The GC shall modify the construction schedule as needed, to reflect phased commissioning.

3.3 FUNCTIONAL TESTING

A. Objectives and Scope:

1. The objective of functional testing is to demonstrate that each system is operating according to the Contract Documents. Functional testing facilitates bringing the systems to full dynamic operation. During the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems.
2. In general, each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze conditions, low oil pressure, no flow, equipment failure, etc. shall also be tested.
3. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub- systems at the discretion of the CxA and GC. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all pre-functional checklists as soon as possible.

B. Documentation and Non-Conformance:

1. Documentation: The GC and CxA will witness and the CxA will document the results of all functional performance tests using the specific procedural forms developed for that purpose.
2. Non-Conformance:
 - a. The CxA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted.
 - b. Corrections of minor deficiencies identified may be made during the tests. In such cases, the deficiency and resolution will be documented on the procedure form.
 - c. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures.

- d. All deficiencies or non-conformance issues identified during the functional testing shall be corrected and retested at no additional cost to the owner.

3.4 CLOSEOUT DOCUMENTATION AND OPERATION AND MAINTENANCE MANUALS

A. Closeout Documentation and O&M Manuals

- 1. Contractor shall submit 1 draft copy of the completed operating and maintenance manual to the architect/engineer and CxA for review within 60 calendar days after review of equipment shop drawings.
- 2. Contractor shall provide approved O&M manuals prior to Owner training sessions.

B. Commissioning Records

- 1. The Commissioning Agent shall provide a Final Commissioning Report. The report shall include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing activities and a general description of testing and verification methods. All outstanding non-compliance items shall be specifically listed. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall be listed. Each non-compliance issue shall be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented. The functional performance and efficiency section for each piece of equipment shall include brief description of the verification method used (manual testing, BAS trend logs, data loggers, etc.) and include observations and conclusions from the testing.

- a. The Commissioning Agent shall provide the General Contractor the following documentation to be included in the Systems Manual:

- i. OPR
- ii. Basis of Design
- iii. Commissioning Plan
- iv. Initial Commissioning Report
- v. Final Commissioning Report
- vi. Commissioning Reviews and Field Reports
- vii. Completed Pre-functional checklists
- viii. Completed Functional Testing Procedures
- ix. Schematics for Each Commissioned Component
- x. Start-Up Reports
- xi. Functional Test Reports

3.5 DEFERRED TESTING

- A. Unforeseen Deferred Tests: If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklist and functional testing may be delayed upon approval of the CxA.

3.6 PREREQUISITES TO SUBSTANTIAL COMPLETION

- A. The commissioning must be completed, except for training, prior to the Substantial Occupancy Date, unless scheduled and approved by the Owner.

END OF SECTION **019113**

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected site elements.
2. Salvage of existing items to be reused or recycled.

1.2 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 ready for reuse.
- 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.

1.3 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.

1.4 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. All gaming equipment
 - b. All Furniture and equipment in spaces to be renovated
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Storage or sale of removed items or materials on-site is not permitted.
- E. 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.

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. Survey existing conditions and correlate with requirements indicated to determine extent of selectivedemolition required.
- C. 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.

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 Section 011000 "Summary."

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 Section 015000 "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.
- 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.

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. 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.
 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 3. 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 portable fire-suppression devices during flame-cutting operations.
 4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 5. Dispose of demolished items and materials promptly.
- B. Reuse of Building Elements: Project has been designed to result in end-of-Project rates for reuse of building elements as follows. Do not demolish building elements beyond what is indicated on Drawings without Architect's approval.
- C. 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 on-site.
 5. Protect items from damage during transport and storage.
- D. 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.
- E. 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 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 Section 017419 "Construction Waste Management and Disposal."
- B. Disposal: Transport demolished materials off Owner's property and legally dispose of them.
- 3.6 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 **024119**

SECTION 033000 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, reinforcement accessories, concrete materials, concrete mixtures, and concrete finishes.

1.2 DEFINITIONS

- A. Aggregate Exposure:** Projection of coarse aggregate from matrix or mortar after completion of exposure operations.
- B. Cast-in-Place Concrete:** Concrete that requires concrete materials, formwork, placement, or finishes to obtain specified appearance.
- C. Cementitious Materials:** Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- D. Design Reference Sample:** Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural concrete.
- E. Water/Cement Ratio (w/cm):** The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference:** Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Form-facing panels.
2. Form joint tape.
3. Form joint sealant.
4. Wood sealer.
5. Form-release agent.
6. Surface retarder.
7. Form ties.
8. Bar supports.
9. Portland cement.
10. Fly ash.
11. Slag cement.
12. Blended hydraulic cement.
13. Aggregates.

14. Admixtures:

- a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Calculated equilibrium unit weight, for lightweight concrete.
6. Slump limit.
7. Air content.
8. Nominal maximum aggregate size.
9. Amounts of mixing water to be withheld for later addition at Project site if permitted.
10. Intended placement method.
11. Alternative design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each of the following:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.

B. Material Test Reports: For the following, by a qualified testing agency:

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

1.6 QUALITY ASSURANCE

A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Installer Qualifications: An experienced cast-in-place architectural concrete installer, as evidenced by not less than five consecutive years' experience, specializing in installing cast-in-place architectural concrete similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

1. Provide written evidence of qualifications and experience.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.
- B. Form-Release Agent: Commercially formulated, colorless form-release agent that does not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments and finishes of concrete surfaces.
- C. Surface Retarder: Water-soluble chemical liquid set retarder, for application on form-facing materials, capable of temporarily delaying final hardening of newly placed concrete surface to depth of aggregate exposure specified.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. W.R. Meadows, Inc.

2.2 CONCRETE MATERIALS

- A. Cementitious Materials:
 - 1. Portland Cement: ASTM C150/C150M, Type I/II, gray.
- B. Normal-Weight Aggregates: ASTM C33/C33M, coarse aggregate or better, graded. Provide aggregates from single source from single manufacturer.
 - 1. Alkali-Silica Reaction: Comply with one of the following:
 - a. Expansion Result of Aggregate: Not more than 0.04 percent at one year when tested in accordance with ASTM C1293.
 - b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at 16 days when tested in accordance with ASTM C1567.
 - c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.
 - 2. Maximum Coarse-Aggregate Size: 3/4 inch.
 - 3. Gradation: graded.
- C. Normal-Weight Fine Aggregate: ASTM C33/C33M or ASTM C144, manufactured or natural sand, free of materials with deleterious reactivity to alkali in cement, from same source for entire Project.
- D. Chemical Admixtures: As certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

- E. Water and Water Used to Make Ice: ASTM C94/C94M, potable or complying with ASTM C1602/C1602M, including all limits listed in Table 2 and requirements of paragraph 5.

2.3 CONCRETE MIXTURES, GENERAL

- A. Obtain each color, size, type, and variety of concrete mixture from single manufacturer with resources to provide cast-in-place architectural concrete of consistent quality in appearance and physical properties.
- B. Prepare design mixtures for each type and strength of cast-in-place architectural concrete proportioned on basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs, based on laboratory trial mixtures.
- C. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash or Other Pozzolans: 25 percent by mass.
 - 2. Slag Cement: 50 percent by mass.
 - 3. Total of Fly Ash or Other Pozzolans, Slag Cement: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass.
 - 4. Total of Fly Ash or Other Pozzolans: 35 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass.
- D. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

2.4 CONCRETE MIXTURES

- A. Class: K Normal-weight concrete.
 - 1. Maximum w/cm: 0.46.

2.5 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and ASTM C1116/C1116M and furnish batch ticket information.
 - 1. Clean equipment used to mix and deliver cast-in-place concrete to prevent contamination from other concrete.
 - 2. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
 - 3. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
 - 4. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

- A. Limit deflection of form-facing panels to not exceed ACI 301 requirements.
- B. Limit cast-in-place concrete surface irregularities, as follows:
 - 1. Surface Finish-1.0: ACI 117 Class D, 1 inch.
 - 2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
 - 3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.
- C. Construct forms to result in cast-in-place concrete that complies with ACI 117.
- D. Coat contact surfaces of wood rustications and chamfer strips with wood sealer before placing reinforcement, anchoring devices, and embedded items.
- E. Coat contact surfaces of forms with form-release agent, in accordance with manufacturer's written instructions, before placing reinforcement, anchoring devices, and embedded items.
- F. Coat contact surfaces of forms with surface retarder, in accordance with manufacturer's written instructions, before placing reinforcement, anchoring devices, and embedded items.

3.2 JOINTS

- A. Construction Joints: Install construction joints true to line, with faces perpendicular to surface plane of cast-in-place architectural concrete, so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.
 - 2. Locate joints for slabs at third points of spans.
 - 3. Locate horizontal joints at top of floor slabs.
 - 4. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- B. Contraction Joints: Form weakened-plane contraction joints true to line, with faces perpendicular to surface plane of cast-in-place architectural concrete, so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.

3.3 FINISHING FORMED SURFACES

- A. Architectural Concrete Finish: Match existing conditions, identified and described as indicated, to satisfaction of Architect.
- B. As-Cast Surface Finishes: Comply with the following:
 - 1. ACI 301 Surface Finish-1.0 (SF-1.0.)
 - 2. ACI 301 Surface Finish-2.0 (SF-2.0.)
 - 3. ACI 301 Surface Finish-3.0 (SF-3.0.)

3.4 REPAIR

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

3.5 CLEANING

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

3.6 PROTECTION

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

3.7 FINAL ACCEPTANCE

- A. Final acceptance of completed concrete work will be determined by Architect's representative prior to being covered by other work.

END OF SECTION **033000**

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.2 FIELD CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in

TMS 602/ACI 530.1/ASCE 6.

- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
 - 1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.2 TOLERANCES

- A. Dimensions and Locations of Elements:
 - 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.

2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- E. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- F. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.4 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
 2. Bed webs in mortar in all courses of piers, columns, and pilasters.

3. Bed webs in mortar in grouted masonry, including starting course on footings.
 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
- B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.5 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
1. Space reinforcement not more than 16 inches o.c.
 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.

3.6 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
1. Provide an open space not less than 1 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.7 FLASHING

- A. General: Install embedded flashing at ledges and other obstructions to downward flow of water in wall where indicated.
- B. Install flashing as follows unless otherwise indicated:
1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 2. At lintels, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.

3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
 4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

3.8 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 2. Limit height of vertical grout pours to not more than 60 inches.

3.9 PARGING

- A. Parge exterior faces of below-grade masonry walls, where indicated, in two uniform coats to a total thickness of 3/4 inch. Dampen wall before applying first coat, and scarify first coat to ensure full bond to subsequent coat.
- B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. Form a wash at top of parging and a cove at bottom.
- C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.10 REPAIRING, POINTING, AND CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
 2. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.11 MASONRY WASTE DISPOSAL

- A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 - 1. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- B. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION **042200**

SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference:** Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data:** For manufacturer and Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Quality Standard Compliance Certificates:** AWI Quality Certification Program certificates.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:** Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

- B. Installer Qualifications:** Manufacturer of products or Licensed participant in AWI's Quality Certification Program.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CABINET MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products meeting AWI standards that may be incorporated into the Work include, but are not limited to, the following:
1. Cohen Architectural Woodworking.
 2. Cabinet Masters, Inc.
 3. Square One Studio.
 4. Architectural Components Group.
 5. Village Gallery Inc.
 6. Tummons Custom Woodworking

2.2 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.
1. Provide labels and certificates from AWI certification program indicating that woodwork complies with requirements of grades specified.
- B. Architectural Woodwork Standards Grade: Premium.
- C. Type of Construction: Frameless.
- D. Door and Drawer-Front Style: Flush overlay.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Abet Laminati Inc.
 - b. Formica Corporation.
 - c. Lamin-Art, Inc.
 - d. Pionite; a Panolam Industries International, Inc. brand.
 - e. Wilsonart LLC.
- F. Laminate Cladding for Exposed Surfaces:
1. Horizontal Surfaces: Grade HGS.
 2. Vertical Surfaces: Grade HGS.
 3. Edges: Grade HGS.
 4. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
- G. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.
- I. 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 selected by Architect from laminate manufacturer's full range in the following categories:
 - a. Solid colors with core same color as surface, matte finish.
 - b. Wood grains, matte finish.
 - c. Patterns, matte finish.

2.3 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 1. Wood Moisture Content: 8 to 13 percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 1. Composite Wood Products: Products shall be made without urea formaldehyde.
 2. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
 3. Particleboard: ANSI A208.1, Grade M-2.
 4. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.4 CABINET HARDWARE AND ACCESSORIES

- A. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 170 degrees of opening, self-closing.
- B. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.
- C. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04071; with shelf rests, B04081.
- D. Shelf Rests: ANSI/BHMA A156.9, B04013; metal.
- E. Drawer Slides: ANSI/BHMA A156.9.
 1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer.
 - a. Type: Full extension.
 - b. Material: Zinc-plated steel with polymer rollers.
 2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
 3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 2.

4. For drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide Grade 1.
 5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-100.
 6. For computer keyboard shelves, provide Grade 1.
 7. For trash bins not more than 20 inches high and 16 inches wide, provide Grade 1HD-100.
- F. Door Locks: ANSI/BHMA A156.11, E07121.
- G. Drawer Locks: ANSI/BHMA A156.11, E07041.
- H. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.
- I. Tempered Float Glass for Cabinet Doors: ASTM C1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3, 6 mm thick unless otherwise indicated.
- J. Tempered Float Glass for Cabinet Shelves: ASTM C1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3; with exposed edges seamed before tempering, 6 mm thick.
- K. Grommets for Cable Passage: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
1. Color: Black.
- L. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.
1. Satin Chromium Plated: ANSI/BHMA 626 for brass or bronze base; ANSI/BHMA 652 for steel base.
- M. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.
- 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. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesives: Do not use adhesives that contain urea formaldehyde.
- D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.
- 2.6 FABRICATION
- A. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

- B. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
- C. Install glass to comply with applicable requirements in Section 088000 "Glazing" and in GANA's "Glazing Manual."
 - 1. For glass in frames, secure glass with removable stops.
 - 2. For exposed glass edges, polish and grind smooth.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.
- B. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.
 - 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 - 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips.

END OF SECTION **064116**

SECTION 068300 - COMPOSITE PANELING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Installation of high performance, composite polymer resin wall/ceiling panels and trims.

1.2 RELATED REQUIREMENTS

- A. Section 092900 – Gypsum Board.
- B. Section 092216 – Non-Structural Metal Framing

1.3 REFERENCE STANDARDS

- A. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

1.4 QUALITY ASSURANCE

- A. Installer's Qualifications: Installer is regularly engaged, for past 10 years, in installation of similar type of paneling to that specified.
- B. Mock-ups: Construct mock-ups of composite resin decorative wall/ceiling paneling and trim for evaluation of fabrication, finishing techniques and workmanship.
- C. Construct mock-ups using same materials for use in the Work.
- D. Do not proceed until shop fabrication and shop finishing techniques and workmanship of mock-ups are approved by Architect.
- E. Approved Mock-ups: Standard for shop fabrication and shop finishing techniques and workmanship.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened packaging, with labels clearly identifying product name and manufacturer.
- B. Storage and Handling Requirements:
 1. Store and handle materials in accordance with manufacturer's instructions.
 2. Keep materials in manufacturer's original, unopened containers and packaging until installation.
 3. Store materials in interior, clean, dry, conditioned area.
 4. Store materials on flat, level surface, raised above floor, with adequate support to prevent sagging.
 5. Protect materials and finish during storage and handling to prevent damage.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Products: Cielo High Performance Paneling | www.cielo.us | 833.868.152.
- B. Decorative Composite Wall/Ceiling Panel (CWP/CCP):
 - 1. Composition: Cielo High Performance Panels comprised of multiple homogeneous layers of varied polymer resins. Panels are flexible, lightweight, and resistant to impact and chemical contact.
 - 2. Surface Burning Characteristics, ASTM E 84: Class C / Class 3.
 - 3. Panel Sizes: Per Drawings and verified field dimensions.
 - 4. Panel Thickness: 5/32".
 - 5. Factory Edge Detail: Micro Bevel
 - 6. Color: Standard Luxe and Custom Luxe finishes per Interior Finish Legend
 - 7. Substrate: Primed Gypsum Board
 - 8. Weight: 1 pound per square foot
- C. Trim:
 - a) Fry-Reglet Trim Profiles as indicated on drawings
 - b) Length: manufacturer's standard stock lengths
 - c) Color: As indicated on drawings

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine surrounding area and supporting structure to receive decorative wall/ceiling paneling.
- B. Verify field dimensions.
- C. Verify that receiving wall/ceiling is a clean and flat surface.
- D. Verify that composite resin panels are in prime condition and ready for installation.
- E. Notify Architect of conditions that would adversely affect installation or subsequent use.
- F. Do not begin installation until unacceptable conditions are corrected.

3.2 INSTALLATION

- A. Install decorative wall/ceiling panels per project requirements, in accordance with manufacturer's written guidelines at locations indicated on the Drawings.
- B. Use the Cielo High Performance Paneling installation kit(s) and additional Cielo adhesives and support materials to install decorative wall/ceiling panels per project requirements in accordance with manufacturer's written guidelines.

1. Butt Joints: Install decorative wall/ceiling panels with expansion joints per manufacturer's written guidelines. Paint wall/ceiling behind seams to match the specified Cielo color.
 2. Trim Joints: Install specified Cielo anodized aluminum or color-matched trims per project requirements, following manufacturer's written guidelines.
- C. Leave protective peel coat in place until date of Substantial Completion.

3.3 CLEANING

- A. Remove protective peel coat covering at date of Substantial Completion.
- B. Clean decorative wall panel surfaces using Cielo Care & Maintenance Kit in accordance with manufacturer's written guidelines.
- C. Do not use harsh cleaning chemicals, materials, or methods that could damage finish.

END OF SECTION **068300**

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetration firestopping systems for the following applications:
 - a. Penetrations in fire-resistance-rated walls.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.4 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Approval according to FM Approval 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provided systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified

testingagency.

- 1) UL in its "Fire Resistance Directory."
- 2) Intertek Group in its "Directory of Listed Building Products."
- 3) FM Approval in its "Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Fire Protection Products.
 - b. Grabber Construction Products.
 - c. Hilti, Inc.
 - d. RectorSeal.
 - e. Tremco, Inc.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.
- D. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- 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. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- D. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing and inspecting agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.3 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION **078413**

SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.

1.2 PREINSTALLATION MEETINGS

- ##### **A. Preinstallation Conference:** Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- ##### **A. Product Data:** For each type of product.

- ##### **B. Product Schedule:** For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

- ##### **A. Product test reports.**

1.5 CLOSEOUT SUBMITTALS

- ##### **A. Installer Certificates:** From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

- ##### **A. Installer Qualifications:** A firm that has been approved by FM Approvals according to FM Approvals 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- ##### **A. Fire-Test-Response Characteristics:**

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.

2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."

2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Fire Protection Products.
 - b. Grabber Construction Products.
 - c. Hilti, Inc.
 - d. RectorSeal.
 - e. Tremco, Inc.
 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.
- D. Accessories: Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. General: Install joint firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- C. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

- D. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:
 - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.3 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION **078443**

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonstaining silicone joint sealants.
2. Urethane joint sealants.
3. Mildew-resistant joint sealants.
4. Latex joint sealants.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference:** Conduct conference at Project site. Foreman for Sub-contractor who will be on site for the duration of the project is required to attend preinstallation conference.

1.3 ACTION SUBMITTALS

- A. Product Data:** For each joint-sealant product.
- B. Samples:** For each kind and color of joint sealant required.
- C. Joint-Sealant Schedule:** Include the following information:
1. Joint-sealant application, joint location, and designation.
 2. Joint-sealant manufacturer and product name.
 3. Joint-sealant formulation.
 4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.**
- B. Preconstruction field-adhesion-test reports.**
- C. Field-adhesion-test reports.**
- D. Sample warranties.**

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications:** Qualified according to ASTM C1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing:** Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
 3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with stone substrates.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
- 1.7 WARRANTY
- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

- A. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 756 SMS.
 - b. GE Construction Sealants; Momentive Performance Materials Inc; SilPruf NB.
 - c. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex Sil 295 FPS NB.
 - d. Pecora Corporation; 864NST.
 - e. Tremco Incorporated; Spectrem 2.

2.3 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:

- a. BASF Corporation Construction Systems; Sonalastic TX1.
 - b. ER Systems, an ITW Company; Pacific Polymers Elasto-Thane 230 MP.
 - c. Pecora Corporation; Dynatrol I-XL.
 - d. Polymeric Systems, Inc.; Flexiprene 1000.
 - e. Schnee-Morehead, Inc., an ITW company; Permthane SM7108.
 - f. Sherwin-Williams Company (The); Stampede-1.
 - g. Sika Corporation U.S.; Sikaflex Textured Sealant.
 - h. Tremco Incorporated; Dymonic.
 - B. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Corporation Construction Systems; Sonolastic SL 1.
 - b. Pecora Corporation; NR-201.
 - c. Polymeric Systems, Inc.; Flexiprene 952.
 - d. Schnee-Morehead, Inc.; an ITW company; Permthane SM7101.
 - e. Sherwin-Williams Company (The); Stampede 1SL.
 - C. Urethane, M, P, 50, T, NT: Multicomponent, pourable, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 50, Uses T and NT.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. LymTal International, Inc.; Iso-Flex 888QC.
 - D. Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 25, Uses T and NT.
- 2.4 MILDEW-RESISTANT JOINT SEALANTS
- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
 - B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 786-M White.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.; SCS1700 Sanitary.
 - c. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex Sil 100 WF.
 - d. Soudal USA; RTV GP.
 - e. Tremco Incorporated; Tremsil 200.
 - C. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals - Building Systems; Sonolac.

- b. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex 600.
- c. Pecora Corporation; AC-20.
- d. Sherwin-Williams Company (The); 850A Siliconized Acrylic latex Caulk.
- e. Tremco Incorporated; Tremflex 834.

2.5 JOINT-SEALANT BACKING

- A. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Construction Chemicals - Building Systems.
 - b. Construction Foam Products, a division of Nomaco, Inc.
- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 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 laitance and form-release agents from concrete.
 - 2. 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.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.
 - a. Temperature: Described work to be performed when temperatures are 40 degrees and rising.

3.2 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with ASTM C1193 and joint-sealant manufacturer's written installation

instructions for products and applications indicated, unless more stringent requirements apply.

- B. 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.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- 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 to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 1. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
 - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.4 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Control and expansion joints in brick pavers.
 - b. Isolation and contraction joints in cast-in-place concrete slabs.
 - c. Joints between plant-precast architectural concrete paving units.
 - d. Tile control and expansion joints.
 - e. Joints between different materials listed above.
 - f. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, M, P, 50, T, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Joints between plant-precast architectural concrete units.
 - c. Control and expansion joints in unit masonry.
 - d. Joints in dimension stone cladding.
 - e. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, S, P, 25, T, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Tile control and expansion joints.
 - c. Vertical joints on exposed surfaces of unit masonry, concrete, walls, and partitions.
 - d. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, S, NS, 25, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
 - 1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Acrylic latex.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

G. Joint-Sealant Application: Concealed mastics.

1. Joint Locations:
 - a. Aluminum thresholds.
 - b. Sill plates.
 - c. Other joints as indicated on Drawings.
2. Joint Sealant: Butyl-rubber based.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION **079200**

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

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 standard steel doors and frames.
 - 2. Interior custom hollow-metal doors and frames.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
- C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.4 QUALITY ASSURANCE

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
 - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Black Mountain Door, LLC.
 - 2. Ceco Door; ASSA ABLOY.
 - 3. Curries Company; ASSA ABLOY.
 - 4. MPI Group, LLC (The).
 - 5. National Custom Hollow Metal Doors & Frames.
 - 6. Republic Doors and Frames.
 - 7. Steelcraft; an Allegion brand.
 - 8. Steward Steel Door & Frame Division.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.
- B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B.
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch.
 - d. Edge Construction: Model 2, Seamless.
 - e. Core: Manufacturer's standard.
 - f. Fire-Rated Core: Manufacturer's standard laminated mineral board core for fire-rated doors.
 - 2. Frames:
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
 - b. Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction: Full profile welded.

2.4 INTERIOR CUSTOM HOLLOW-METAL DOORS AND FRAMES

- A. Hollow-Metal Doors and Frames: NAAMM-HMMA 860; ANSI/SDI A250.4, Physical Performance Level A. At locations indicated in the Door and Frame Schedule.
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch.
 - d. Edge Construction: Continuously welded with no visible seam.
 - e. Core: Steel stiffened.
 - f. Fire-Rated Core: Manufacturer's standard laminated mineral board core for fire-rated doors.
 - 2. Frames:
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
 - b. Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction: Full profile welded.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 - 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
 - 3. Postinstalled Expansion Anchor: Minimum 3/8-inch- diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

2.6 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- G. Glazing: Comply with requirements in Section 088000 "Glazing."

2.7 FABRICATION

- A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations

require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Provide stops and moldings flush with face of door, and with beveled stops unless otherwise indicated.
 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
 4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
 5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.8 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding facejoint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 - 2. Fire-Rated Openings: Install frames according to NFPA 80.
 - 3. Floor Anchors: Secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 4. Solidly pack mineral-fiber insulation inside frames.
 - 5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
 - 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - 7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, 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.
- B. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
 - 1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 REPAIR

- A. 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.
- B. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION **081113**

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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Solid-core doors with plastic-laminate faces.

1.3 SUBMITTALS

- A. Product Data: For each type of door. Include details of core and edge construction, louvers, and trim for openings.
- 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 fire ratings for fire doors.
- C. Samples for Initial Selection: Color charts consisting of actual materials in small sections for the following:
 - 1. Plastic-Laminate Door Faces: Show the full range of colors, textures, and patterns available.
- D. Samples for Verification:
 - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish.
 - 2. Plastic laminate, 6 inches square, for each color, texture, and pattern selected.

1.4 QUALITY ASSURANCE

- A. Quality Standard: Comply with NWWDA I.S.1-A, "Architectural Wood Flush Doors."
- B. Fire-Rated Wood Doors: Doors 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 UBC Standard 7-2.

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 building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 - 1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 2. Warranty shall be in effect during the following period of time from date of Substantial Completion:
 - a. Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flush Wood Doors with plastic laminate faces:
 - a. Algoma.
 - b. Masonite Architectural.
 - c. Marshfield Door Systems.
 - d. Mohawk Flush Doors, Inc.
 - e. Unilux.
 - f. Gaulhofer USA.

2.2 DOOR CONSTRUCTION, GENERAL

- A. Adhesives: Do not use adhesives containing urea formaldehyde.
- B. Plastic-Laminate-Faced Doors:
 - 1. Grade: Premium.
 - 2. Laminate Faces: High-pressure decorative laminates complying with NEMA LD 3, Grade HGS.
 - 3. Colors, Patterns, and Finishes: As selected by Interior Designer from laminate manufacturer's full range of products.
 - 4. Stiles: Plastic-laminate matching faces, applied before faces.

2.3 SOLID-CORE DOORS

- A. Particleboard Cores: Comply with the following requirements:
 - 1. Particleboard: ANSI A208.1, Grade LD-2.
 - a. Use particleboard made with binder containing no urea-formaldehyde resin.
 - 2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
- B. Fire-Rated Doors:
 - 1. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as needed to provide fire rating indicated.
 - 2. Blocking: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated as needed to eliminate through-bolting hardware.
 - 3. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile matching face veneer, and laminated backing at hinge stiles for improved screw-holding capability and split resistance.
 - 4. Pairs: Provide fire-rated pairs with fire-retardant stiles matching face veneer that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals.

2.4 FABRICATION

- A. Fabricate doors in sizes indicated for Project-site fitting.
- B. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:
 - 1. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements in NFPA 80 for fire-rated doors.

- C. 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 measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.

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 8 Section "Door Hardware."
- B. Manufacturer's Written Instructions: Install doors to comply with manufacturer's written instructions, 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: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or 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 **081416**

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Mechanical door hardware for swinging doors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Details of electrified door hardware.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Other Action Submittals:
 - 1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
 - b. Content: Include the following information:
 - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.
 - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - 4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - 2. Keying Schedule: Prepared by owner per keying conference.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

- B. Source Limitations: Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- D. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
 - 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
 - 4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.
- F. Keying Conference: Conduct conference at Owner's designated site to coordinate Owner's keying requirements. 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. Requirements for access control.

1.4 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. 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. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

- D. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
 - 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door 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 "Door Hardware Schedule" Article.
 - 2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.
 - 3. Basis of Design Products: Where Specifications name a product, or refer to a scheduled product 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. 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:
 - a. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents, and that it will produce the indicated results, and that it is compatible with other portions of the Work.
 - b. 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.
 - c. Evidence that proposed product provides specified warranty.
 - d. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 - e. Samples, if requested.
 - 4. Product, Manufacturer: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements. Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
 - 5. Owner's Standard: Where Specifications refer to a product or manufacturer as an owner standard, substitutions are not allowed.

2.2 HINGES

- A. Non-electrified butt hinges shall be manufactured by Hager, no substitutions. Actual hinge shall be selected based upon the application.
- B. Electrified butt hinges used with electrified Yale mortise locksets shall be McKinney ElectroLynx Hinge (QC Option), no substitutions.
 1. McKinney ElectroLynx retrofit harnesses with factory applied connectors shall be used.
 2. Provide wire harness lengths as required for the application
 3. Wire nuts or field wire connections in lieu of factory applied connectors are not acceptable.
- C. Electrified butt hinges used with electrified Von Duprin exit devices shall be Ives, 5BB1 TW8CON 652, no substitutions.
 1. Allegion Connect 8-pin wiring harnesses with factory applied connectors (CON) shall be used.
 2. Provide wire harness lengths as required for the application
 3. Wire nuts or field wire connections in lieu of factory applied connectors are not acceptable.

Hinge Description	Type
5K Full Mortise Swing Clear (Non- Ferrous) .190 inch	Type 1
5K Full Mortise (Ferrous) .134 inch	Type 2
5K Full Mortise (Non- Ferrous) .134 inch	Type 3
5K Full Mortise (Ferrous) .180 inch	Type 4
5K Full Mortise (Non-Ferrous) .180 inch	Type 5
Heavy Duty Continuous Hinge - Exterior	Type 6
Heavy Duty Continuous Hinge – Interior	Type 7

4. Application:
 - a. Exterior out swinging doors (unless otherwise specified) Type 5 x NRP
 - b. Exterior in swinging doors and vestibule doors Type 5
 - c. Interior doors Type 2 & Type 4
 - d. Provide NRP (non-removable pins) at out swinging lockable doors and exterior applications.
 - e. Patient rooms, clean, soil, exam rooms Type 1
 - f. Restrooms, showers and selected clean areas Type 3
 - g. Continuous hinges as required. Type 6 & Type 7
5. Hinge Size:
 - a. 2-1/4 inch doors: 5 inch x 5 inch
 - b. Doors 42 inches and wider: 5 inch x 4-1/2 inch
 - c. 1-3/4 inch doors: 4-1/2 inch x 4-1/2 inch
6. Hinge Thickness:
 - a. Standard weight: .134 inch at offices, exam, mechanical, electrical and data rooms.

- b. Heavy weight: .180 inch at all high use openings and any doors over 36 inches in width.
- 7. Hinge Quantity:
 - a. 2 hinges per leaf for openings up to 60 inches high.
 - b. 1 additional hinge per leaf for each additional 30 inches in height or fraction thereof.
 - c. 4 hinges at Dutch doors up to 90 inches in height
- D. Factory pre-drilled 5/32 inch hole with No. 12, 1-1/4 inch steel threaded wood screws for hinges on wood doors.
- E. Stainless steel hinges shall be used in rooms which are subject to extensive moisture.

2.3 ELECTRIC POWER TRANSFER

- A. Manufacturer: Power transfer shall be Von Duprin EPT-10 CON, no substitutions.
 - 1. Allegion Connect 8-pin wiring harnesses with factory applied connectors (CON) shall be used.
 - 2. Provide wire harness lengths as required for the application.
 - 3. Wire nuts or field wire connections in lieu of factory applied connectors are not acceptable.
- B. Locate electric power transfer per manufacturer's template and UL requirements.

2.4 MECHANICAL LOCKS AND LATCHES

- A. Non-electrified lockset shall be Yale 8800 Series mortise lockset, no substitutions.
 - 1. Locksets are to be supplied with the Carmel, CRSL lever handle.
- B. For renovations or special circumstances, a Yale 5400LN Series cylindrical lockset may be used.
- C. Mechanical Functions:

Type
For offices: Classroom or Office Lock
For classrooms: Classroom or Office Lock
Storerooms: Storeroom Lock
Rooms not requiring a lockable door: Passage or Closet Latch

- D. Electrified lockset shall be Yale 8800 Series ITS, Fail Secure mortise lockset, no substitutions.
 - 1. McKinney ElectroLynx retrofit harnesses with factory applied connectors shall be used.
 - 2. Provide wire harness lengths as required for the application.
 - 3. Wire nuts or field wire connections in lieu of factory applied connectors are not acceptable.

E. Stand Alone Pushbutton Lockset:

1. Where pushbutton is specified for access control, the manufacturer shall be Alarm Lock, no substitutions: The following series shall be used for these applications:

Type	Trilogy	Notes
Mortise Applications	Trilogy T2 DL3500 Series	No scheduling or audit trail with key override
Cylindrical Applications	Trilogy T2 DL2700 Series	No scheduling or audit trail with key override
Interchangeable core and Rim Cylinder adapter kit	ETDL Series	2,000 user codes, 40,000 event audit trail, 500 scheduled event capability

2.5 LOCK CYLINDERS

- A. Lock Cylinders: Medeco 6-pin high security cylinders. KS3 keyway with Z47 cams. Verify existing facility keyway – to be matched. Contractor to provide factory keyed cylinders, per owner’s keying direction provided at keying meeting. A letter of authorization will be provided by the university to the contractor upon award of any contract allowing the purchase of restricted section product. **Owner Standard – No Substitutions.**
- B. Keys: Contractor to provide two cut keys per cylinder. One box of key blanks are also to be provided for every thirty (30) cylinders on the project. When less than 30 cylinders are required on a project, no key blanks need to be provided.
- C. Cylinders, keys, and key blanks shall be furnished by the contractor and shipped directly from the manufacturer to the campus lockshop in facilities maintenance at MSU. Shipping labels should be clearly labeled with the university’s project number and sent to the following address:
 - a. Missouri State University, Facilities Management, ATTN: Academic Locksmith. 901 South National Avenue, Springfield, MO 65897

2.6 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Match owner’s existing keying, and incorporate decisions made in keying conference.
- B. MSU Locksmith will key cylinders, cut keys and install cylinders.
- C. The contractor is responsible for the project site and any temporary construction keying during construction. For any locks installed at a perimeter fence or for any temporary cylinders installed within the construction site, 2 copies of the keys to access the site and building shall be distributed to the University project manager.

2.7 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: BHMA A156.3. Grade 1; except with extended cycle performance testing certified for minimum 8,000,000 cycles; listed by UL for accident and hazard; and conforming to applicable requirements of NFPA 80 and NFPA 101.
1. Product: Subject to compliance with requirements, provide scheduled products manufactured by Von Duprin; Allegion, PLC. (VON). **Owner Standard – No Substitutions.**
 2. Requirements:
 - a. Internal springs: Coil compression type
 - b. Provide security dead latching for active latch bolts
 - c. Latch Bolts: Self lubricating coating to reduce friction and wear. Plated latchbolts are not acceptable.
 - d. Touch Pad: Stainless steel with return stroke fluid dampers and rubber bottoming dampers.
 - e. Provide filler plates and shim kits as needed for flush mounting of devices on doors.
 - f. Devices with exposed rivets or screws on back of device that would be visible through a glass light are not acceptable.
 - g. Provide exits with MicroShield antimicrobial coating.

2.8 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4 Grade 1; except tested to exceed 10 million (10,000,000) full load operating cycles by an independent test laboratory;
1. Product: Subject to compliance with requirements, provide products manufactured by LCN Closers; Allegion, PLC. (LCN) **Owner Standard – No Substitutions.**
 - a. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use.
 - b. Provide factory-sized rack-and-pinion hydraulic type closers that are adjustable to meet field conditions and requirements for opening force.
 - c. Provide closers, constructed with high strength cast iron cylinders, forged main arms, and one piece forged steel pistons, with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm.
 - d. Cylinder Body: 1½" piston diameter with 3/4" journal double heat treated shaft, 5/8" full complement bearing, chrome silicon steel spring.
 - e. Hydraulic Fluid: ULTRA X TM fluid with constant temperature control from +120° F (49° C) to -30° F (-35° C).
 - f. Closers with pressure release valves are not acceptable.
 - g. Closers shall be installed with thru-bolts.

2.9 ELECTRIC STRIKES

- A. All electric strikes shall be manufactured by HES, 1006 CLB, no substitutions.
1. Provide HES Smart Pac II controller for electric strikes for reduction of voltage when in continuous use to extend the life of the electric strike.

2.10 POWER SUPPLY

- A. All Power supplies shall be Von Duprin PS900 series, as required for the application, no substitutions.
- B. Requirements:
 - 1. Provide power supplies per manufacturer's recommendations for the electrified locking component, operation of the electrified locks, electrified exit devices, electric strikes, and other components requiring a power supply.

2.11 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide scheduled product manufactured by IVES Hardware; Allegion, PLC, (IVE) or a comparable product by:
 - a. Hager Companies. (HAG)
 - b. Rockwood Manufacturing Company. (ROC)
- B. Provide door stops for all doors in accordance with the following requirements:
 - 1. Provide convex type wall stops wherever possible.
 - 2. Where wall stops cannot be used, provide floor stops of the proper height.
 - 3. At opening where wall or floor stop cannot be used, provide overhead stop.

2.12 OVERHEAD STOPS AND HOLDERS

- A. Overhead Stops and Holders: BHMA A156.8.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide scheduled product manufactured by Glynn-Johnson; Allegion, PLC, (GLY) or comparable product by one of the following:
 - a. Architectural Builders Hardware Mfg., Inc. (ABH)
 - b. Rockwood Manufacturing Company. (ROC)

2.13 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
 - 1. Manufacturers: Subject to compliance with requirements, provide the scheduled product. Weather-stripping and gaskets shall be manufactured by Pemko, no substitutions.

2.14 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide the scheduled product. Thresholds shall be manufactured by Pemko, no substitutions.

2.15 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 - 2. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
 - 3. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.16 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 HARDWARE INSTALLATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Mounting Heights: Mount door hardware units at heights indicated or as required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
- 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. 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 for proper installation and operation.
 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- D. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- E. Temporary Construction Cylinders: Install construction cylinders to secure building and areas during construction period.
- F. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room. Verify location with Architect.
1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.
- G. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- H. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- I. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- J. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- K. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
- 3.2 FIELD QUALITY CONTROL
- A. Perform tests and inspections.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

HARDWARE SET: 01

FOR USE ON DOOR #(S):

103B

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	HINGE	BB1191	630	HAG
1	EA	ELEC. HINGE	BB1191 ETW	630	HAG
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-99-L-03 24 VDC	626AM	VON
1	EA	LFIC RIM CYLINDER	MEDECO X VERIFY KEYWAY	626	MED
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	346C	AL	PEM
1	SET	SEALS	2891APK	AL	PEM
1	EA	DOOR SWEEP	345ANB	AL	PEM
1	EA	THRESHOLD	2005A	AL	PEM
1	EA	DOOR CONTACT	679-05 HM/WD AS REQ'D	WHT	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC	LGR	SCE
1	EA	CARD READER	BY SECURITY SYSTEM INTEGRATOR		
1	EA	WIRING DIAGRAM	BY SECURITY SYSTEM INTEGRATOR		

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. ENTRY BY CARD READER, MOMENTARILY RETRACTING DEVICE LATCH. INSIDE PUSH PAD ALWAYS FREE EGRESS.

HARDWARE SET: 02

FOR USE ON DOOR #(S):

105

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	HINGE	BB1279	652	HAG
1	EA	ELEC. HINGE	BB1279 ETW	652	HAG
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-99-L-03 24 VDC	626AM	VON
1	EA	LFIC RIM CYLINDER	MEDECO X VERIFY KEYWAY	626	MED
1	EA	SURFACE CLOSER	4040XP RW/PA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKET	S88BL	BLK	PEM
1	EA	DOOR CONTACT	679-05 HM/WD AS REQ'D	WHT	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC	LGR	SCE
1	EA	CARD READER	BY SECURITY SYSTEM INTEGRATOR		
1	EA	WIRING DIAGRAM	BY SECURITY SYSTEM INTEGRATOR		

HARDWARE SET: 03

FOR USE ON DOOR #(S):

113

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	BB1279	652	HAG
1	EA	PANIC HARDWARE	99-L-03	626AM	VON
1	EA	LFIC RIM CYLINDER	MEDECO X VERIFY KEYWAY	626	MED
1	EA	SURFACE CLOSER	4040XP RW/PA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKET	S88BL	BLK	PEM

HARDWARE SET: 04

FOR USE ON DOOR #(S):

103A

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	BB1168	652	HAG
2	EA	HINGE	BB1168 ETW	652	HAG
1	EA	ELEC FIRE EXIT HARDWARE	RX-LC-QEL-9927-L-DT-F-LBR-03-499F 24 VDC	626AM	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-LC-QEL-9927-L-F-LBR-03-499F 24 VDC	626AM	VON
1	EA	LFIC RIM CYLINDER	MEDECO X VERIFY KEYWAY	626	MED
2	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	GASKET	S88BL	BLK	PEM
1	EA	ASTRAGAL (SET)	18041CNB	AL	PEM
2	EA	DOOR CONTACT	679-05 HM/WD AS REQ'D	WHT	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC	LGR	SCE
1	EA	CARD READER	BY SECURITY SYSTEM INTEGRATOR		
1	EA	WIRING DIAGRAM	BY SECURITY SYSTEM INTEGRATOR		

OPERATION: DOORS NORMALLY CLOSED AND LOCKED. ENTRY BY CARD READER, MOMENTARILY RETRACTING DEVICE LATCHES. INSIDE PUSH PADS ALWAYS FREE EGRESS.

HARDWARE SET: 05

FOR USE ON DOOR #(S):

115

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	BB1279	652	HAG
1	EA	STOREROOM LOCKSET	CRSL 8805FL LESS CYL	626	YAL
1	EA	CONV. MORTISE CYLINDER	MEDECO X VERIFY KEYWAY	626	MED
1	EA	WALL STOP	WS406/407CCV	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE SET: 06

FOR USE ON DOOR #(S):

117

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	BB1279	652	HAG
1	EA	STOREROOM LOCKSET	CRSL 8805FL LESS CYL	626	YAL
1	EA	CONV. MORTISE CYLINDER	MEDECO X VERIFY KEYWAY	626	MED
1	EA	SURFACE CLOSER	4040XP RW/PA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKET	S88BL	BLK	PEM

END OF SECTION **087100**

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.

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 on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for steel unless otherwise indicated.
 - 2. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.
- B. Studs and Tracks: ASTM C 645.
- C. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ClarkDietrich Building Systems.
 - b. MRI Steel Framing, LLC.
 - 2. Minimum Base-Steel Thickness: 0.0296 inch.
 - 3. Depth: 7/8 inch.

- D. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Clark Dietrich Building Systems.
 - b. MRI Steel Framing, LLC.
 - 2. Configuration: hat shaped.

2.3 SUSPENSION SYSTEMS

- A. 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.
- B. Hanger Attachments to Concrete:
 - 1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 AC193 AC58 or AC308 as appropriate for the substrate.
 - a. Uses: Securing hangers to structure.
 - b. Type: Torque-controlled, expansion anchor or adhesive anchor.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- D. Flat Hangers: Steel sheet, in size indicated on Drawings.
- E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch and minimum 1/2-inch- wide flanges.
 - 1. Depth: As indicated on Drawings.
- F. Furring Channels (Furring Members):
 - 1. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
 - a. Minimum Base-Steel Thickness: 0.0296 inch.
 - 2. Resilient Furring Channels: 1/2-inch- deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical or hat shaped.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
 - 1. Asphalt-Saturated Organic Felt: ASTM D 226/D 226M, Type I (No. 15 asphalt felt), nonperforated.
 - 2. 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 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
 - 2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
 - 3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
 - 4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grabbars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 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 at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 - 1. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch 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.
 - 2. 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.

3. 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.
4. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
5. 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.

3.3 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- 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, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not attach hangers to steel roof deck.

6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. 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 **092216**

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Gypsum board, Type X.
 - 2. Gypsum ceiling board.
 - 4. Mold-resistant gypsum board.
 - 5. Glass-mat, water-resistant backing board.
 - 6. Joint treatment materials.
 - 7. Laminating adhesive.
 - 8. Sound-attenuation blankets.
 - 9. Acoustical sealant.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C1396/C1396M.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum
 - b. CertainTeed Corporation.
 - c. CertainTeed Gypsum.
 - d. Continental Building Products, LLC.

- e. Georgia-Pacific Gypsum LLC.
 - f. National Gypsum Company.
 - g. PABCO Gypsum.
 - h. USG Corporation.
 - 2. Thickness: 5/8 inch.
 - 3. Long Edges: Tapered.
 - B. Gypsum Ceiling Board: ASTM C1396/C1396M.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum.
 - b. CertainTeed Corporation.
 - c. CertainTeed Gypsum.
 - d. Continental Building Products, LLC.
 - e. Georgia-Pacific Gypsum LLC.
 - f. National Gypsum Company.
 - g. PABCO Gypsum.
 - h. USG Corporation.
 - 2. Thickness: 1/2 inch.
 - 3. Long Edges: Tapered.
 - C. core and paper surfaces.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum.
 - b. CertainTeed Corporation.
 - c. Continental Building Products, LLC.
 - d. Georgia-Pacific Gypsum LLC.
 - e. National Gypsum Company.
 - f. PABCO Gypsum.
 - g. USG Corporation.
 - 2. Core: 5/8 inch, Type X.
 - 3. Long Edges: Tapered.
 - 4. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
- 2.4 TILE BACKING PANELS
- A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Georgia-Pacific Gypsum LLC.
 - c. National Gypsum Company.
 - d. USG Corporation.
 - 2. Core: 5/8 inch, Type X.
 - 3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
 - 1. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
- 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. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 2. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - 3. Finish Coat: For third coat, use drying-type, all-purpose compound.
- D. Joint Compound for Tile Backing Panels:
 - 1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.6 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - 1. Use screws complying with ASTM C954 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.
- C. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- D. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealant".
- E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."
- F. Vapor Retarder: As specified in Section 072600 "Vapor

Retarders."PART 3 - EXECUTION

3.1 INSTALLATION AND FINISHING OF PANELS

- A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- B. Comply with ASTM C840.

- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. 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.
- D. 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.
- E. Prefill open joints and damaged surface areas.
- F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for tile.
 - 3. Level 3: Where indicated on Drawings.
 - 4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
 - 5. Level 5: Where indicated on Drawings.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- H. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.2 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION **092900**

SECTION 09303 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Porcelain tile.
 - 2. Waterproof membrane for thinset applications.
 - 3. Crack isolation membrane.
 - 4. Metal edge strips.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples:
 - 1. Each type and composition of tile and for each color and finish required.
 - 2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required.
 - 3. Stone thresholds.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.4 MAINTENANCE MATERIAL SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer is a Five-Star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup of each type of floor tile installation.
 - 2. Build mockup of each type of wall tile installation.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.2 TILE PRODUCTS

- A. Ceramic Tile Type: As indicated on the Finish Schedule on the Drawings.

2.3 WATERPROOF MEMBRANE

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Waterproofing and Tile-Setting Adhesive: One-part, fluid-applied product intended for use as both waterproofing and tile-setting adhesive in a two-step process.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Boiardi Products Corporation; a QEP company.
 - b. Bostik, Inc.

2.4 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. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Bostik, Inc.
 - b. C-Cure.
 - c. Custom Building Products.
 - d. H.B. Fuller Construction Products Inc. / TEC.
 - e. Jamo Inc.
 - f. LATICRETE SUPERCAP, LLC.
 - g. MAPEI Corporation.
 - h. Merkrete; a Parex USA, Inc. brand.
 - i. Siena Products; Omega.
 - j. Southern Grouts & Mortars, Inc.
- C. Latex-Portland Cement Crack-Resistant Mortar: Flexible mortar consisting of cement-based mix and latex additive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ARDEX Americas.
 - b. Boiardi Products Corporation; a QEP company.
 - c. C-Cure.
 - d. H.B. Fuller Construction Products Inc. / TEC.
 - e. MAPEI Corporation.
- D. Crack Isolation Membrane and Tile-Setting Adhesive: One-part, fluid-applied product intended for use as both a crack isolation membrane and tile-setting adhesive in a two-step process.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Boiardi Products Corporation; a QEP company.
 - b. Bostik, Inc.

2.5 SETTING MATERIALS

- A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
- B. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ARDEX Americas.
 - b. Bonsal American, an Oldcastle company.
 - c. C-Cure.
 - d. Custom Building Products.
 - e. H.B. Fuller Construction Products Inc. / TEC.
 - f. LATICRETE SUPERCAP, LLC.
 - g. MAPEI Corporation.
 - h. Merkrete; a Parex USA, Inc. brand.
 - i. Siena Products; Omega.
 2. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
 3. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.
 4. For wall applications, provide nonsagging mortar.

2.6 GROUT MATERIALS

- A. High-Performance Tile Grout: ANSI A118.7.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ARDEX Americas.
 - b. Boiardi Products Corporation; a QEP company.
 - c. Bonsal American, an Oldcastle company.
 - d. Bostik, Inc.
 - e. C-Cure.
 - f. Custom Building Products.
 - g. H.B. Fuller Construction Products Inc. / TEC.
 - h. Jamo Inc.

- i. LATICRETE SUPERCAP, LLC.
 - j. MAPEI Corporation.
 - k. Southern Grouts & Mortars, Inc.
 - l. Summitville Tiles, Inc.
 - 2. Polymer Type: Dry, redispersible form, prepackaged with other dry ingredients.
- B. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ARDEX Americas.
 - b. Atlas Minerals & Chemicals, Inc.
 - c. Boiardi Products Corporation; a QEP company.
 - d. Bonsal American, an Oldcastle company.
 - e. Bostik, Inc.
 - f. C-Cure.
 - g. Custom Building Products.
 - h. H.B. Fuller Construction Products Inc. / TEC.
 - i. Jamo Inc.
 - j. LATICRETE SUPERCAP, LLC.
 - k. MAPEI Corporation.
 - l. Merkrete; a Parex USA, Inc. brand.
 - m. Sauereisen.
 - n. Southern Grouts & Mortars, Inc.
 - o. Summitville Tiles, Inc.

2.7 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; half-hard brass exposed-edge material.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Blanke Corporation.
 - b. Ceramic Tool Company, Inc.
 - c. Schluter Systems L.P.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 2. Verify that concrete substrates for tile floors installed with adhesives or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
- 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 adhesives or thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproof membrane 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 INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors in laundries.
 - c. Tile floors consisting of tiles 8 by 8 inches or larger.
 - d. Tile floors consisting of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting bed thickness so that tiles are flush.
- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize

the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Porcelain Tile: 1/4 inch.
- H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- J. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
 - 1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in improved modified dry-set mortar (thinset).
 - 2. Do not extend waterproof membrane or crack isolation membrane under thresholds set in improved modified dry-set mortar. Fill joints between such thresholds and adjoining tile set on waterproof membrane or crack isolation membrane with elastomeric sealant.
- K. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.
- L. Install tile backing panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.
- M. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
- N. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

3.4 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
 - 1. Ceramic Tile Installation: TCNA F115; thinset mortar; epoxy grout.
 - a. Grout: Water-cleanable epoxy grout.
 - 2. Ceramic Tile Installation: TCNA F122; thinset mortar on waterproof membrane.
 - a. Thinset Mortar: Improved modified dry-set mortar.
 - b. Grout: High-performance unsanded grout.
 - 3. Ceramic Tile Installation: TCNA F125-Full; thinset mortar on crack isolation membrane.
 - a. Thinset Mortar: Improved modified dry-set mortar.
 - b. Grout: Water-cleanable epoxy grout.
- B. Interior Wall Installations, Wood or Metal Studs or Furring:
 - 1. Ceramic Tile Installation: TCNA W245 or TCNA W248; thinset mortar on glass-mat, water-resistant gypsum backer board.

- a. Thinset Mortar: Improved modified dry-set mortar.
 - b. Grout: Water-cleanable epoxy grout.
- C. Bathtub/Shower Wall Installations, Wood or Metal Studs or Furring:
 - 1. Ceramic Tile Installation: TCNA B419; thinset mortar on coated glass-mat, water-resistant gypsum backer board.
 - a. Grout: Water-cleanable epoxy grout.
- D. Shower Receptor and Wall Installations:
 - 1. Ceramic Tile Installation: TCNA B420; thinset mortar on waterproof membrane over coated glass-mat, water-resistant gypsum backer board.
 - a. Thinset Mortar: Improved modified dry-set mortar.
 - b. Grout: Water-cleanable epoxy grout.

END OF SECTION **093013**

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Class A according to ASTM E 1264.
 - 2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL PANELS

- A. Basis-of-Design Product: Cinema Black by Rockfon in 2' x 2' x 5/8" square lay-in or comparable product by one of the following:
 - 1. American Gypsum.
 - 2. Armstrong World Industries, Inc.
 - 3. CertainTeed Corporation.
 - 4. Chicago Metallic Corporation.
 - 5. Tectum Inc.
 - 6. United States Gypsum Company.
- B. Acoustical Panel Standard: Manufacturer's standard panels according to ASTM E 1264.
- C. Classification: Class A.

- D. Color: Black
- E. Edge/Joint Detail: As indicated by manufacturer's designation.
- F. Thickness: As indicated in a schedule.
- G. Modular Size: As indicated in a schedule.

2.3 METAL SUSPENSION SYSTEM

- A. Basis-of-Design Products: Black pre-finished grid where exposed in the Locker Room space. Provide exterior grade galvanized gypsum ceiling suspension in restroom/shower areas, standard system in other spaces, where applicable.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. CertainTeed Corporation.
 - 3. Chicago Metallic Corporation.
 - 4. United States Gypsum Company.
- C. Metal Suspension-System Standard: Manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M. Provide color prefinished face in black ceiling area in the locker room.

2.4 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- B. Hold-Down Clips: Manufacturer's standard hold-down.

2.5 METAL EDGE MOLDINGS AND TRIM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. CertainTeed Corporation.
 - 3. Chicago Metallic Corporation.
 - 4. Fry Reglet Corporation.
 - 5. Gordon, Inc.
 - 6. United States Gypsum Company.
- B. 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.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated.
- B. Layout openings for penetrations centered on the penetrating items.

3.2 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C 636/C 636M and manufacturer's written instructions.
- B. 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. Do not use exposed fasteners, including pop rivets, on moldings and trim.
 - 3. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 - 4. Install hold-down clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.

END OF SECTION **095113**

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vinyl Base.

1.2 ACTION SUBMITTALS

- A. Product Data:** For each type of product.
- B. Samples:** For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 VINYL BASE

- A. Basis-of-design:** Provide Johnsonite Millwork Reveal MW-48F by Tarkett per interior Finish Legend indicated on drawings.
- B. Thickness:** 0.25 inch.
- C. Height:** 4.25 inches.
- D. Lengths:** Coils in manufacturer's standard length.
- E. Outside Corners:** Job formed.
- F. Inside Corners:** Job formed.
- G. Colors and Patterns:** As indicated by manufacturer's designations.

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds:** Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives:** Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.2 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Miter or cope corners to minimize open joints.

3.3 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

END OF SECTION **096513**

SECTION 096516 - RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work of this Section consists of an inlaid wear surface embossed resilient sheet vinyl flooring and accessories including, but not limited to:
 - 1. C.I. TAKIRON (Takiron) **Nattice** Commercial Sheet Vinyl Flooring
 - 2. Accessories
 - a. Adhesives
 - b. Cleaning solutions
 - c. Finish top coatings

1.2 SUBMITTALS

- A. Product Data per SECTION 013300 and as follows: Submit manufacturer's printed descriptions of materials, components and systems, performance criteria, use limitations, recommendations, and installation information.
- B. Shop Drawings per SECTION 013000 or 013300 and as follows: Submit keyed location plans, plans indicating resilient sheet flooring type, layout, pattern direction, edge transitions, columns, doorways, enclosing partitions, built-in furniture, cabinets, cutouts, expansion and control joints, and attachment requirements.
- C. Samples per SECTION 013300.
 - 1. Initial for Selection: Submit printed color charts, sample chains or Architectural Binder indicating manufacturer's complete range to determine color, texture, shape, and/or composition for each type of material finish.
 - 2. Final Selection: Submit two (2) 9-inch x 12-inch samples of each different type, color and pattern selected for acceptance.
- D. Quality Assurance Submittals per SECTION 014000: Test and Evaluation Reports, and Qualification Statements.
- E. Maintenance Material Submittals - Extra Materials: Submit no less than five (5) percent additional full and unopened rolls of each type and pattern of sheet good used.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements
 - 1. Fire-Test-Response Characteristics: As determined by testing identical products as follows by a qualified testing agency.
 - a. ASTM E648: Critical Radiant Flux Classification: Class I
 - b. ASTM E662: Smoke Density: 450 or less B.
 - 2. Manufacturer: A company with a minimum ten (10) years' experience in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance. A single source manufacturer supplying both product and adhesive. a. Company shall be ISO 9001 Certified.

- a. Company shall be ISO 14001 Certified.
 - 3. Installer / Applicator: Perform installation with skilled, experienced, and trained workmen with demonstrated ability to install Takiron products supervised by trained personnel who shall have a minimum three (3) years successful experience in installations of similar size and scope.
 - 4. Testing Agency: An independent testing agency with the experience and capability to conduct the testing indicated, meeting requirements of ISO/IEC Standard 17025 or ASTM E699 and ASTM E329.
 - C. Source Limitations: Obtain primary resilient sheet flooring materials and adhesive through one source from a single manufacturer
 - 1. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.
- 1.4 DELIVERY, STORAGE, AND HANDLING
- A. Delivery, Storage and Handling per industry guidelines, product manufacturer guidelines, and SECTION 016000 requirements.
- 1.5 WARRANTY
- A. Manufacturer Warranty. Provide manufacturer's five (5) year limited warranty to be free from defects in material and workmanship, under normal use and service, to repair or replace all defective sheet flooring.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Manufacturer List: Subject to compliance with requirements, provide products by the following:
 - 1. C.I. TAKIRON, a flooring manufacturer represented by CBC AMERICA LLC, 2000 Regency Parkway, Cary, NC 27518; Telephone: 919.230.8700; E-mail: technical@cbcflooring.com; website: www.cbcflooring.com
 - 2. Substitution Limitations: No substitutions permitted because of the specific attributes listed in sections 2.2, 2.3 and 2.4.
- B. Product Options
 - 1. Flooring Type:
 - a. TAKIRON **Nattice**: Class I per ASTM E648
 - 1). Size: 6' x 66' x 0.10" (1.82m x 20m x 2.5mm)
 - 2). Color and Pattern: The Collection
 - 2. Accessories
 - a. Underlayment leveling compound per SECTION 035416
 - b. Expansion joints per SECTIONS 079200 and 079513
 - c. Indoor and Non-Wet Area Acrylic Adhesive
 - 1). CBC 5001 High Performance Resilient Flooring Adhesive
 - d. Wet Area and Exterior Adhesive 1). CBC 951 2-Part Epoxy Floor Covering Adhesive for Indoor (wet area) and Outdoor Installations
 - e. Wet Area and Exterior Accessory
 - 1). Henkel Teroson MS 939NA or equivalent edge sealant for Indoor (wet area) and

Outdoor Installations

- f. Cleaning products
- g. Takiron Welding Rod to match

2.2 DESCRIPTION

- A. Nattice per ASTM 1303 are Type II, Grade 1, Class B, inlaid embossed commercial slip-retardant sheet flooring.

2.3 MATERIALS

- A. TAKIRON Pathways and Nattice Sheet per ASTM F1303: Type II, Grade 1, inlaid wear layer sheet vinyl.
 - 1. Composition: Sheet vinyl formed under heat and pressure from a PVC layer formulated from polyvinyl esters and inorganic fillers materials, with a backing material of recycled PVC and virgin PVC from polyvinyl esters and inorganic filler materials.
 - 2. Thickness: 0.100" (2.5mm)
 - 3. Roll Size: 6' x 66' (1.82m x 20m)
 - 4. Color: As selected by Architect from Manufacturer's standard Collection.

2.4 ACCESSORIES

- A. Leveling and Patching Compound: Trowelable, latex-modified Portland cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Self-Leveling Underlayment: Pourable latex-modified Portland cement-based formulation provided or approved by manufacturer for applications indicated.
- C. Expansion Joints: Refer to SECTION 079200 and SECTION 079500 or 079513.
- D. Adhesive - Acrylic: Solvent-free, low odor, acrylic based, high tack type adhesive acceptable to resilient sheet flooring manufacturer to suit flooring product and substrate conditions indicated. (indoor non-wet applications only)
 - 1. Manufacturer / Product: CBC 5001 High Performance Resilient Floor Adhesive
- E. Adhesive – Heavy Duty Epoxy: 2-part solvent-free, low odor, flooring epoxy adhesive recommended for all exterior and flooring installations over porous and non-porous substrates under heavy static loads, areas that are subject to top-down water, freezer cases, and areas exposed to extremes of temperature.
 - 1. Manufacturer / Product: CBC 951 2-Part Epoxy Floor Covering Adhesive for Indoor and Outdoor Installations
- F. Edge Sealing – Required for all exterior and wet areas
 - 1. Manufacturer / Product: Henkel Teroson MS 939NA or equivalent edge sealant for indoor wet areas and all Outdoor Installations.
- G. Adhesive Equipment: "V" notched professional adhesive application trowel for interior applications.
 - 1. V-notch 1/16 x 1/16 x 1/16 inch for porous substrates.
 - 2. U-notch 1/32 x 1/16 x 1/32 inch for non-porous substrates or use with CBC 951 2-Part Epoxy H.

Seam Sealing:

- 1. Heat Weld Rod:
 - a. Welding Thread, 3.5 mm diameter Takiron weld rod as recommended for the product(s) specified.
 - b. Color as selected by Architect from manufacturer's full range.

PART 3 – EXECUTION

3.1 FIELD CONDITIONS

- A. Conditions and Measurements: Visit jobsite to verify installation conditions and floor measurements.
 - 1. Ambient and Environmental Conditions per manufacturer's most recent published written recommendations, SECTION 017000 or 017100 or 017116.

3.2 EXAMINATION, PREPARATION AND INSTALLATION

- A. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Verify conditions and test substrates as recommended to meet requirements.
- B. Properly prepare manufacturer acceptable substrates to accept flooring.
- C. Install resilient flooring per manufacturer's current [Installation Guide](#).
- D. Expansion Joints: Locate movement joints where indicated prior to installation of adhesive and resilient flooring and use appropriate expansion joint cover.
- E. Protect flooring from foot traffic for time specified for adhesive before and after installation per adhesive manufacturer's instructions to allow proper set up time.
- F. Protect flooring from heavy traffic, point or rolling loads for a minimum of 48 hours or longer depending on conditions, after installation, when installed using CBC 5001 or CBC 951 Epoxy adhesive.
- G. Wait 48 hours before wet cleaning.

3.3 FIELD QUALITY CONTROL

- A. Site Tests and Inspections (Per SECTION 014000 or 014500 or 014523 and as follows):
 - 1. Inspect floor installation for non- conforming work including lack of adequate adhesion, adhesive overspray, and indications of improper substrate preparation.

3.4 CLEANING, MAINTENANCE AND PROTECTION

- A. Provide Progress Cleaning per SECTION 017000 or 017400 or 017413,
 - 1. Protect newly installed flooring from traffic for specified time on adhesive label.
 - 2. Protect new installed flooring from rolling traffic and point loads for a minimum of 48 hours or longer based on ambient conditions and adhesive cure time.
 - 3. Provide surface protection for installed product and use plywood or rigid panels to roll or move all heavy objects across the flooring before and after owner's acceptance.
 - 4. Permit only light damp mopping with well wrung mop during the first 3-4 days after installation.

3.5 CLOSEOUT ACTIVITIES

- A. Substantial Completion Requirements per DIVISION 01 requirements: Closeout procedures, demonstration and training, and sustainable design closeout documentation.

END OF SECTION **096516**

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid vinyl floor tile.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and pattern specified.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation.

PART 2 - PRODUCTS

2.1 RUBBER FLOOR TILE

- A. Products: Subject to compliance with requirements, provide one of the following:
- B. Basis-of-Design: norament pado, by nora systems, Inc., 9 Northeastern Blvd., Salem, NH 03079; telephone 800-332-NORA or 603-894-1021; fax 603-894-6615.
- C. Tile Standard: ASTM F 1344 Standard Specification for Rubber Floor Tile.
 - 1. Type: IIB and Grade 2.
- D. Thickness: Per Interior Design Finish Schedule.
- E. Size: Per Interior Design Finish Schedule.
- F. Colors and Patterns: As indicated by Interior Finish Schedule.

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floortile and substrate conditions indicated.
 - 1. Adhesives shall have a VOC content of 50 g/L or less.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.2 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay tiles in pattern indicated.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles in pattern of colors and sizes indicated.

- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

END OF SECTION **096519**

SECTION 099124 - INTERIOR PAINTING (MPI STANDARDS)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Concrete masonry units (CMUs).
 - 2. Gypsum board partitions and ceilings
 - 3. Hollow metal doors and frames

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
- B. Product List: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. Kelly-Moore Paint Company Inc.
 - 3. PPG Paints.
 - 4. Pratt & Lambert.
 - 5. Sherwin-Williams Company (The).
- B. Products: Subject to compliance with requirements, provide product listed in the Interior Painting Schedule for the paint category indicated. See Interior Finish Legend in drawings for specific paint selections.

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

- C. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 150 g/L.
 - 3. Primers, Sealers, and Undercoaters: 200 g/L.
- D. Low-Emitting Materials: For field applications that are inside the weatherproofing system, 90 percent of paints and coatings shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- E. VOC Emissions: For field applications inside the building, wall paints shall contain no more than half of the chronic REL of VOCs when tested according to the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit or 33 mcg/cu. m and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- F. Colors: As indicated in a color schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- B. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
- C. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

3.3 INSTALLATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
- B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- C. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards and switch gear.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

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.

3.5 INTERIOR PAINTING SCHEDULE

- A. Existing Corridor and Locker Room Areas:
 1. Latex System, MPI INT 4.2A:
 - a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.
 2. Metal Doors and Frames:
 - a. One Coat: B66W00310 – Pro Industrial Pro-Cryl® Universal Primer
 - b. Two Coats: B54WZ0211 – Pro Industrial Enamel 100
 3. Galvanized Metal (Miscellaneous):
 - a. One Coat: B66W00310 – Pro Industrial Pro-Cryl® Universal Primer
 - b. Two coats: B31WJ8651 – Solo Semi-Gloss Interior/Exterior Low VOC Acrylic Semi-Gloss Enamel
 4. Gypsum Board (Ceilings and soffits):
 - a. One Coat: B28WJ0901 – Wasatch Interior Latex Hi Hide Primer
 - b. Two coats: B30W02651 – ProMar® 200 Zero VOC Interior Latex Flat

5. Gypsum Board (vertical walls and partitions):
 - a. One Coat: B28WJ0901 – Wasatch Interior Latex Hi Hide Primer
 - b. Two coats: B20W02651 – ProMar® 200 Zero VOC Interior Latex Eg-Shel
6. Gypsum Board (epoxy paint for Ceilings in wet areas):
 - a. One Coat: B28WJ0901 – Wasatch Interior Latex Hi Hide Primer
 - b. Two coats: K45W00151 – Pro Industrial Waterbased PreCatalyzed Epoxy Eg-Shel
7. Concrete Block in Wet Areas:
 - a. One coat: B25W00025 – PrepRite® Block Filler
 - b. Two coats: K45W00151 – Pro Industrial Waterbased PreCatalyzed Epoxy Eg-Shel
8. Exposed Decking, Bar Joist, and Structural Steel:
 - a. Spot Prime: B66W00310 – Pro Industrial Pro-Cryl® Universal Primer
 - b. Two coats: B42W00002 – Waterborne Acrylic Dry Fall Eg-Shel

END OF SECTION **099124**

SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes non-illuminated interior room signage.

1.2 REFERENCES

- A. Standards of the following as referenced:
- B. American National Standards Institute (ANSI).
- C. Industry standards:
 - 1. Department of Justice, Office of the Attorney General, "Americans with Disabilities Act", Public Law 101-336, (ADA).
 - 2. ANSI A117.1: Providing Accessibility and Useability for Physically Handicap People, 1986 edition.

1.3 DEFINITIONS

- A. Terms:
 - 1. Braille: Grade 2 Braille including 189 part-word or whole word contractions in addition to Grade 1 Braille 63 characters. Tactile is required whenever Braille is required; see SYSTEM DESCRIPTION article below.
 - 2. Non-tactile: Letters and numbers on signs with width-to-height ratio between 3:5 and 1:1 and stroke width ratio between 1:5 and 1:10 using upper case "X" to calculate ratios. Use typestyles with medium weight; upper and lower case lettering is permitted; serif typestyles are permitted. See SYSTEM DESCRIPTION article below.
 - 3. Symbols: Symbol itself is not required to be tactile but equivalent verbal description is required both in tactile letters and Braille.
 - 4. Tactile: 1/32" raised capital letters without serifs at least 5/8" height and not more than 2" height based on upper case "X". Braille is required whenever tactile is required; see SYSTEM DESCRIPTION article below.

1.4 SYSTEM DESCRIPTION

- A. Signage under this section is intended to include items for identification, control, and information of building where installed as complete integrated system from a single manufacturer.
- B. ADA Design Requirements:
 - 1. Signage requiring tactile graphics:
 - a. Wall mounted signs designating permanent rooms and spaces such as, room numbers and restroom, department, office, and fire exit identifications.
 - b. Individually applied characters are prohibited.
- C. ADA performance requirements:
 - 1. Tactile graphics signs mounting requirements:
 - a. Single doors: Mount 60" to sign centerline above finish floor and on wall adjacent to latch side of door.
 - b. Openings: Mount 60" to sign centerline above finish floor adjacent opening.

- c. No wall space adjacent latch side of door, opening, or double doors: Mount 60" to sign centerline above finish floor on nearest adjacent wall.
- d. See attached typical interior signage locations.

1.5 SUBMITTALS

A. Product data:

- 1. Manufacturer's signed statement regarding compliance with QUALITY ASSURANCE article.
- 2. Manufacturer's product literature indicating units and designs selected.
- 3. Evidence of manufacturer's computerized data retrieval program for tracking of project for sign typography, message strip requirements and other pertinent data from schedule input to final computerized typography on finished product.

B. Shop drawings:

- 1. Indicate materials, sizes, configurations, and applicable substrate mountings.
- 2. Signage schedule complete with location of each sign and required copy; include floor plans.
- 3. Final room names and numbers will not match those indicated in contract documents. Submittals of finalized names and numbers must be approved in writing by Owner prior to fabrication.

C. Samples: Full size samples for holder, insert, and copy in colors specified. Provide sample in small size sign. Samples will not be returned for use in Project.

D. Manufacturer has available software program for personal computers, called "signword pro" enabling end user to produce graphics on insert or sign face.

E. Contract close out:

- 1. Furnish appropriate checklist for aiding in reordering after Date of Substantial Completion.
- 2. Maintenance data and cleaning requirements for exterior surfaces.
- 3. Furnish one complete SignWord software package Windows 3.0 or Windows 95 or later, Windows NT 4.0 or later in Owner selected format for PC type computer.
- 4. Furnish SignWord Color paper system

1.6 QUALITY ASSURANCE

A. Qualifications:

- 1. Manufacturer:
 - a. Work required under this section from manufacturers regularly engaged in work of this magnitude and scope for minimum of five years.
 - b. Maintain computer link between schedule input and computerized typography production.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Acceptance at site: Coordinate delivery of work to Project site under this section for immediate installation.

1.8 SEQUENCING AND SCHEDULING

A. Schedule system installation after related finishes have been completed.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Acceptable product:

1. APCO; FullView Display System; 17 Jennycliffe Lane, St. Louis, MO 63005.
2. Standard Assembly - Combination of extruded aluminum components, composite aluminum sheet and injection molded components, creating modular signs with a special, concealed pin lock device to secure a clear cover and/or sign insert material into the frame. Possible sign inert/display combinations include:
 - a. Non-Glare Acrylic Lens with Subsurface Paper Insert/Digital Output Display
 - b. ADA (Tactile/Braille) Plaques
3. Assembly allows for flexibility of size and configuration, providing a modular, vandal- resistant solution for signs ranging from single-insert identification signs to large directories and directional signs.
 - a. Surface Mounted Signs (Wall): Attachment to wall surfaces via or concealed mechanical fasteners.

2.2 FULLVIEW DISPLAY SYSTEM

A. Modular Sign System with tamper proof locking pin for sign types: name plate, room/floor identification, directional use:

1. Standard Sizes (acrylic lens dimensions shown):
2. Vertical Edge Configurations - Surface Mount: (aluminum edge profiles at left/right of sign)
 - a. Sign Type A:
 - 1) FVS5585(V). 5.5" height x 8.5" wide. Standard Assembly
 - 2) 5.5" x 8.5" Novacryl Clear ADA Photopolymer with room number tipped A01 white.
 - 3) Right color band, sub surface silkscreened, A 54 Graphite. Building name masked off so paper color shows through.
 - 4) (glued on letters and Braille, Braille strips and engraving or routing to achieve raised lettering and Braille is prohibited).
 - 5) Paper insert by client.
 - 6) Mechanical Mounting holes.
 - 7) NMS-4 Notifier bar below to hold notes. 8.5" length, natural satin finish.
 - b. Sign Type B:
 - 1) FVS0806(V). 8" height x 6" wide. Standard Assembly
 - 2) FullView aluminum holder, Square profile.
 - 3) 8" x 6" Novacryl Clear ADA Photopolymer with room name and symbols tipped A01 white.
 - 4) Sub surface background color, A 54 Graphite.
 - 5) (glued on letters and Braille, Braille strips and engraving or routing to achieve raised lettering and Braille is prohibited).
 - 6) Mechanical Mounting holes.
3. Color: Selected by Architect from manufacturer's standard NS-Natural Satin anodized (204R1)
4. Select from Edge Shapes: Square
5. Select Mounting Wall Signs: MF - Mechanical Fasteners

B. Graphics:

1. Type sizes: Selected from manufacturer's standard sizes indicated in SCHEDULES article for particular units; meet ADA requirements for letter proportions and sizes. Clear coating on ADA bands or painted and tipped surfaces as required in SCHEDULES article.
 - a. (ARN) Arial Narrow

2.3 FABRICATION

A. Shop assembly:

1. Fabricate units to configurations indicated on reviewed shop drawings. Internally reinforce units in accord with reviewed shop drawings.
2. Wrap each individual unit with polyethylene. Provide special Suction Cup Removal Tool (SCT) and Locking Pin removal tool.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install signage holders in locations with mounting types indicated in accord with reviewed shop drawings. Square, plumb, and level units.
- B. Install inserts not more than 48 hours prior to Date of Substantial Completion complete with correct copy in place. Conform to ADA requirements for tactile graphics signage.
- C. Provide brushed aluminum backup plate to match sign size on the back of the glass where room signs are installed on glass units.

3.2 CLEANING

- A. Clean exposed surfaces not more than 48 hours prior to Date of Substantial Completion in accord with manufacturer's written cleaning instructions.

3.3 SCHEDULES

- A. See attached sheet for Schedule.

END OF SECTION **101400**

SECTION 102113.17 – PHENOLIC-CORE TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Through-color phenolic-core toilet compartments configured as toilet enclosures and urinal screens.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, and attachment details.
- C. Samples for each type of toilet compartment material indicated.

1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.2 PHENOLIC-CORE TOILET COMPARTMENTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Global Partitions; ASI Group
2. Bradley Corporation.
3. Bobrick Washroom Equipment, Inc.

- B. Toilet-Enclosure Style: Floor anchored, overhead braced.

- C. Urinal-Screen Style: Wall hung, flat panel.

- D. Door, Panel, Screen and Pilaster Construction: Through-color phenolic-core panel material with eased and polished edges. Provide minimum ¾" thick doors and pilasters and minimum ½" thick panels.

1. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units of size and material adequate for panel to withstand applied downward load on grab-bar of at least 250 lbf, when tested according to ASTM F446, without deformation of panel.

- 2. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.
- E. Urinal-Screen Construction:
 - 1. Flat-Panel Urinal Screen: Matching panel construction.
- F. Pilaster Shoes Sleeves (Caps): Stainless steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.
- G. Brackets (Fittings):
 - 1. Stirrup Type: Ear or U-brackets; chrome-plated zamac.
- H. Phenolic Panel Finish:
 - 1. Color: As selected by Architect/Interior Designer from manufacturer's full range to match Finish Index basis-of-design color.

2.3 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories: Manufacturer's heavy-duty stainless steel operating hardware and accessories.
 - 1. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories, and solid blocking within panel where required for attachment of toilet accessories.
- B. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- wide, in-swinging doors for standard toilet compartments and 36-inch- wide, out-swinging doors with a minimum 32-inch- wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position indicated with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch.
 - b. Panels and Walls: 1 inch.
 - 2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.
 - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.

3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION **102113.17**

SECTION 102800 – TOILET AND BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Washroom accessories.
 - 2. Underlavatory guards.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each finish specified, full size.
 - 1. Approved full-size Samples will be returned and may be used in the Work.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Design accessories and fasteners to comply with the following requirements:
 - 1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Grab Bars:
 - 1. Manufacturers: Subject to compliance with requirements, provide the following:
 - a. American Specialties, Inc.; Models 163 and 166
 - 2. Mounting: Flanges with concealed fasteners.
 - 3. Material: Stainless steel, 0.05 inch thick.

- a. Finish: Smooth, ASTM A480/A480M 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.
 - B. All Others: see bathroom elevation drawing A4.3 for Accessories Schedule and balance of other accessories required, both OFCI and Contractor furnished and installed.
- 2.3 UNDERLAVATORY GUARDS
- A. Underlavatory Guard:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Plumberex Specialty Products, Inc. – Trap Gear Kit
 - 2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
 - 3. Material and Finish: Antimicrobial, molded plastic, PVC in **gray** finish.
- 2.4 FABRICATION
- A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. 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.
 - 1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.

END OF SECTION **102800**

SECTION 105123 - PLASTIC-LAMINATE-CLAD LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes custom laminate lockers and accessories.

1.2 SUBMITTALS

- A. Product Data: For each specific to materials used in construction of the locker.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Indicate locker plan layout, component profiles and elevations, schedule of finishes, and accessories.
- C. Samples: For each type of locker; include no less than three of each standard veneer, hardware and / or accessories involving material and color selection.

1.3 QUALITY ASSURANCE

- A. All parts and hardware shall be AWI compliant, structurally sound, and free from defects, in material and workmanship under normal use and service for the full warranty period.

1.4 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install lockers until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature at operating levels during the remainder of the construction period. Maintain environmental conditions (temperature {Average 70 degrees F}, humidity {25-55%}, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's and AWI Standards.
- B. During and after installation, maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- C. Protect locker finish and adjacent surfaces from damage.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of lockers that fail in materials or workmanship within specified warranty period
 - 1. Warranty Period: Three (3) years from date of Substantial Completion.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Store products in a dry, ventilated area until ready for installation.
- B. Protect finishes from moisture, soiling and damage during handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Minimum fifteen (15) comparable locker room projects successfully completed over the last ten (10) years.

2.2 PLASTIC-LAMINATE-CLAD LOCKERS

- A. **Basis-of-Design:** **HOLLMAN, INC.**.; 1825 W. Walnut Hill Lane, Irving, TX. 972-815-4000
- B. Others: Subject to compliance with all requirements –
 - 1. Shield Lockers
 - 2. Hamilton Casework Solutions
 - 3. Case Systems

2.3 MATERIALS

- A. Construction Style: As indicated on drawings.
- B. Material shall be a MDF – Medium-density fiberboard core with .030 inch vertical grade high pressure laminate.
 - 1. Standard Class B fire rated
- C. Locker Body: tops, sides, and back shall be constructed of MDF with .030 inch vertical grade high pressure laminate. Finished lockers to have no more than 1/16" expansion or contraction.
- D. Doors: doors shall be constructed of MDF with .030 inch vertical grade high pressure laminate. Locker door for pad compartment shall be the full width of the locker box and shall be frameless, allowing access to the entire width of the compartment as indicated on drawings.
- E. End Panels: Match style, material, construction, and finish of plastic-laminate-clad doors.
- F. Edges: All exposed edges of locker are edge-banded using 1mm thermally fused PVC edge-banding in accent color or laminate in color as indicated on drawings.
- G. Material Thickness:
 - 1. Doors, tops, end panels, and toe kick plates – ¾" finished thickness.
 - 2. Locker boxes: Tops, back, bottoms, sides and shelves – minimum 5/8" finished thickness.

H. Plastic-Laminate Colors, Patterns, and Finishes:

1. As indicated on drawings, selected by Architect from plastic-laminate manufacturer's full range of colors.

2.4 HARDWARE

- A. Door Hinges: Frameless hinge (European Type) fully concealed, nickel-plated heavy-duty steel allowing 110-degree opening with a limited lifetime warranty. Hinges shall be attached to the locker box and door with theft-proof torx-head screws.
 1. 3 hinges per door 36-59" high and over, and 2 hinges per door 35" high and under.
- B. Lift-up Seat Hardware: Maxi Chest heavy duty with soft-close concealed hinge and mounting plate with 90 degree opening angle, adjustable chest stay system, zinc-plated steel finish.
- C. Lift-up Door Hardware: Hafele Swing-up fitting with 107 degree opening, standard finish steel with nickel plating and grey cover cap.
- D. Hooks: Provide single and double-sided undermounted and side mounted hooks as shown on drawings in stainless steel finish.

2.5 ACCESSORIES

- A. Name Identification Plates: Provide custom magnetic name and number plate panel for each upper pad storage compartment as indicated on drawings.
- B. Receptacles: Provide power duplex receptacle with USB charging (type A and C) to be located in lock box. Receptacle shall be Leviton T5632 in 'white' finish and face-plate.
- C. LED Lighting: Provide LED light at open helmet shelf / lock box. Match color temperature of LEDs provided by Electrical Contractor (see light fixture schedule) attached to top of locker and toe-kick area.
- D. Cushions: Provide bench top and lumbar cushion in black vinyl. Lumbar cushion to feature custom university logo as indicated on drawings.
- E. Grilles: Provide free area and 14 ga. aluminum ventilation grilles for exhaust flow in locations and configurations as indicated on drawings.
- F. Digital Lock: Provide digital lock with integral pull and standard body style for each enclosed lock box cubby, 1 per locker. Lock/pull to be equal to Digilock Axis with keypad, deadbolt latching and brushed nickel finish. Provide a minimum of six (6) Electronic Key Management tools for university lock management.
- G. Pulls: Provide satin aluminum continuous pulls for Upper pad storage compartment.
- H. Pad Racks: Provide V-shaped Shoulder pad rack for upper pad storage compartment in black finish.

2.6 FABRICATION

- A. Fabricate lockers square, rigid, without warp, and with finished faces flat and free of dents, scratches, and chips. Accurately factory machine components for attachments. Make joints tight and true.
- B. 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.
- C. Shop cut openings, to maximum extent possible, to receive hardware, 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.

PART 3 - EXECUTION

3.1 EXAMINATION

3.2 INSTALLATION

- A. Install lockers level, plumb, and true; use concealed shims.
- B. Connect groups of lockers together with manufacturer's standard fasteners, through predrilled holes, with no exposed fasteners on face frames. Fit lockers accurately together to form flush, tight, hairline joints.
- C. Install lockers without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings, providing unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Installation Tolerance: No more than 1/8 inch in 96-inch, bow, or other variation from a straight line. Shim as required with concealed shims.
- D. Locker Anchorage: Fasten lockers through back, near top and bottom, at ends with No. 8 flush-head wood screws sized for 1-inch penetration into wood framing, blocking, or furring and spaced not more than 16 inches o.c.
- E. Install number identification plates and name identification plates after lockers are in place.

END OF SECTION **105123**

SECTION 105200 - FIRE-PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Portable fire extinguishers.
 - 2. Fire-protection cabinets for the following:
 - a. Portable fire extinguishers.
 - 3. Mounting brackets for fire extinguishers.
- B. Related Sections include the following:
 - 1. Division 21 Section 'Water-Based Fire Suppression Systems'
- C. Schedule of Types:
 - 1. **FEC 1** – 10 LB multi-purpose dry chemical type fire extinguisher in fully-recessed stainless steel cabinet with solid door.
 - a. General:
Coordinate size of fire extinguisher cabinet with size of extinguisher specified. Refer to drawings for mounting dimensions.
 - 2. **FEC 2** – 10 LB multi-purpose dry chemical type fire extinguisher in semi-recessed stainless steel cabinet with solid door.
 - a. General:
Coordinate size of fire extinguisher cabinet with size of extinguisher specified. Refer to drawings for mounting dimensions.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection cabinets.
 - 1. Fire Extinguishers: Include rating and classification.
 - 2. Fire-Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

- B. Samples for Initial Selection: Samples for initial selection purposes in the form of manufacturer's color charts consisting of actual units or sections of units showing full range of colors, textures, and patterns available for each type of cabinet finish indicated or exposed to view.
- C. Maintenance Data: For fire extinguishers and fire-protection cabinets to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire extinguishers and fire-protection cabinets through one source from a single manufacturer.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
- D. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements of ASTM E 814 for fire-resistance rating of walls where they are installed.

1.5 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of portable 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 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Stainless-Steel Sheet: ASTM A 666, Type 304.
- C. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 PORTABLE FIRE EXTINGUISHERS

- A. Manufacturers:
 - 1. JL Industries, Inc.
 - 2. Larsen's Manufacturing Company.
 - 3. Modern Metal Products; Div. of Technico.
- B. General: Provide fire extinguishers of type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
 - 1. Valves: Manufacturer's standard.
 - 2. Handles and Levers: Manufacturer's standard.
 - 3. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- C. Multipurpose Dry-Chemical Type in Steel Container: MP10, UL-rated 4A:80B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.4 FIRE-PROTECTION CABINETS

- A. Manufacturers:
 - 1. JL Industries, Inc.
 - 2. Larsen's Manufacturing Company.
 - 3. Modern Metal Products; Div. of Technico.
- B. Cabinet Type: Suitable for fire extinguisher.
- C. Cabinet Material: As scheduled.
- D. Cabinets: Cabinet box partially and fully recessed in walls of indicated 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) for semi-recessed models.
 - 1. **FEC 1:** Recessed: Basis of design: Larsen's- Model SS2409-R2
 - 2. **FEC 2:** Square Trim Semi Recessed: 1-1/2-inch. Basis of design: Larsen's- Model SS2409-R7
- E. Cabinet Trim Material: 304 Stainless-steel, #4 Finish.
- F. Door Material: 304 Stainless-steel, #4 Finish
- G. Door Style: Solid Stainless Steel Panel with vertical Die Cut lettering.

- H. Door Glazing: None
- 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 lever handle with self-adjusting roller catch.
 - 2. Provide manufacturer's standard hinge 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. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
 - 3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER".
 - i. Application Process: **Die Cut Lettering.**
 - ii. Lettering Color: Black.
 - iii. Orientation: Vertical.
- K. Finishes:
 - 1. Manufacturer's standard baked-enamel paint for the following:
 - a. Interior of cabinet and door.
 - 2. Stainless Steel: No. 6 finish.

2.5 MOUNTING BRACKETS

- A. Manufacturers:
 - 1. JL Industries, Inc.
 - 2. Larsen's Manufacturing Company.
 - 3. Modern Metal Products; Div. of Technico.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
 - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

2.6 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. Construct fire-rated cabinets with double walls fabricated from 0.0428-inch- thick, cold-rolled steel sheet lined with minimum 5/8-inch- thick, fire-barrier material.

- a. Provide factory-drilled mounting holes.

- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
 2. Miter and weld perimeter door frames.

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

2.7 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 STEEL FINISHES

- A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond using manufacturer's standard methods.
- B. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

2.9 STAINLESS-STEEL FINISHES

- A. General: Remove tool and die marks and stretch lines or blend into finish.
 1. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- B. Satin, Directional Polish: No. 6 finish.
- C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.
- B. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- B. Fire-Protection Cabinets: Fasten fire-protection cabinets to structure, square and plumb.
 - 1. Provide semirecessed fire-protection cabinets.
 - 2. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
- D. Identification: Apply decals and die cut vinyl lettering at locations indicated.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection specialties are installed, unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding.
- 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 manufacturer.
- 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 **105200**

SECTION 123661.16 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid surface material countertops.
 - 2. Solid surface material backsplashes.
 - 3. Solid surface material end splashes.

1.2 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples: For each type of material exposed to view.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Formica Corporation.
 - b. LG Chemical, Ltd.
 - c. Samsung Chemical USA, Inc.
 - d. Swan Corporation (The).
 - e. Wilsonart International Holdings, Inc.
 - 2. Colors and Patterns: As selected by Architect from manufacturer's full range.
- B. Particleboard: ANSI A208.1, Grade M-2.

2.2 COUNTERTOP FABRICATION

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
 - 1. Grade: Custom.
- B. Configuration:
 - 1. Front: Straight, slightly eased at top.
 - 2. Backsplash: Straight, slightly eased at corner.
 - 3. End Splash: Matching backsplash.
- C. Countertops: 3/4-inch- thick, solid surface material with front edge built up with same material.

- D. Backsplashes: 1/2-inch- thick, solid surface material.
- E. Joints: Fabricate countertops without joints.
- F. Cutouts and Holes:
 - 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
 - 1. Adhesives shall have a VOC content of 70 g/L or less.
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer.
- B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- C. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions.
- D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
- E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive.
- F. Install aprons to backing and countertops with adhesive.
- G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION **123661.16**

000110 – TABLE OF CONTENTS

Missouri State University

Football Locker Room Renovation for
Forsythe Athletics Center
827 S Kings Ave
Springfield, MO 65897

DIVISION 21 – Fire Suppression

- 210500 Common Work Results for Fire Suppression
- 211310 Fire Suppression Sprinkler Systems

DIVISION 22 – PLUMBING

- 220500 Common Work Results for Plumbing
- 220523 Valves for Plumbing Piping
- 220529 Hangers, Supports and Vibration Isolation for Plumbing Piping and Equipment
- 220553 Identification for Plumbing Piping and Equipment
- 220700 Plumbing Insulation
- 221100 Facility Piping and Specialties
- 224000 Plumbing Fixtures

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING

- 230500 Common Work Results for HVAC
- 230514 Variable Frequency Drives
- 230519 Meters and Gauges
- 230523 Valves for HVAC Piping
- 230529 Hangers, Supports and Vibration Isolation for HVAC Piping and Equipment
- 230553 Identification for HVAC Piping and Equipment
- 230593 Testing and Balancing
- 230700 HVAC Insulation
- 230701 HVAC Piping Insulation
- 230902 Building Management Controls System
- 232113 HVAC Piping and Specialties
- 232123 HVAC Pumps
- 233113 HVAC Ductwork
- 233300 Air Duct Accessories
- 233600 Air Terminal Units
- 233713 Grilles, Registers and Diffusers
- 237200 Energy Recovery Unit

DIVISION 26 – ELECTRICAL

- 260500 Common Work Results for Electrical
- 260519 Conductors and Cables
- 260533 Raceways and Boxes for Electrical Systems
- 260553 Identification for Electrical Equipment and Wiring
- 260923 Lighting Control Devices
- 262416 Panelboards
- 262726 Wiring Devices
- 265100 Light Fixtures

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

- 280500 Common Work Results for Electronic Safety and Security
- 283111 Addressable Fire Alarm System

210500 – COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 CODE SECTIONS

- A. 2012 International Mechanical Code
- B. 2012 International Building Code
- C. 2012 International Plumbing Code
- D. 2011 National Electric Code
- E. 2012 International Fire Code
- F. ADA – American Disabilities Act
- G. ANSI – American National Standards Institute
- H. ASHRAE – American Society of Heating Refrigerating and Air Conditioning Engineers
- I. ASTM – American Society of Testing Materials
- J. NFPA – National Fire Protection Association
- K. NFPA 13 - Installation of Sprinkler Systems
- L. NFPA 13R - Installation of Sprinkler Systems in Residential Occupancies up to and Including four stories in height
- M. NFPA 24 - Installation of Private Fire Service Mains and Their Appurtenances
- N. NEMA – National Electrical Manufacturers Association
- O. OSHA – Occupational Safety and Health Act
- P. UL – Underwriter's Laboratories
- Q. All codes listed on architectural Code Reference Sheet or project cover sheet.

1.2 GENERAL

- A. Provide all work in accordance with applicable codes, rules, ordinances, and regulations of local, State, and Federal Governments and other Authorities Having Jurisdiction (AHJ).
- B. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the drawings and specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system functioning as indicated by the design and the equipment specified. Elements of the work include materials, supervision, supplies, equipment, transportation, and utilities.
- C. The drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, piping, etc. without showing all the exact details as to elevations, offsets, control lines, and other installation requirements. The contractor shall use the drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system. Plans shall not be scaled
- D. Contractor shall coordinate with all other trades to ensure that all required project components are included in project bid.
- E. If in any case the plans or specifications conflict with either manufacturer's requirements or minimum code requirements the information on plans and specifications shall be superseded by manufacturers and code requirements.
- F. If in any case the plans or specifications conflict with themselves, the most stringent of the conflicting information shall be the basis for bid. Contractor shall seek clarification of all conflicts prior to bid.

- G. All change order requests shall be accompanied with itemized tabular breakdown of all materials and labor associated with installation of all associated materials for review of the design team. Lump sum pricing will not be accepted.
- H. Contractor shall refer to each drawing and specification section in construction document set. No bids shall be submitted without review of all construction documents.
- I. All pipe sizes indicated in this specification are nominal pipe sizes (NPS).

1.3 LOCAL CONDITIONS

- A. Visit site and determine existing local conditions affecting work in contract.
- B. Failure to determine site conditions or nature of existing or new construction will not be considered a basis for granting additional compensation.

1.4 ALLOWABLE MANUFACTURERS

- A. Allowable manufactures for all products listed in division 21 are listed on "Schedule of Manufacturers" on plans.

1.5 SUBMITTAL REQUIREMENTS

- A. Submittals for products in division 21 shall include the following items.
 - 1. Product data showing type, model and construction characteristics of product.
 - 2. Layout drawings for any systems requiring interconnection of various system components.
 - 3. All other documentation required to show compliance with the specifications.
- B. The contractor shall provide a schedule of submittals indicating dates on which each submittal will be provided to design team for review. Schedule shall be submitted 10 working days in advance of delivery of first submittal for review.
- C. Contractor shall allow a minimum of ten working days for design team of review of submittals.

1.6 WARRANTY REQUIREMENTS

- A. Unless noted elsewhere in the specifications, all work shall be warranted for a period of not less than one year from the date of substantial completion. The contractor shall provide work at no additional cost to correct any deficiencies in their work that were identified to have been present during the warranted period.
- B. The following additional items shall be guaranteed:
 - 1. Piping shall be free from obstructions, holes or breaks of any nature.
 - 2. Insulation shall be effective.
 - 3. Proper circulation of fluid in each piping system.
- C. The above guarantees shall include both labor and material; and repairs or replacements shall be made without additional cost to the Owner.
- D. Any remedial work as a result of the above mentioned items shall be performed promptly, upon written notice from the Architect or Owner.

1.7 DEMOLITION

- A. Where demolition work is required contractor shall disconnect, demolish and remove plumbing systems, equipment and components indicated to be removed.
- B. All patching of piping and other fixtures shall be performed with materials matching existing conditions and reinsulated to maintain performance of previous conditions.
- C. All equipment to be removed and reinstalled shall be disconnected, with services capped, cleaned and stored for reconnection.
- D. Owner shall have first right of refusal for all materials being removed.

- E. If pipe, insulation, or equipment to remain is damaged or unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
- F. Where demolition process has caused damage to equipment, fixtures, piping and other devices to remain, these items shall be repaired at contractor's expense to the approval of the Architect.

1.8 INSTALLATION

- A. All equipment in division 21 shall be installed according to manufacturer's requirements and minimum code requirements. If in any case the plans or specifications are in conflict with either manufacturer's requirements or minimum code requirements the information on plans and specifications shall be superseded by manufacturers and code requirements.
- B. Apply firestopping to penetrations of fire rated floor and wall assemblies for electrical installations to restore original fire resistance rating of assembly.
- C. No combustible materials shall be allowed in return air plenum regardless of indication on plans.
- D. If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- E. Install all equipment to facilitate service, maintenance and repair or replacement of components of both plumbing equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

PART 2 – PRODUCTS

2.1 SLEEVES

- A. Sleeves shall be constructed from the following materials at contractor's option.
 - 1. Galvanized steel round tubing, closed with welded longitudinal joint.
 - 2. Schedule 40 Steel Pipe.
 - 3. DUCTED RETURN ONLY – Schedule 40 PVC pipe.

2.2 ESCUTCHEONS

- A. Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. Options:
 - 1. One-Piece, deep-drawn, box-shaped brass with polished chrome-plated finish.
 - 2. One-Piece, Cast-Brass with set screw with polished chrome plated finish.
 - 3. Split-Casting, Cast-Brass with concealed hinge and set screw and polished chrome plated finish.

2.3 GROUT

- A. ASTM C 1107, grade B, nonshrink and nonmetallic, dry hydraulic-cement grout
- B. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
- C. Design Mix: 5000 psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

211310 – FIRE SUPPRESSION SPRINKLER SYSTEMS

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 DESIGN REQUIREMENTS

- A. Fire sprinkler shall be designed in accordance with NFPA 13 standards.
- B. Fire protection sprinkler contractor shall provide complete design of sprinkler system. Any details, routing or equipment shown on plans shall be incorporated into design as part of minimum design requirements.
- C. Fire protection sprinkler system shall be designed via delegated design. System design shall include comprehensive engineering analysis by a qualified professional engineer, licensed to design fire sprinkler systems in jurisdiction encompassing the project location.
- D. Design Engineer of record shall make final determination of Sprinkler hazard classification.
- E. The system shall be a complete system as required by local authorities. All wiring required by the contract shall be provided by the contractor.
- F. Design shall include all water supply piping, pumps, storage tanks and other appurtenances required for supply of sprinkler system from water supply source.
- G. In instances in which a fire pump is required based on engineered system design, Fire Protection Contractor shall review the electrical plans to verify that electrical service is explicitly called out for powering the fire pump. If no circuit is present, Fire Protection Contractor shall include circuiting of the fire pump in his bid or shall notify A/E for clarification prior to bid.
- H. Design shall account for all ductwork, conduit or piping intended to be routed through structure. Sprinkler piping located in conflict with other trades will require relocation unless physical limitations prohibit alternate installation.
- I. Provide hydrant flow test as required for design.
- J. Project Description:
 - 1. Contractor shall remove and replace sprinkler heads in areas of renovation to accommodate new ceiling installation.
 - 2. Contractor shall provide new branch piping and heads as required for reconfigured rooms.

1.2 INSTALLATION AND EXECUTION REQUIREMENTS

- A. Furnish all design, labor, materials, fabrication, equipment, and services necessary to provide a complete and operational automatic fire sprinkler system as specified herein and as required for satisfactory operation of the system.
- B. After installation all piping shall be completely flushed and hydrostatically tested for a period of not less than two hours at 200 PSI pressure. Upon detection of any leaks, system shall be completely drained, leaks repaired and retested. No portion of the system shall be concealed until system is certified to be free of leaks. Authority having jurisdiction shall be present during testing. Contractor shall make proper notice of authorities to obtain testing observation as needed for project schedule. Contractor shall notify owner 24 hours in advance of all tests to allow owner's observation at their discretion.
- C. Flexible hose fittings shall be permitted for installation in lay-in ceilings where allowed by local authority having jurisdiction.
- D. Contractor shall furnish spare sprinkler heads of each type used in the project. If quantity of head is less than or equal to 300, provide six spare heads. If quantity of head is greater than 300, provide twelve spare heads. Contractor shall provide emergency spare cabinet, and shall locate cabinet in mechanical room as directed by owner or where indicated on plans.
- E. Sprinkler heads shall be centered in ceiling tiles where installed in lay-in ceiling.
- F. Sprinkler heads shall be centered between rows of lights and coordinated with HVAC diffuser and grille locations.

- G. Sprinkler piping shall be installed tight to bottom of floor deck or roof structure above and closely coordinated with other trades. Installation at bottom of structural members such as bar joists shall only be performed if all other trades are coordinated with sprinkler piping and location of piping does not interfere with the installation of other trades.
- H. Where all sprinkler piping cannot be installed in bar joists due to solid building structural members. Sprinkler piping system shall be designed with lines routed perpendicular to building structure in no more than one location. Branches shall tee off of top of main line to accommodate installation of branch piping at bottom of roof deck.
- I. Sprinkler piping shall be concealed in all areas in which a drywall or lay in ceiling is specified. Contractor shall seek clarification from A/E for any areas in which they wish to expose piping.
- J. Installation location of all sprinkler piping and heads shall account for all ductwork, conduit or piping intended to be routed through structure. Sprinkler piping located in conflict with other trades will require relocation unless physical limitations prohibit alternate installation.
- K. Electrical tamper and flow switches are not shown but are required. Contractor shall provide switches at all valves in system as required and shall provide the wiring for connection to the fire alarm system or alarm communicator as applicable.
- L. Provide all flow switches, gongs, bells, horns, etc. as required by local authority having jurisdiction regardless of indication on plans.
- M. Install system with drains for complete system drainage.
- N. Pressurize and check pre action sprinkler system piping and air pressure maintenance devices or air compressors where applicable.
- O. Do not install pendant or sidewall wet sprinklers in areas subject to freezing.
- P. Where applicable, do not interrupt existing sprinkler service to facilities occupied by owner or others unless under the following conditions and then only after arranging to provide temporary service:
 - 1. Notify Architect no fewer than seven days of proposed interruption of existing service.
 - 2. Do not proceed with interruption of existing service without written permission of owner or owner's agent.

1.3 SUBMITTAL REQUIREMENTS

- A. All submittal documents shall bear the seal and signature of the contractor's design engineer, licensed to design fire suppression sprinkler systems in the jurisdiction encompassing the project location.
- B. Provide scaled layout drawings indicating locations of piping runs, sprinkler heads, slopes of horizontal runs, head elevations, wall and floor penetrations and connections. Indicate adjacent equipment, and fixtures on plan to depict clearances with all other trades.
- C. Submittals of required wiring shall be included in the submittal package and sent to the local Authority.

1.4 CERTIFICATION AND INSPECTION

- A. The fire protection engineer of record shall inspect the system installation for conformance with design and all applicable code requirements. Contractor shall submit report indicating all deficiencies or conflicts a minimum of two weeks prior to substantial completion. Report shall bear seal and signature of engineer of record. All work required to correct deficiencies, conflicts and errors noted in the report shall be performed by installing contractor at no additional expense. As built records of all hydraulic calculations shall be revised to include and any all additions and modifications and shall bear the seal of the engineer of record.
- B. Provide certification upon completion of installation of sprinkler system indicating system is in compliance with and has been tested in accordance with applicable NFPA standards.

1.5 QUALIFICATION

- A. Fire protection work shall be installed by a contractor with a minimum of three years of successful installation experience. Project experience shall include projects of similar scope and size to the project depicted on drawings. Contractor shall hold all licenses and certifications required in local jurisdiction.

1.6 HEAD TYPE SCHEDULE:

- | | |
|---|-------------------|
| A. Finished Areas: | Concealed |
| B. Areas with exposed Ceiling and No Structure: | Exposed |
| C. Side Wall: | Semi Recessed |
| D. Areas Subject to Abuse – Gyms, Locker Rooms, All other areas noted on plans: | Exposed with Cage |

1.7 EXISTING SPRINKLER SYSTEM MODIFICATIONS:

- A. The existing building sprinkler system shall be modified to provide adequate protection for the proposed renovated space. The existing system shall be reviewed by a licensed professional engineer to determine the extent of the modifications necessary. Where modifications are required, the sprinkler system shall be designed by and bear the seal of a professional engineer licensed by the applicable state. The fire sprinkler system contractor shall provide drawings for a fire sprinkler system per NFPA-13 which are sealed and signed by a professional engineer licensed in the applicable state. All piping from the "point of service" including the underground used for the sprinkler standpipe system must be installed by a registered sprinkler contractor. Shop drawings for sprinkler system, underground water supply including hydraulic calculations and fire alarm system shall be submitted for a separate review and approval.

PART 2 – PRODUCTS

2.1 SPRINKLER HEADS

- A. Temperature rating of fusible link shall be appropriate for application and ambient condition of area in which the head is located.
- B. Finish:
1. Concealed: Brass Unplated heads with cover plate and trim to match ceiling color.
 2. Semi Recessed: Brass pendant heads with all parts finished with polished chrome.
 3. Exposed: Brass Unplated heads.

2.2 PROTECTIVE CAGE

- A. Description: Hard wire steel cage with clear chromate finish over zinc plating.

2.3 FLEXIBLE HOSE FITTINGS

- A. Hoses shall be type 304 braided stainless steel with fully welded non-mechanical fittings. Hoses shall be factory leak tested, limited to a maximum length of three feet, with a maximum pressure rating of 175 PSI. Minimum size shall be 1"
- B. Hoses shall attached to lay-in ceiling grid with multiport style galvanized ceiling bracket with self securing fasteners to security hose to grid and tamper resistant screws.
- C. Hoses and fittings shall comply with all NFPA requirements and performance requirements of Factory Mutual 1637 and UL 2443.

220500 – COMMON WORK RESULTS FOR PLUMBING

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 CODE SECTIONS & INDUSTRY STANDARDS

- A. 2012 International Mechanical Code
- B. 2012 International Building Code
- C. 2012 International Plumbing Code
- D. 2011 National Electric Code
- E. ADA – American Disabilities Act
- F. ANSI – American National Standards Institute
- G. ASHRAE – American Society of Heating Refrigerating and Air Conditioning Engineers
- H. ASTM – American Society of Testing Materials
- I. NFPA – National Fire Protection Association
- J. NEMA – National Electrical Manufacturers Association
- K. OSHA – Occupational Safety and Health Act
- L. UL – Underwriter's Laboratories
- M. All codes listed on architectural Code Reference Sheet or project cover sheet.

1.2 GENERAL

- A. Provide all work in accordance with applicable codes, rules, ordinances, and regulations of local, State, and Federal Governments and other Authorities Having Jurisdiction (AHJ).
- B. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the drawings and specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system functioning as indicated by the design and the equipment specified. Elements of the work include materials, supervision, supplies, equipment, transportation, and utilities.
- C. The drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, piping, etc. without showing all the exact details as to elevations, offsets, control lines, and other installation requirements. The contractor shall use the drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system. Plans shall not be scaled.
- D. Contractor shall coordinate with all other trades to ensure that all required project components are included in project bid.
- E. If in any case the plans or specifications conflict with either manufacturer's requirements or minimum code requirements the information on plans and specifications shall be superseded by manufacturers and code requirements.
- F. If in any case the plans or specifications conflict with themselves, the most stringent of the conflicting information shall be the basis for bid. Contractor shall seek clarification of all conflicts prior to bid.
- G. All change order requests shall be accompanied with itemized tabular breakdown of all materials and labor associated with installation of all associated materials for review of the design team. Lump sum pricing will not be accepted.
- H. Contractor shall refer to each drawing and specification section in construction document set. No bids shall be submitted without review of all construction documents.

- I. Contractor shall provide heat trace cable for all piping installed in areas subject to freezing temperatures.
- J. All water lines serving flush valves shall be equipped with hammer arrestors. A single hammer arrestor shall be allowed to be installed on piping main serving a group of flush valves.
- K. All pipe sizes indicated in this specification are nominal pipe sizes (NPS).

1.3 LOCAL CONDITIONS

- A. Visit site and determine existing local conditions affecting work in contract.
- B. Failure to determine site conditions or nature of existing or new construction will not be considered a basis for granting additional compensation.

1.4 ALLOWABLE MANUFACTURERS

- A. Allowable manufactures for all products listed in division 22 are listed on "Schedule of Manufacturers" on plans.

1.5 SUBMITTAL REQUIREMENTS

- A. Submittals for products in division 22 shall include the following items.
 - 1. Product data showing type, model and construction characteristics of product.
 - 2. Layout drawings for any systems requiring interconnection of various system components.
 - 3. All other documentation required to show compliance with the specifications.
- B. The contractor shall provide a schedule of submittals indicating dates on which each submittal will be provided to design team for review. Schedule shall be submitted 10 working days in advance of delivery of first submittal for review.
- C. Contractor shall allow a minimum of ten working days for design team of review of submittals.

1.6 WARRANTY REQUIREMENTS

- A. Unless noted elsewhere in the specifications, all work shall be warranted for a period of not less than one year from the date of substantial completion. The contractor shall provide work at no additional cost to correct any deficiencies in their work that were identified to have been present during the warranted period.
- B. The following additional items shall be guaranteed:
 - 1. Piping shall be free from obstructions, holes or breaks of any nature.
 - 2. Insulation shall be effective.
 - 3. Proper circulation of fluid in each piping system.
- C. The above guarantees shall include both labor and material; and repairs or replacements shall be made without additional cost to the Owner.
- D. Any remedial work as a result of the above-mentioned items shall be performed promptly, upon written notice from the Architect or Owner.

1.7 DEMOLITION

- A. Where demolition work is required contractor shall disconnect, demolish and remove plumbing systems, equipment and components indicated to be removed.
- B. All patching of piping and other fixtures shall be performed with materials matching existing conditions and reinsulated to maintain performance of previous conditions.
- C. All equipment to be removed and reinstalled shall be disconnected, with services capped, cleaned and stored for reconnection.
- D. Owner shall have first right of refusal for all materials being removed.
- E. If pipe, insulation, or equipment to remain is damaged or unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

- F. Where demolition process has caused damage to equipment, fixtures, piping and other devices to remain, these items shall be repaired at contractor's expense to the approval of the Architect.

1.8 INSTALLATION

- A. All equipment in division 22 shall be installed according to manufacturer's requirements and minimum code requirements. If in any case the plans or specifications are in conflict with either manufacturer's requirements or minimum code requirements the information on plans and specifications shall be superseded by manufacturers and code requirements.
- B. Apply firestopping to penetrations of fire rated floor and wall assemblies for electrical installations to restore original fire resistance rating of assembly.
- C. No combustible materials shall be allowed in return air plenum regardless of indication on plans.
- D. If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- E. Install all equipment to facilitate service, maintenance and repair or replacement of components of both plumbing equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

1.9 TEMPORARY FACILITIES

- A. Contractor shall provide temporary facilities as required for construction of the project. Temporary facilities shall include temporary water service and distribution, electrical power and lighting service, heating cooling and ventilation, telephone and data service, and sanitary facilities including drinking water.
- B. Permanent HVAC equipment shall not be used to heat, cool or ventilate the facility during construction.
- C. Whether during a renovation or a phased construction project, the contractor shall include all temporary facilities to maintain functionality and suitable space conditions in all areas of a building that are occupied by the owner while construction activities are underway.
- D. The contractor shall provide temporary facilities as required to maintain a safe working environment and to protect all building materials and provide space conditions within range required for material installation.
- E. 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. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- F. Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Relocate temporary services and facilities as the Work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist on-site.

PART 2 – PRODUCTS

2.1 DIELECTRIC FITTINGS

- A. Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Dielectric Unions: Factory-fabricated, union assembly, for 250 psig minimum working pressure at 180 deg F.
- C. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for minimum working pressure as required to suit system pressures.
- D. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300 psig minimum working pressure at 225 deg F.
- E. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300 psig minimum working pressure at 225 deg F.

2.2 SLEEVES

- A. Sleeves shall be constructed from the following materials at contractor's option.
 - 1. Galvanized steel round tubing, closed with welded longitudinal joint.
 - 2. Schedule 40 Steel Pipe.
 - 3. DUCTED RETURN ONLY – Schedule 40 PVC pipe.

2.3 ESCUTCHEONS

- A. Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. Options:
 - 1. One-Piece, deep-drawn, box-shaped brass with polished chrome-plated finish.
 - 2. One-Piece, Cast-Brass with set screw with polished chrome plated finish.
 - 3. Split-Casting, Cast-Brass with concealed hinge and set screw and polished chrome plated finish.

2.4 GROUT

- A. ASTM C 1107, grade B, nonshrink and nonmetallic, dry hydraulic-cement grout
- B. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
- C. Design Mix: 5000 psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

220523 – VALVES FOR PLUMBING PIPING

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 INSTALLATION REQUIREMENTS

- A. Prior to installation, examine valve interior for cleanliness. Operate valves to ensure proper operation. Examine guides, seats, threads and flanges to ensure there are no conditions that could cause valve malfunction or leakage. Do no attempt to repair defective valves; replace with new valves.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance and equipment removal without system shutdown. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in position to allow full stem movement. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install necessary valves within piping systems to provide required flow control and to allow isolation for inspection, maintenance and repair of each piece of equipment of fixture and on each main and branch service loop.
- E. Valves 2" and smaller have screwed end connections as required by associated piping materials unless otherwise noted. Valves 2.5" and larger shall have flanged or butt weld ends as scheduled.
- F. Valves shall be the same size as adjacent piping. Reduced valve size will not be allowed unless specifically noted.
- G. Valve pressure and temperature ratings shall not be less than indicated and as required for system pressures and temperatures.

1.2 GENERAL VALVE APPLICATIONS

- A. If valve applications are not noted, use the following:
 - 1. Shutoff service: Ball, Butterfly valves
- B. Valves shall be sized the same as upstream piping unless otherwise noted.
- C. Actuator type valves:
 - 1. Handwheel for valves other than quarter-turn types
 - 2. Hand lever for quarter-turn valves 6" and smaller
- D. Valves in Insulated Piping: (shall be provided with 2" stem extensions and the following)
 - 1. Ball Valves shall be provided with an extended operating handle of non-thermal-conductive material and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

1.3 VALVE ENDS SELECTION

- A. Select Valves with the following ends or types of connections:
 - 1. Copper tube 2" and smaller: solder ends, threaded ends

PART 2 – PRODUCTS

2.1 BALL VALVES

- A. Bronze Ball Valve: Apollo series 77-14X-01 ball valve. Class 150 valve. Valve shall conform to standard MSS SP-110. Body design shall be two piece, bronze with threaded ends, stainless steel ball and stem, Teflon seats and full porting. For potable water uses, valve shall be lead free, certified to NSF/ANSI 61 of NSF/ANSI 372.

220529 – HANGERS, SUPPORTS AND VIBRATION ISOLATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic restraint hangers and supports for piping and equipment. Obtain approval from authorities having jurisdiction where required by local requirements.

1.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers, supports, clamps and attachments to support piping properly from building structure. Do not attach to ceilings, equipment, ductwork, conduit or other non-structural elements such as floor or roof decking.
- B. Hangers, supports, clamps and attachments shall comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible. Install supports with maximum spacing specified within Division 22 piping sections. Where piping of various sizes is supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.
- C. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length specified in Division 22 piping sections. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping as specified in Division 22 piping sections. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through openings at top of inserts.
- D. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Provide two nuts on threaded supports to securely fasten the support.
- E. Field fabricated heavy duty steel trapeze supports shall be fabricated from steel shapes selected for loads required. Weld steel in accordance with AWS D-1.1.
- F. Install appropriate types of hangers and supports to allow control movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
- G. Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- H. Install hangers to provide indicated pipe slopes and so that maximum deflection of piping allowed by ASME B31.9 is not exceeded.
- I. Insulated piping:
 - 1. Riser Clamps: Attach riser clamps, including spacers, to piping with riser clamps projecting through insulation. Do not exceed pipe stresses allowed by ASME B31.9. Do not use riser clamps to support horizontal, insulated piping. Seal insulation for hot piping and protect vapor barrier for cold piping as specified in Division 23 "HVAC Insulation".
 - 2. Insulation protection shield: Install insulation protection shield and high density insulation, sized for the insulation thickness used as specified in insulation schedule. Install a minimum 8" long section at each support point, top and bottom halves or the pipe of same thickness of insulation used.
- J. Pre-engineered Support Strut Systems: Channel strut systems can be used at the Contractors option in lieu of individual hangers for horizontal pipes. Space channel strut systems at the required distance for the smallest pipe supported. Provide channel gauge and hanger rods per the manufacturer's recommendations for the piping supported. Where strut systems are attached to walls, install anchor bolts per manufacturer's recommendations.
 - 1. Uninsulated copper pipe: Install with plastic galvanic isolators.

2. Insulated Tube or Pipe: Install with 360 degree insulation protection shields or pre-engineered thermal hanger shield inserts.

1.3 INSTALLATION OF ANCHORS

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ASME B 31.9 and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install anchors by welding steel shapes, plates and bars to piping and to structure. Comply with ASME B 31.9 and with AWS Standards D1.1.
- C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions to control movement to compensators.
- D. Anchor spacing: Where not otherwise indicated, install anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

1.4 INSTALLATION OF PIPE ALIGNMENT GUIDES

- A. Install pipe alignment guides on piping that adjoins expansion joints as required by expansion joint manufacturer and elsewhere as indicated on plans and specification sections to eliminate binding and torsional stress on piping systems. Where not otherwise indicated, install guides as required by ASME B 31.9. Anchor guides to building substrate.

1.5 EQUIPMENT SUPPORTS

- A. Fabricate structural steel supports to suspend equipment from structure above or support equipment from floor. Place grout under supports for piping and equipment.

1.6 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Clean all welds and touch up paint to match factory finish of all materials or color and finish of adjacent materials when supports and adjacent elements are painted.
- C. Adjust vibration isolators after piping system is at operating weight.
- D. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- E. Adjust active height of spring isolators and adjust restraints to permit free movement of equipment within normal mode of operation.

PART 2 – PRODUCTS

2.1 STEEL PIPE HANGERS AND SUPPORTS

- A. Comply with MSS SP-58 types 1-58 factory fabricated components. Hangers shall be pre-galvanized or hot dipped. Where non-metallic coatings are indicated, provide plastic coating, jacket or liner.
- B. Where hangers are installed in a corrosive environment or outdoors, hangers and supports shall be type 304 stainless steel.

2.2 TRAPEZE PIPE HANGERS

- A. Trapeze hangers shall comply with MSS SP-69 and shall be type 59 shop or field fabricated pipe support assembly made from structural steel shapes with MSS SP-58 hanger rods, nuts, saddles and U-bolts.

2.3 THERMAL HANGER SHIELD INSERTS

- A. Inserts shall have 100 PSI minimum compressive strength and shall be encased in sheet metal shield.
- B. For trapeze and clamped systems, insert and shield shall cover entire circumference of pipe.

- C. For clevis hangers, insert and shield shall cover lower 180 degrees of pipe.
- D. Insert length shall extend 2" beyond sheet metal shield for piping operating below ambient air temperature.

FINAL REVIEW
NOT FOR
CONSTRUCTION

220553 – IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 VALVE IDENTIFICATION

- A. Provide valve tag on every valve and control device in each piping system. Exclude check valves, valves within factory fabricated equipment units, plumbing fixtures and equipment and similar rough-in connections of end-use fixtures and units.
- B. List each tagged valve in valve schedule for each piping system. And provide valve schedule to owner in operations and maintenance manuals.

1.2 PLUMBING EQUIPMENT IDENTIFICATION

- A. Install engraved plastic laminate sign or plastic equipment marker on or near each major item of plumbing equipment and each operational device as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
 - 1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - 2. Meters, gauges, thermometers and similar units.
 - 3. Pumps
 - 4. Heat exchangers
 - 5. Water heaters, tanks and pressure vessels.
 - 6. Strainers, water treatment systems and similar equipment.
- B. Where lettering larger than 1" height is needed for proper identification because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved sign at contractor's option.
- C. Lettering shall be minimum 1/4" high where viewing distance is less than 2'-0"; 1/2" high for distances up to 6'-0" and proportionately larger for greater distances. Secondary lettering shall be 2/3 to 3/4 of size of the principal lettering.

1.3 PIPING IDENTIFICATION

- A. Install pipe markers on each piping system and include arrows to show normal direction of flow.
- B. Install pipe markers where piping is exposed to view, concealed by only a removable ceiling system, installed in machine rooms, installed in accessible maintenance spaces and exterior non-concealed locations.
 - 1. Within 5 feet of each valve and control device.
 - 2. Within 5 feet of each branch, excluding take-offs less than 25 feet in length for fixtures or equipment connections; mark flow direction of each pipe at branch connection.
 - 3. Within 5 feet where pipes pass through walls, floors or ceilings or enter non-accessible enclosures. Provide identification on each side of wall, floor or ceiling.
 - 4. At access doors, manholes and similar access points which permit view of concealed piping.
 - 5. Within 5 feet of major equipment items and other points of origination and termination.
 - 6. Spaced intermediately at maximum spacing or 50' along each piping run. Spacing shall be reduced to 25' in congested areas of piping and equipment where there are more than two piping systems or pieces of equipment.
- C. Provide identification on the following systems; domestic cold water, domestic hot water, domestic hot water recirculation, lawn irrigation, sanitary waste, storm water, vent and natural gas piping.

PART 2 – PRODUCTS

2.1 ENGRAVED LAMINATE SIGN

- A. Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thickness indicated, engraved with the engravers standard letter style of the sizes and wording indicated. Signs shall be black with white core except as otherwise noted and shall be punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
- B. Thickness shall be 1/16" for units up to 20 square inches or 8" in length and 1/8" for larger units.
- C. Signs shall be fastened with self-tapping stainless steel screws, except contact type permanent adhesive where screws cannot or should not penetrate the substrate.

2.2 PLASTIC VALVE TAGS

- A. Provide manufacturer's standard solid plastic valve tags with printed enamel lettering with system abbreviation in approximately 3/16" high letters and sequenced valve numbers approximately 3/8" high and with 5/32" hole for fastener
- B. Tags shall be 1-1/8" square white tags with black lettering.

2.3 PAINTED IDENTIFICATION

- A. Painting where allowed shall be performed using standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping and similar applications. Minimum letter height shall be 1.25" high for ductwork and equipment and 0.75" high for access door signs and similar operational instructions.
- B. Paint shall be exterior type, oil based, black paint.

2.4 PLASTIC TAPE PIPE MARKERS

- A. Provide manufacturer's standard color-coded pressure sensitive vinyl tape not less than 3 mils thick.
- B. Tape width shall be 1.5" for pipes less than 6" in diameter and 2.5" wide for larger pipes.
- C. Colors shall comply with ANSI A13.1 except where noted otherwise.
- D. Lettering shall be manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by A/E in cases of variance with names shown or specified. Abbreviate system names only as necessary for each application length.
- E. Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering or as a separate unit of plastic.

220700 – PLUMBING INSULATION

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 GENERAL

- A. Provide necessary materials and accessories for installation of insulation for plumbing and mechanical systems as specified and/or detailed on drawings. Insulation type, jacket, and thickness for specific piping systems or equipment shall be as listed in this specification section.
- B. Products or their shipping cartons shall bear label indicating their flame and smoke ratings. Treatments of jackets or facings for impart flame and smoke safety shall be permanent. Use of water soluble treatments such as corn paste or wheat paste is prohibited. This does not exclude approved lagging adhesives.
- C. Install insulation over clean dry surfaces with joints firmly butted together. Insulation at equipment, flanges, fittings, etc. shall have straight edges with box type joints with corner beads as required. Where plumbing and heating insulation terminates at equipment or unions, taper insulation at 30 degree angle to pipe with one coat finishing cement and finish same as fittings. Total insulation system shall have neat smooth appearance with no wrinkles, or folds in jackets, joint strips, or fitting covers. Seal butt joints at maximum intervals of 45 feet to prevent vapor barrier failures from being transmitted to adjoining insulations sections.
- D. Undamaged insulation systems on cold surface piping and equipment shall perform their intended functions as vapor barriers and thermal insulation without premature deterioration or vapor barrier. Contractor shall take every reasonable precaution to provide insulation systems with continuous unbroken vapor barriers.
- E. Products shall not contain asbestos, lead, mercury or mercury compounds.

1.2 QUALITY ASSURANCE

- A. Flame/Smoke Ratings: Provide composite Plumbing insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.
 - 1. Exception: Outdoor Plumbing insulation may have flame spread index of 75 and smoke developed index of 150.
- B. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- C. Insulation installer shall advise contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.
- D. All exterior piping insulation shall be painted with ultraviolet-resistant paint. Color as selected by architect.
- E. Provide an aluminum jacket over all exterior piping.

1.3 PIPING INSULATION INSTALLATION

- A. Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps.
- C. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.
- D. Maintain integrity of vapor-barrier jackets on cold pipe insulation, and protect insulation with shields to prevent puncture or other damage. Provide high density insulation of material as specified herein and of length equivalent to pipe shield. Provide pipe hangers sized for the pipe outside diameter plus insulation thickness. Seal butt joint between insulation and high density insulation with wet coat of vapor barrier lap cement.
 - 1. Exception for vertical piping: Provide clamps sized for the outside diameter of the vertical pipe and extend clamp through insulation. Seal penetrations of insulation and vapor barrier with wet coat of vapor barrier lap cement.

- E. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- F. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- G. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
- H. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

1.4 EQUIPMENT INSULATION

- A. Cold equipment (below ambient temperature):
 - 1. Insulate drip pans under chilled equipment and roof drain bodies with either 1" elastomeric flexible insulation or 2" fiberglass for surfaces above 35 deg F or 3" fiberglass for surfaces 35 deg F or lower.
- B. Hot equipment (above ambient temperature):
 - 1. Insulate hot water storage tanks and expansion/compression tanks with 1" flexible elastomeric insulation.
- C. Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.
- D. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.
- E. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.
- F. Do not apply insulation to equipment, breechings, or stacks while hot.
- G. Apply insulation using the staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.
- H. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving a smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.
- I. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2". Apply over vapor barrier where applicable.
- J. Do not insulate boiler manholes, handholes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.
- K. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.
- L. Equipment Exposed to Weather: Protect outdoor insulation from weather by installation of weather-barrier mastic protective finish, or jacketing, as recommended by the manufacturer.

1.5 INSULATION APPLICATION SCHEDULE

A. Domestic Cold Water (Up to 1.25")	Elastomeric	0.5" Thickness
B. Domestic Cold Water (Above 1.25")	Elastomeric	1" Thickness
C. Domestic Hot Water (Up to 1.25")	Elastomeric	1" Thickness
D. Domestic Hot Water (Above 1.25")	Elastomeric	1.5" Thickness
E. Domestic Hot Water Recirculation	Elastomeric	1" Thickness
F. Vent Piping (Within 6' of roof outlet)	Elastomeric	0.5" Thickness
G. Condensate Drain	Elastomeric	0.5" Thickness
H. P-Traps Receiving Condensate Drainage	Elastomeric	0.5" Thickness

PART 2 - PRODUCTS

2.1 ELASTOMERIC INSULATION

- A. Flexible Elastomeric insulation shall be closed-cell, sponge or expanded-rubber materials and comply with ASTM C 534, type I for tubular materials and type II for sheet products. Maximum insulation conductive value shall be 0.22 BTU-in/(h-sqft-°F). Insulation values shall comply with energy code minimum requirements. See common work results for current code edition.

2.2 ADHESIVES AND TAPES

- A. Insulating cements and adhesives shall be compatible with the insulation materials, jackets and substrates for bonding insulation to itself and to surfaces to be insulated.
- B. Mastics shall be compatible with insulation materials, jackets, and substrates and shall comply with MIL-A-24179A Type II. Vapor-barrier mastic shall be water based suitable for indoor and outdoor use on below ambient services.
- C. Tapes shall be white, vapor-retarder tape matching factory-applied jacket with acrylic adhesive and shall comply with ASTM C 1136.
- D. All insulation finishes shall be compatible with the insulation product being finished and shall be in a color as selected by architect.

FINAL REVIEW
NOT FOR
CONSTRUCTION

SECTION 220800 - COMMISSIONING OF PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes
 - 1. Commissioning of Plumbing Systems

1.2 RELATED DOCUMENTS

- A. Section 019113 – General Commissioning Requirements
- B. Section 230800 – Commissioning of HVAC Systems
- C. Section 260800 – Commissioning of Electrical Systems

1.3 DEFINITIONS

- A. CxA: Commissioning Agent.
- B. GC: Contractor; General Contractor, not a Subcontractor.
- C. O&M: Operations and Maintenance.

1.4 DESCRIPTION

- A. This section describes commissioning requirements applicable to commissioned items and systems specified in Division 22 to ensure that all systems are operating in a manner consistent with the Contract Documents.
- B. Conform to commissioning requirements and the commissioning plan.

1.5 RESPONSIBILITIES

- A. Mechanical, Plumbing, Controls, and TAB Contractors: The commissioning responsibilities applicable to each of the mechanical, controls, and TAB contractors of Division 22 are as follows (all references apply to commissioned equipment only).
 - 1. Construction and Acceptance Phases
 - a. Include the cost of participating in commissioning in the contract price. Commissioned equipment is defined in section 019113.
 - b. In each purchase order or subcontract written, include requirements for submittal data, completion of commissioning documentation, O&M data and training.
 - c. Attend and actively participate in a commissioning scope meeting and other meetings

necessary to facilitate the Commissioning process.

- d. Provide requested documentation to the CxA for development of the functional testing procedures.
 - e. Complete CxA furnished functional performance tests and procedures. Subs shall review test procedures to ensure feasibility, safety and equipment protection, and provide necessary written alarm limits to be used during the tests.
 - f. Complete a start-up and initial checkout plan, as required in the related section, using manufacturer's start-up procedures and the CxA furnished Pre-functional checklists for all commissioned equipment. Submit to GC for review prior to startup. CxA will verify plan for compliance. Refer to Section 019113 for further details related to start-up.
 - g. During the startup and initial checkout process, execute the plumbing-related portions of the pre-functional checklists for all commissioned equipment.
 - h. Correct system deficiencies before functional testing. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air-or water-related systems.
 - i. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the GC.
 - j. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments, and problem-solving.
 - k. Provide all test equipment necessary to fulfill specified testing requirements.
 - l. Perform functional performance testing under the direction of the CxA for specified equipment. Assist the CxA in interpreting the monitored data, as necessary.
 - m. Correct deficiencies (differences between specified and observed performance) as interpreted by the CxA and A/E and retest the equipment.
 - n. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions. O&M's to be consistent with the final tested condition of all installed systems.
 - o. During construction, maintain as-built mark-ups for all drawings. Update as needed following functional testing. Furnish final copy to CxA for inclusion in final report.
 - p. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
2. Operation Manuals shall include:
- a. A table of all setpoints and implications when changing them.

- b. Schedules.
 - c. Instructions for operation of each piece of equipment for emergencies.
 - d. Startup and shutdown procedures.
 - e. First year maintenance requirements.
 - f. Recommended ongoing maintenance schedules
- 3. Warranty Period
 - a. Participate in deferred functional performance testing, organized by the CxA, according to the specifications.
 - b. Correct deficiencies and make necessary adjustments to O&M Manuals and as-built drawings for applicable issues identified in any seasonal testing.
 - c. Participate in the 10-month post-occupancy walk-through, as required.
- B. Plumbing Contractor: The commissioning responsibilities of the plumbing contractor, during construction and acceptance phases in addition to those listed in Paragraph A, above, are:
 - 1. Participate in the Commission the plumbing systems listed in Section 019113 and the Commission Plan.
 - 2. Provide submittals as required by A/E and those listed on the pre-functional test sheets.
 - 3. During the startup and initial checkout process, execute the plumbing-related portions of the pre-functional checklists for all commissioned equipment.
 - 4. Provide all test equipment necessary to fulfill specified testing requirements (Testing per this section is a section requirement. Include all documentation and scheduling to the CxA).
 - 5. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CxA.
 - 6. Prepare a preliminary schedule for pipe system testing, flushing and cleaning, and equipment start-up for use by the CxA. Update the schedule as appropriate.
 - 7. Notify the GC when pipe system testing, flushing, cleaning, and startup of each piece of equipment will occur. Be responsible to notify the GC ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed and that the CxA has the scheduling information needed to efficiently execute the commissioning process.
 - 8. Refer to Section 019113 for specific details on non-conformance issues relating to pre-functional checklists and tests and for issues relating to functional performance tests.
 - 9. The training shall consist of a review of the O&M manuals and hands-on training. Hands-on training shall include start-up, operation in all-modes possible, including manual, shutdown, and any

emergency procedures and preventative maintenance for all pieces of equipment. The plumbing contractor shall fully explain and demonstrate the operation, function, and overrides of any local package controls, not controlled by the central control system. Training shall occur after functional testing is complete, unless approved otherwise by the GC. Contractor and vendor training will be as specified for the product or system. Training will be scheduled by the GC and monitored by the GC and CxA.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 STARTUP

- A. The plumbing contractor shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in Division 01. Division 22 has start-up responsibility and is required to complete systems and sub-systems, so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the Commissioning Agent or Owner.
- B. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the GC. Beginning system testing before full completion, does not relieve the Contractor from fully completing the system, including all pre-functional checklists as soon as possible.

3.2 TRAINING OF OWNER PERSONNEL

- A. The GC shall be responsible for reviewing the content and adequacy of the training of Owner personnel for commissioned equipment or systems. CxA will verify compliance.
- B. Mechanical and Plumbing Contractor: The mechanical and plumbing contractors shall have the following training responsibilities for their commissioned systems
 - 1. Provide the GC with a training plan 4 weeks before the planned training.
 - 2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of commissioned equipment.
 - 3. Training shall start with classroom sessions followed by hands on training on each piece of equipment.
 - 4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M Manual or sequence of operations, the system will be repaired or adjusted as necessary, and the demonstration repeated.
 - 5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment is required. More than 1 party may be required to execute the training.

6. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.
7. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M Manuals for reference.
8. Training shall include:
 - a. Use the printed installation, operation, and maintenance instruction material included in the O&M Manuals.
 - b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
 - c. Discussion of relevant health and safety issues and concerns.
 - d. Discussion of warranties and guarantees.
 - e. Common troubleshooting problems and solutions.
 - f. Explanation of information included in the O&M Manuals.
 - g. Discussion of any peculiarities of equipment installation or operation.
 - h. Classroom sessions shall include the use of overhead projections, slides, video/audio taped material as might be appropriate.
9. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and maintenance of all pieces of equipment.
10. Fully explain and demonstrate the operation, function, and overrides of any local packaged controls, not controlled by the central control system.

END OF SECTION **220800**

221100 – FACILITY PIPING AND SPECIALTIES

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 GENERAL

- A. Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing, slope, expansion, and other design considerations. So far as practical, install piping as indicated.
- B. Use fittings for all changes in direction and all branch connections.
- C. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- D. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- E. Seal pipe penetrations through exterior walls using sleeves and sealer.
- F. Seal pipe penetrations through underground exterior walls using sleeves and mechanical sleeve sealers.
- G. Where pipes pass through fire rated walls, partitions, ceilings and floors, maintain the fire rated integrity.
- H. Provide sleeves and seal pipes that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade.
- I. Where pipes pass through foundation walls above strip footings or under strip footings, protect pipes from building load with cast iron soil pipe sleeves two pipe sizes larger than the pipe. Sleeves installed under the strip footing shall be encased in concrete.
- J. Piping exposed to interior dry environment shall have a minimum of (1) primer and (1) finish coat of paint. Piping installed in exterior locations shall have a minimum of (1) primer and (2) finish coats of paint with total thickness of at least 5 mils. Finish coat colors in finish areas shall be as selected by architect.

1.2 FIELD QUALITY CONTROL

- A. Inspect Water Distribution Piping as follows:
 - 1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction.
 - 2. During the progress of the installation, notify the plumbing official having jurisdiction at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
 - a. Arrange for inspection of the piping system before concealed or closed in after system is roughed in and prior to setting fixtures.
 - b. Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.
 - c. Whenever the plumbing official finds that the piping system will not pass the test or inspection, make the required corrections and arrange for re-inspection by the plumbing official.
 - d. Prepare inspection reports signed by the plumbing official and turn over to the Architect upon completion of the project.
- B. Perform one of the following tests on all piping:
 - 1. Hydrostatic Test:
 - a. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - b. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.

- c. Isolate expansion tanks and determine that hydronic system is full of water.
 - d. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 - e. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
2. Procedures required by authority having jurisdiction that exceed requirements of tests listed above shall be performed by contractor to obtain system acceptance.
- C. Inspect Waste & Vent Piping as follows:
- 1. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction.
 - 2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
 - a. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.
 - b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to insure compliance with the requirements of the plumbing code.
 - c. Reinspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for reinspected by the plumbing official.
 - 3. Piping System Test, Test drainage and vent system in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:
 - a. Test for leaks and defects all new drainage and vent piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
 - b. Leave uncovered and unconcealed all new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose all such work for testing, that has been covered or concealed before it has been tested and approved.
 - c. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open jointed drain tile, test the piping of plumbing drainage and venting systems upon completion of the rough piping installation. Tightly close all openings in the piping system, and fill with water to the point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before the inspection starts, through completion of the inspection. Inspect all joints for leaks.
 - d. Final Plumbing Test Procedure: After the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas and water-tight. Plug the stack openings on the roof and building drain where it leaves the building, and introduce air into the system equal to a pressure of 1" water column. Use a "U" tube or manometer inserted in the trap of a water closet to measure this pressure. Air pressure shall remain constant without the introduction of additional air throughout the period of inspection. Inspect all plumbing fixture connections for gas and water leaks.
 - e. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.

1.3 WATER PIPING AND SPECIALTIES INSTALLATION

- A. Provide piping material for use as listed in piping materials schedule shown on plans.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Select system components with pressure rating equal to or greater than system operating pressure.
- G. Install groups of pipes parallel to each other spaced to permit application of insulation and servicing of valves.
- H. Install drains, consisting of a tee fitting, NPS 0.75" ball valve and short NPS 0.75" threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- I. Install piping at uniform grade of 0.2 percent upward in direction of flow.
- J. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- K. Install branch connections to mains using mechanically formed tee fittings in main pipe with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- L. Install unions in piping 2" and smaller, adjacent to valves, at final connections of equipment and at other locations noted on plans.
- M. Install flanges in piping 2.5" and larger at final connections of equipment and elsewhere as indicated.
- N. Install strainers on inlet side of each control valve, pressure reducing valve, solenoid valve, in-line pump and at other locations noted on plans. Install 0.75" nipple and ball valve in blowdown connection of strainers 2" and larger. Match size of strainer blowoff connection for strainers smaller than 2".
- O. Identify piping as specified in Division 22.
- P. Do not interrupt service to facilities occupied by owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to the following:
 - 1. Notify Architect no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of water-distribution service without Architects and owners written permission.
- Q. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with Authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application. Do not install bypass piping around backflow preventers unless directed by local jurisdiction.

1.4 WASTE & VENT PIPING AND SPECIALTIES INSTALLATION

- A. Provide piping material for use as listed in piping materials schedule shown on plans.
- B. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- C. Install horizontal piping as high as possible allowing for proper slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications where required, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- D. Make changes in direction for drainage and vent piping using appropriate 45 degree wyes, combination wye and eighth bend, or long sweep, quarter, sixth, eighth, or sixteenth bends. Sanitary tees or quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long-turn pattern combination wye and eighth bends where two fixtures are installed back to back and have a

common drain. Straight tees, elbows, and crosses may be used on vent lines. No change in direction of flow greater than 90 degrees shall be made. Where different sizes of drainage pipes and fittings are connected, use proper sized standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.

- E. Install underground building drains to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- F. Install drainage piping pitched down at a minimum slope of 1/8 inch per foot unless otherwise required by International Plumbing Code. Install vent piping pitched to drain back by gravity to the sanitary drainage piping system.
- G. Install backwater valves in sanitary building drain piping as indicated, and as required by the plumbing code. For interior installation, provide cleanout cover flush to floor centered over backwater valve cover and of adequate size to remove valve cover for service.
- H. Install expansion joints on stacks or horizontal piping as indicated, and as required by the plumbing code.
- I. Install above ground cleanouts in above ground piping and building drain piping as indicated, and:
 - 1. as required by plumbing code;
 - 2. at each change in direction of piping greater than 45 degrees;
 - 3. at minimum intervals of 50' for piping 4" and smaller and 100' for larger piping;
 - 4. at base of each vertical soil and waste stack.
- J. Install floor and wall cleanout covers for concealed piping, types as indicated.
- K. Install floor cleanouts in below floor building drain piping at minimum intervals of 50' for piping 4" and smaller and 75' for larger piping.
- L. Install exterior cleanouts as detailed on drawings.
- M. Install frost-proof vent caps.
- N. Installation of Floor Drains, Floor Sinks and Floor Troughs
 - 1. Install floor drains, floor sinks and floor troughs in accordance with manufacturer's written instructions and in locations indicated.
 - 2. Install floor drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor. Set floor sinks and floor troughs flush with the level finish floor.
 - 3. Refer to architectural documents for floor slope requirements and set floor drain elevation to match.
 - 4. Provide P-traps for drains connected to the sanitary sewer.
 - 5. Install floor drains, floor sinks and floor troughs in waterproof floors with waterproof membrane securely flashed with drain flashing clamp so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.
 - 6. Position drains so that they are level, accessible and easy to maintain.
- O. Preparation of Foundation for Underground Sanitary Building Drains
 - 1. Grade trench bottoms to provide a smooth, firm, and stable foundation, free from rock, throughout the length of the pipe.
 - 2. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with clean sand or pea gravel to indicated invert elevation.
 - 3. Pipe Beds:

- a. Cast Iron Soil Pipe: Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand backfill. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation.. For piping with rock trench bottoms, provide sand pipe bed 6" underneath and around sides of pipe, including fittings.
 - b. Provide backfill above top of pipe bed as required for field conditions. Refer to Division 22 Section "General Plumbing Requirements" for materials and methods for backfill.
- P. Pipe Applications - Above Ground, Within Building
1. See piping materials schedule for piping and fitting materials.
- Q. Pipe Applications - Below Ground, Within Building
1. See piping materials schedule for piping and fitting materials.

1.5 HANGERS AND SUPPORTS

- A. Copper and Steel Pipe hangers shall be installed with the following maximum spacing and minimum rod sizes.
- | | | | |
|----|------------|----------------|-------------------------|
| 1. | 0.75" Pipe | - Max Span 5' | - Minimum Rod Size 3/8" |
| 2. | 1" Pipe | - Max Span 6' | - Minimum Rod Size 3/8" |
| 3. | 1.25" Pipe | - Max Span 7' | - Minimum Rod Size 3/8" |
| 4. | 1.5" Pipe | - Max Span 8' | - Minimum Rod Size 3/8" |
| 5. | 2" Pipe | - Max Span 8' | - Minimum Rod Size 3/8" |
| 6. | 2.5" Pipe | - Max Span 9' | - Minimum Rod Size 1/2" |
| 7. | 3" Pipe | - Max Span 10' | - Minimum Rod Size 1/2" |
| 8. | 4" Pipe | - Max Span 14' | - Minimum Rod Size 5/8" |
- B. Plastic piping hangers shall be spaced according to pipe manufacturer's written instructions for service conditions. Avoid point loading and space and install hangers with the fewest practical rigid anchor points.
- C. Support vertical piping runs at roof, each floor and at 10 foot intervals between floors.

1.6 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered joints: Apply ASTM B813 water-flushable flux to tube end unless otherwise indicated. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook." Using lead free solder allow complying with ASTM B 32.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook", "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full interior diameter. Join pipe fittings as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Do not used pipe of pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Welded Joints: Construct joints according to ASW D10.12/D10.12M, using qualified processes and welding operators according to specified quality assurance requirements.

- G. Flanged Joints: Select appropriate gasket material, size, type and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. Plastic Piping Solvent Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following.
 - 1. Comply with ASTM F402 for safe handling practice of cleaners, primers and solvent cements.
 - 2. CPVC piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Pressure Piping: Join schedule 40, 80 and 120 according to ASTM D 2672. Join other-than-schedule number 40, 80 and 120 PVC pipe and socket fittings according to ASTM D 2855.
 - 4. 4.PVC Non-pressure Piping: Join according to ASTM D 2855.
- I. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions
- J. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings
- K. Mechanically Formed, Copper Tube Outlet Joints: Use manufacturer-recommended tool and procedure and brazed joints.
- L. Pressure Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.
- M. Copper Tubing: Solder joints in accordance with the procedures specified in AWS "Soldering Manual."
- N. Cast-Iron Soil Pipe: Make hubless joints in accordance with the Cast-Iron Soil Pipe & Fittings Handbook, Chapter IV. Install Couplings as followings:
 - 1. Coordinate requirement for heavy duty no-hub couplings with Owner and Architect for installation on sanitary piping 3" and larger. Coordinate with section 3 of this text and general notes.
 - 2. Install hubless couplings complying with CISPI 310 on soil, waste and vent piping.
 - 3. Install hubless couplings complying with CISPI 310 on and soil and waste piping 3" and smaller and all vent piping.
 - 4. Install heavy duty hubless couplings on soil or waste stacks, soil and waste piping connections to soil or waste stacks and all soil and waste piping 5" and larger.
 - 5. Install No-Hub fitting restraints on joints 5" and larger at:
 - a. Changes of direction from vertical to horizontal
 - b. Branches, including wyes and wye combination fittings 4" and larger
 - c. Horizontal changes of direction 22-1/2 degrees and greater
- O. PVC DWV Pipe: Joining and installation of PVC drainage pipe and fittings shall conform to ASTM D2665.
- P. ABS to PVC Transition Joints: When joining ABS to PVC components (such as an ABS building drain to PVC sewer pipe) make joints using solvent cements conforming to ASTM D3138.
- Q. Cast Iron to PVC Below Grade: Join cast iron to PVC with underground shielded adapter couplings.

1.7 PIPE EXPANSION

- A. Provide expansion joints, expansion loops, anchors and guides as required for proper control of expansion and contraction of piping. Piping from mains to equipment branches and risers shall be provided with swing, swivel joints or offsets to relieve stresses due to expansion or contraction of piping.
- B. Provide pipe loops as shown on drawings or specified. Where pipe loop dimensions are not shown on plans they shall be as recommended by pipe manufacturer based on thermal expansion.

- C. Expansion Joints Specified below shall comply with the following:
1. Install expansion joints of sizes matching sizes of piping in which they are installed
 2. Install packed type expansion joints with packing suitable for fluid service
 3. Install metal bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturer's Association, Inc."
 4. Install rubber packless joints according to FSA-NMEJ-702.
 5. Install grooved joint expansion joints to grooved-end steel piping.
- D. Expansion loops shall comply with the following:
1. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- E. Alignment guide anchors specified below shall comply with the following:
1. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
 2. Install two guides on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
 3. Install anchors at locations required to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of location and stresses to connected equipment.

1.8 TRAP SEALS

- A. Install trap seals in accordance with manufacturer's written instructions and in locations indicated.
- B. Make watertight seal using an adhesive type caulk along bottom of trap seal, if required by the manufacturer.
- C. Employ a test plug for testing and remove before normal floor drain use. Clean inside of drain tailpiece and install trap seal after testing.
- D. Do not touch elastomeric plug or allow contact with primer or solvent cement.

1.9 ADJUSTING AND CLEANING

- A. Clean and disinfect water distribution piping as follows:
 1. Purge all new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired prior to use.
 2. Use the purging and disinfecting procedure proscribed by the authority having jurisdiction or, in case a method is not prescribed by that authority, the procedure described in either AWWA C651, or AWWA C652, or as described below:
 - a. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.
 - b. Fill the system or part thereof with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system or part thereof and allow to stand for 24 hours.
 - c. Drain the system or part thereof of the previous solution and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
 - d. Following the allowed standing time, flush the system with clean, potable water until chlorine residual is lowered to incoming city water level.
 - e. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.
 3. Prepare disinfection reports signed by the authority having jurisdiction and turn over to the Architect upon completion of the project.

- A. Fill the system. Check compression tanks to determine that they are not air bound and that the system is completely full of water.
- B. Before operating the system, perform these steps:
 - 1. Close drain valve, hydrants, and hose bibbs.
 - 2. Open valves to full open position.
 - 3. Remove and clean strainers.
 - 4. Check pumps for proper direction of rotation. Correct improper wiring.
 - 5. Lubricate pump motors and bearings.

PART 2 – PRODUCTS

2.1 PIPING

- A. Copper Tube:
 - 1. Provide hard temper copper water tubing conforming to ASTM B 88. Tubing shall be type K, L or M as listed in schedule.
 - 2. Tubing joints shall be soldered or brazed as indicated in schedule.
- B. DWV Copper Tube:
 - 1. Type M DWV copper tubing shall conform to ASTM B 306, type DWV.
- C. ACR Copper Tubing:
 - 1. Provide hard temper nitrogenized copper refrigerant tubing conforming to ASTM B 88. Tube shall be L or K as listed in schedule.
 - 2. Tubing shall be brazed or grooved joints manufactured to copper tube dimensions. Flaring tubing ends to accommodate alternate sized couplings is not allowed.
- D. Steel Pipe:
 - 1. Steel pipe shall conform to ASTM A53 and shall be black steel with plain ends. Type, grade and wall thickness shall be as indicated in piping materials schedule.
- E. Plastic Pipe:
 - 1. PVC Plastic pipe shall conform to ASTM D 1785. Piping shall be schedule 40 or schedule 80 as listed in schedule.
 - 2. CPVC Plastic pipe shall conform to ASTM F 438 for schedule 40 pipe and ASTM F 439 schedule 80 pipe.
- F. Polyethylene (PE) Pipe:
 - 1. Conform to ASTM D 2239, with SDR numbers 5.3, 7, 9 or 11.5 with PE compound number required to achieve required system working pressure.
 - 2. U-Bend Assembly shall be factory fabricated with embossed depth stamp every 36" from U-Bend.
- G. PEX Tube
 - 1. Provide as listed in schedule with crimped joints.
- H. Cast-Iron DWV: CISPI 301 and ASTM A888, no-hub pipe.
- I. PVC DWV Pipe: Schedule 40 pipe meeting ASTM D1785 and ASTM D2665 with "solid wall" PVC meeting ASTM D1784 with cell class 1245-B.
- J. Underground Shielded Adapter Couplings: ASTM C1173 with neoprene adapter gasket with stainless steel shield and stainless steel hose clamp.

2.2 FITTINGS

- A. Provide piping fittings for use as listed in piping materials schedule shown on plans.
- B. Wrought Copper Fittings:
 - 1. Provide wrought solder joint copper tube fitting conforming to ANSI B 16.22
- C. Nickel Copper Alloy Steel Welding Fittings:
 - 1. Provide nickel copper alloy steel welding fittings conforming to ANSI B16.9 and ASTM A234.
- D. Steel piping fittings:
 - 1. Wrought Steel Fittings:
 - a. Provide carbon steel fittings conforming to ASTM A 234/A 2345M with wall thickness to match adjoining pipe.
 - 2. Wrought Cast and Forged Steel Flanges:
 - a. Fittings shall conform to ASME B 16.5 including bolts nuts and gaskets of material group 1.1. End connections shall be butt welded and facings shall be raised face type.
 - 3. Welded Fittings
 - a. Fittings shall conform to ASTM A 234, seamless or welded, for welded joints.
 - i. 1.25" and smaller shall be socket type
 - ii. 1.5" and larger shall be butt weld type
- E. Cast Bronze Fittings:
 - 1. Cast bronze fittings shall be solder joint type conforming to ANSI B 16.18.
- F. Plastic piping Fittings:
 - 1. PVC Plastic Pipe
 - a. Socket type fittings conforming to ASTM D 2466 for schedule 40 and ASTM D 2467 for schedule 80.
 - 2. CPVC Plastic Pipe
 - a. Socket type fittings conforming to ASTM F 438 for Schedule 40 and ASTM F 439 for Schedule 80.
- G. Polyethylene (PE) fittings:
 - 1. Molded PE fittings conforming to ASTM D 2683 or ASTM D 3261 made with PE resin and socket or butt fusion type made to match PE pipe dimensions and class.
- H. Cast-Iron DWV Fittings: CISPI 301 and ASTM A888, no-hub fittings.
 - a. Couplings and compression gaskets, NSF Certified: ASTM C564 and CISPI 310.
 - b. Heavy duty couplings and compression gaskets: ASTM C1540 and meeting FM 1680.
- I. PVC DWV Pipe: Schedule 40 fittings meeting ASTM D1785 and ASTM D2665.
 - a. Fittings: DWV pattern meeting ASTM D2665 with solvent cement socket joints.
 - b. Solvent: ASTM D2564

2.3 JOINING MATERIALS

- A. Pipe flange gasket materials shall be suitable for chemical and thermal conditions of piping system contents. Provide 1/8" maximum thickness, nonmetallic, flat, asbestos free material conforming to ASME B 16.21.
- B. Flange bolts and nuts shall conform to ASME B18.2.1 and shall be carbon steel unless otherwise noted.
- C. Plastic pipe flange gasket bolts and nuts shall be type and material recommended by piping system manufacturer.

- D. Solder filler metals shall conform to ASTM B 32 and shall be lead free alloys that include water flushable flux according to ASTM B 813.
- E. Brazing filler metals shall conform to AWS A 5.8 BCuP series and shall be copper phosphorus alloys for joining copper with copper or Bag-1 silver alloy for joining copper with bronze or steel.
- F. Welding filler materials shall comply with ASW D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements for Joining Plastic Pipe:
 - 1. CPVC piping cements shall conform to ASTM F 493.
 - 2. PVC piping solvent cements shall conform to ASTM D 2564. Include primer complying with ASTM F 656.
- H. Gasket material thickness, material and type shall be suitable for fluid to be handled and working temperatures and pressures.

2.4 TRANSITION FITTINGS

- A. Plastic to Metal Transition Fittings:
 - 1. Provide one piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.
- B. Plastic to Metal Transition Unions:
 - 1. Provide MSS SP-107 union. Include brass or copper end, schedule 80 solvent cement joint end, rubber gasket and threaded union.

2.5 DIELECTRIC FITTINGS

- A. Fittings shall be combination fitting of copper alloy and ferrous materials with threaded solder joint plain or weld neck end connections that match piping system materials.
- B. Insulating material shall be suitable for system fluid, pressure and temperature
- C. Dielectric unions:
 - 1. Provide factory fabricated union assembly with pressure and temperature rating suitable for system operating range.
- D. Dielectric Flanges:
 - 1. Provide factory fabricated companion flange assembly with pressure and temperature rating suitable for system operating range.
- E. Dielectric Coupling:
 - 1. Provide galvanized steel coupling with inert and non-corrosive thermoplastic lining and threaded ends. Coupling shall have pressure and temperature rating suitable for system operating range.
- F. Dielectric Nipples:
 - 1. Provide electroplated steel nipple with inert and noncorrosive, thermoplastic lining, plain, threaded or grooved ends. Nipples shall have pressure and temperature rating suitable for system operating range.

2.6 ALIGNMENT GUIDES AND ANCHORS

- A. Provide steel, factory fabricated alignment guide with bolted two-section outer cylinder and base for attaching to structure; with two section guiding spider for bolting to pipe.
- B. Anchors shall be mechanically fastened with tension and shear capacities appropriate for application.

2.7 DRAINAGE WASTE AND VENT SPECIALTIES

- A. Cleanouts
 - 1. Floor Cleanouts

- a. For Hard Flooring areas provide a cast iron level cleanout assembly with round, adjustable, scoriated, nickel bronze top, and no hub outlet.
 - b. For Carpeted Flooring areas provide a cast iron floor level cleanout assembly with round, adjustable, scoriated, nickel bronze top and carpet clamping frame, and no-hub outlet.
- 2. Wall Cleanouts
 - a. For finished areas provide cast iron cleanout tee and cast iron countersunk plug with chrome round cover and screw.
 - b. For unfinished areas provide cast iron cleanout tee and cast iron countersunk plug.
- B. Floor Drains
 - 1. See plumbing fixture schedule for drain type.
 - 2. All floor drains in finished areas shall have nickel-bronze strainers except at showers where they shall be chrome-plated strainers.
 - 3. Provide each drain that does not have an integral "P" trap with a cast iron "P" trap in connecting piping.
 - 4. See architectural plans for floor drain top elevations and floor drainage.
- C. Floor Sinks
 - 1. See plumbing fixture schedule for drain type.
 - 2. See architectural plans for floor sink top elevations and floor drainage.

2.12 THERMOSTATIC MIXING VALVES

- A. Mixing valves shall be thermostatically controlled with 125psig pressure rating and be constructed to ADDE 1017 standard. It shall have a Bronze body with corrosion-resistant interior components and a rough bronze finish with threaded connections. Valve shall include manual temperature control, check stops on hot and cold water supplies, and adjustable temperature control handle.

2.13 TRAP GUARDS

- A. Smooth, soft, flexible, elastomeric PVC material molded into shape of duck's bill, open on top with curl closure at bottom. The flow of wastewater allows duck's bill to open and adequately discharge to floor drain through its interior. The duck's bill closes and returns to original molded shape after wastewater discharge is complete. Or, smooth, soft, flexible, elastomeric PVC material with a flapper closure. The flow of wastewater allows flapper to open and adequately discharge to floor drain through its interior. The flapper closes and returns to original molded shape after wastewater discharge is complete.

2.14 STRAINERS

- A. Y-Pattern Strainers
 - 1. Strainers shall have a minimum pressure rating of 125psig (unless otherwise indicated).
 - 2. 2" and smaller strainers shall have a Bronze body, a stainless steel screen with round perforations, threaded end connections and a drain.
 - 3. 2.5" and larger strainers shall have a Cast Iron body with epoxy coated FDA approved liner, a stainless steel screen with round perforations, flanged end connections and a drain.

2.15 SHOCK ABSORBER

- A. Arresters shall be copper tube with piston and designed to ASSE 1010 or PDI-WH 201 standards. Sizes shall be determined by application.

2.16 VALVE BOXES

- A. Water Meter Boxes

1. Boxes shall have cast-iron body and cover for water meter, with lettering in cover as required by local authority; and with slotted, open-bottom base section of length to fit over service piping. Base section may be cast-iron, PVC, clay, or other pipe.
- A. Enclosure Bases:
- a. 4-inch- or 6-inch minimum thickness precast concrete, of dimensions required to extend at least 6 inches beyond edges of enclosure housings. Include openings for piping.

FINAL REVIEW
NOT FOR
CONSTRUCTION

224000 – PLUMBING FIXTURES

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 GENERAL

- A. Provide plumbing fixtures and trim, fittings, other components, and supports as specified on the drawings and below.
- B. Install supports for plumbing fixtures in accordance with categories indicated, and of type required:
 - 1. Carriers for following fixtures:
 - a. Wall-hanging water closets.
 - b. Wall hanging lavatories
 - c. Wall hanging electric water coolers and drinking fountains.
 - d. Wall-hanging fixtures supported from wall construction.
 - 2. Chair carriers for the following fixtures:
 - a. Wall-hanging urinals.
 - b. Wall-hanging lavatories and sinks.
 - c. Wall-hanging drinking fountains and electric water coolers.
 - 3. Heavy-duty chair carriers for the following fixtures:
 - a. Fixtures where specified.
 - 4. Reinforcement for the following fixtures:
 - a. Floor-mounted lavatories required to be secured to wall.
 - b. Floor-mounted sinks required to be secured to wall.
 - c. Recessed, box-mounted electric water coolers.
 - d. Wall mounted and mop sink faucets.
 - e. Urinal flush valve solid pipe ring supports.

1.2 SPARE PARTS

- A. Deliver spare parts to Owner. Furnish spare parts described below matching products installed, packaged with protective covering for storage, and identified with labels clearly describing contents.
- B. Faucet Washers, Cartridges and O-rings: Furnish quantity of identical units not less than 5 percent of amount of each installed with a minimum of 1
- C. Flushometer Repair Kits: Furnish quantity of identical units not less than 10 percent of amount of each flushometer installed with a minimum of 1
- D. Provide individual metal boxes or a hinged-top wood or metal box having separate compartments for each type and size of above extra materials.
- E. Water Closet Tank Repair Kits: Furnish quantity of identical flush valve units not less than 5 percent of amount of each type installed with a minimum of 1.
- I. Waterless Urinal Sealant & Cartridges: Furnish quantity of sealant and manufacturer approved cleaner per waterless urinal not less than amount for one year of operation per the manufacturer's recommended maintenance schedule. For cartridge type waterless urinals, furnish quantity of cartridges per waterless urinal not less than the amount for one year of operation per manufacturer's recommended maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.
- C. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings and controls.
- D. Operate and adjust disposers, hot water dispensers, and controls. Replace damaged and malfunctioning units and controls.
- E. Adjust water pressure at drinking fountains, electric water coolers, and faucets, shower valves and flush valves having controls, to provide proper flow and stream.
- F. Adjust all flush valve diaphragms as required to ensure single closing action is achieved without inducing any vibration or water hammer in supply piping system.
- G. Replace washers of leaking and dripping faucets and stops.
- H. Clean fixtures, fittings, and spout and drain strainers with manufacturers' recommended cleaning methods and materials.
- I. Adjust faucet wrist blade handles perpendicular to the spout while in the closed position.
- J. Set the shower valve temperature limit stop to 110deg F. Perform work after the shower head is installed and the domestic water heater is in operation. Allow the hot water to run for 5 minutes minimum or until temperature reaches equilibrium. Allow cold to run for 5 minutes minimum or until temperature reaches equilibrium.

1.4 INSTALLATION OF PLUMBING FIXTURES

- A. Install plumbing fixtures level and plumb, in accordance with fixture manufacturers' written installation instructions, roughing-in drawings, and referenced standards.
- B. Install floor-mounted, floor-outlet water closets with closet flanges and gasket seals.
- C. Install floor-mounted, back-outlet water closets with fittings and gasket seals.
- D. Install wall-hanging, back-outlet water closets with support manufacturer's tiling frame or setting gauge.
- E. Install wall-hanging, back-outlet urinals with gasket seals.
- F. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate when supports are specified, and to building wall construction where no support is indicated.
- G. Fasten floor-mounted fixtures and special fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.
- H. Fasten wall-mounted fittings to reinforcement built into walls.
- I. Fasten counter-mounting-type plumbing fixtures to casework.
- J. Secure supplies behind wall or within wall pipe space, providing rigid installation.
- K. Install stop valve in an accessible location in each water supply to each fixture.
- L. Install trap on fixture outlet except for fixtures having integral trap.
- M. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork. Use deep pattern escutcheons where required to conceal protruding pipe fittings.
- N. Seal fixtures to walls, floors, and counters using a sanitary-type, one-part, mildew-resistant, silicone sealant in accordance with sealing requirements specified in joint sealant specification section. Match sealant color to fixture color.
- O. Install insulation kits on ADA compliant sink and lavatory waste, continuous wastes, hot and cold water supplies where indicated on the drawings and as required by the ADA.

- P. Shower Heads: Shower head and hand showers shall be installed so that water discharges parallel to shower door/curtain unless otherwise noted. Coordinate locations with architectural plans. Contractor shall notify A/E in the event of a conflict between architectural details and door opening.

1.4 CONNECTIONS

- P. Piping installation requirements are specified in other sections of Division 22. The Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
1. Install piping connections between plumbing fixtures and piping systems and plumbing equipment specified in other sections of Division 22.
 2. Install piping connections indicated between appliances and equipment specified in other, direct connected to plumbing piping systems.

PART 2 – PRODUCTS

2.1 PLUMBING FIXTURES

- A. See Plumbing Fixture Schedule on plans for all product requirements.

2.2 PLUMBING FIXTURE SUPPORTS

- A. ASME A112.6.1M, categories and types as required for wall-hanging fixtures specified, and wall reinforcement.
- B. Support categories are:
1. Carriers: Supports for wall-hanging water closets and fixtures supported from wall construction. Water closet carriers shall have an additional faceplate and coupling when used for wide pipe spaces. Provide tiling frame or setting gauge with carriers for wall-hanging water closets.
 2. Chair Carriers: Supports with steel pipe uprights for wall-hanging fixtures. Urinal chair carriers shall have bearing plates.
 3. Chair Carriers, Heavy Duty: Supports with rectangular steel uprights for wall-hanging fixtures.
 4. Reinforcement: 2-inch by 4-inch wood blocking between studs or 1/4-inch by 6-inch steel plates attached to studs, in wall construction, to secure floor-mounted and special fixtures to wall.
- C. Support Types: Provide support of category specified, of type having features required to match fixture.
- D. Provide supports specified as part of fixture description, in lieu of category and type requirements above.

2.3 INSULATION KITS

- A. Insulation kits for lavatory and sink waste and supplies of vinyl plastic with reusable fasteners and openings for access to supply stop handles.

230500 – COMMON WORK RESULTS FOR HVAC

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 CODE SECTIONS

- A. 2012 International Mechanical Code
- B. 2012 International Building Code
- C. 2012 International Plumbing Code
- D. ADA – American Disabilities Act
- E. ANSI – American National Standards Institute
- F. ASHRAE – American Society of Heating Refrigerating and Air Conditioning Engineers
- G. ASTM – American Society of Testing Materials
- H. NFPA – National Fire Protection Association
- I. NEMA – National Electrical Manufacturers Association
- J. OSHA – Occupational Safety and Health Act
- K. UL – Underwriter's Laboratories
- L. SMACNA – Sheet Metal Air Conditioning National Association
- M. All codes listed on architectural Code Reference Sheet or project cover sheet.

1.2 GENERAL

- A. Provide all work in accordance with applicable codes, rules, ordinances, and regulations of local, State, and Federal Governments and other Authorities Having Jurisdiction (AHJ).
- B. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the drawings and specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system functioning as indicated by the design and the equipment specified. Elements of the work include materials, supervision, supplies, equipment, transportation, and utilities.
- C. The drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, piping, etc. without showing all the exact details as to elevations, offsets, control lines, and other installation requirements. The contractor shall use the drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system. Plans shall not be scaled.
- D. Contractor shall coordinate with all other trades to ensure that all required project components are included in project bid.
- E. If in any case the plans or specifications conflict with either manufacturer's requirements or minimum code requirements the information on plans and specifications shall be superseded by manufacturers and code requirements.
- F. If in any case the plans or specifications conflict with themselves, the most stringent of the conflicting information shall be the basis for bid. Contractor shall seek clarification of all conflicts prior to bid.
- G. All change order requests shall be accompanied with itemized tabular breakdown of all materials and labor associated with installation of all associated materials for review of the design team. Lump sum pricing will not be accepted.
- H. Contractor shall refer to each drawing and specification section in construction document set. No bids shall be submitted without review of all construction documents.

- I. Contractor shall provide heat trace cable for all condensate drains located in attics, through exterior walls or any other areas subject to freezing temperatures.
- J. Contractor shall provide heat trace cable for all piping installed in areas subject to freezing temperatures.
- K. All pipe sizes indicated in this specification are nominal pipe sizes (NPS).

1.3 LOCAL CONDITIONS

- A. Visit site and determine existing local conditions affecting work in contract.
- B. Failure to determine site conditions or nature of existing or new construction will not be considered a basis for granting additional compensation.

1.4 ALLOWABLE MANUFACTURERS

- A. Allowable manufactures for all products listed in division 23 are listed on "Schedule of Manufacturers" on plans.

1.5 SUBMITTAL REQUIREMENTS

- A. Submittals for products in division 23 shall include the following items.
 - 1. Product data showing type, model and construction characteristics of product
 - 2. Layout drawings for any systems requiring interconnection of various system components
 - 3. All other documentation required to show compliance with the specifications.
- B. The contractor shall provide a schedule of submittals indicating dates on which each submittal will be provided to design team for review. Schedule shall be submitted 10 working days in advance of delivery of first submittal for review.
- C. Contractor shall allow a minimum of ten working days for design team of review of submittals.

1.6 WARRANTY REQUIREMENTS

- A. Unless noted elsewhere in the specifications, all work shall be warranted for a period of not less than one year from the date of substantial completion. The contractor shall provide work at no additional cost to correct any deficiencies in their work that were identified to have been present during the warranted period.

1.7 DEMOLITION

- A. Where demolition work is required contractor shall disconnect, demolish and remove HVAC systems, equipment and components indicated to be removed.
- B. All patching of ductwork and piping shall be performed with materials matching existing conditions and reinsulated to maintain performance of previous conditions.
- C. All equipment to be removed and reinstalled shall be disconnected, with services capped, cleaned and stored for reconnection.
- D. Owner shall have first right of refusal for all materials being removed.
- E. If duct, pipe, insulation, or equipment to remain is damaged or unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

1.8 INSTALLATION

- A. All equipment in division 23 shall be installed according to manufacturer's requirements and minimum code requirements. If in any case the plans or specifications are in conflict with either manufacturer's requirements or minimum code requirements the information on plans and specifications shall be superseded by manufacturers and code requirements.
- B. Apply firestopping to penetrations of fire rated floor and wall assemblies for electrical installations to restore original fire resistance rating of assembly.
- C. No combustible materials shall be allowed in return air plenum regardless of indication on plans.

- D. If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements. Contractor shall coordinate scope of work with fire sprinkler system installation where applicable to ensure no sprinkler piping is installed in a fashion that will limit installation height of ductwork.
- E. Install all equipment to facilitate service, maintenance and repair or replacement of components of both mechanical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

1.9 EXECUTION REQUIREMENTS

- A. No combustible materials shall be allowed in return air plenum regardless of indication on plans.

1.10 TEMPORARY FACILITIES

- A. Contractor shall provide temporary facilities as required for construction of the project. Temporary facilities shall include temporary water service and distribution, electrical power and lighting service, heating cooling and ventilation, telephone and data service, and sanitary facilities including drinking water.
- B. Permanent HVAC equipment shall not be used to heat, cool or ventilate the facility during construction.
- C. Whether during a renovation or a phased construction project, the contractor shall include all temporary facilities to maintain functionality and suitable space conditions in all areas of a building that are occupied by the owner while construction activities are underway.
- D. The contractor shall provide temporary facilities as required to maintain a safe working environment and to protect all building materials and provide space conditions within range required for material installation.
- E. 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. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- F. Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Relocate temporary services and facilities as the Work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist on-site.

PART 2 – PRODUCTS

2.1 HOUSEKEEPING PADS

- A. All equipment shall be installed on concrete housekeeping pads. Pad shall extend beyond equipment perimeter 4" and shall elevate equipment off of finish floor 4".
- B. Contractor shall have option to provide prefabricated housekeeping pad or pour pad in place.

2.2 SLEEVES

- A. Sleeves shall be constructed from the following materials at contractor's option.
 - 1. Galvanized steel round tubing, closed with welded longitudinal joint.
 - 2. Schedule 40 Steel Pipe.
 - 3. DUCTED RETURN ONLY – Schedule 40 PVC pipe.

2.3 DIELECTRIC FITTINGS

- A. Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Dielectric Unions: Factory-fabricated, union assembly, for 250 psig minimum working pressure at 180 deg F.
- C. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for minimum working pressure as required to suit system pressures.

- D. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300 psig minimum working pressure at 225 deg F.
- E. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300 psig minimum working pressure at 225 deg F.

2.4 GROUT

- A. ASTM C 1107, grade B, nonshrink and nonmetallic, dry hydraulic-cement grout
- B. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
- C. Design Mix: 5000 psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

230514 – VARIABLE FREQUENCY DRIVES

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 GENERAL

- A. The HV600 is a high performance PWM (pulse-width-modulated) AC drive. Three-phase input line power is converted to a sine-coded, variable frequency output, which provides optimum speed control of any conventional squirrel cage induction motor. The use of IGBTs (Insulated Gate Bipolar Transistors), with a carrier frequency range of 2 kHz to 12.5 kHz, permits quiet motor operation.
- B. This drive has one control logic board for all horsepower ratings. Printed circuit boards employ surface-mount technology, providing both high reliability, and small physical size of the printed circuit assemblies. The microprocessor delivers the computing power necessary for complete three-phase motor control in building automation systems.
- C. Operating Principle: Input three-phase AC line voltage is first rectified to a fixed DC voltage. Using pulse width modulation (PWM) inverter technology, the DC voltage is processed, to produce an output waveform in a series of variable-width pulses. Unique firmware algorithms optimize motor magnetization through control of voltage, current, and frequency applied to generate a nearly sinusoidal output waveform.
- D. STANDARDS
 - 1. UL 508A (Industrial Control Panels)
 - 2. BTL Listed
 - 3. UL, cUL listed
 - 4. CBC, IBC, ASCE7, ICC-ES 156
 - 5. HCAI (OSHPPD)
- E. ENVIRONMENTAL & SERVICE CONDITIONS
 - 1. Ambient service temperature: Narrow Bypass UL Type 1: -10°C to 40°C
 - 2. Ambient storage temperature: Narrow Bypass UL Type 1: -20°C to 70°C
 - 3. Humidity: 0% to 95%, non-condensing
 - 4. Altitude: to 1,000 meters (3,300 feet); higher by derating
 - 5. Service factor: 1.0
 - 6. RoHS 2 Compliant

1.2 QUALITY ASSURANCE

- A. In-circuit testing of all printed circuit boards is conducted to ensure proper manufacturing. Final printed circuit board assemblies are functionally tested via computerized test equipment. All fully assembled controls are computer tested with induction motor loads to assure unit specifications are met. The average MTBF (Mean Time Between Failure) is 28 years.

1.3 CONSTRUCTION

- A. Input Section of the VFD - VFD power input stage converts three-phase AC line power into a fixed DC voltage via a solid-state, full-wave diode rectifier with MOV (Metal Oxide Varistor) surge protection. An internal 5% split choke built in both positive and negative DC bus reduces harmonics for cleaner power.
- B. Intermediate Section of the VFD - DC bus maintains a fixed DC voltage with filtering and short circuit protection as a DC supply to the VFD output section. It is interfaced with the VFD diagnostic logic circuit to continuously monitor and protect the power components.

- C. Output Section of the VFD - Insulated Gate Bipolar Transistors (IGBTs) convert DC bus voltage to a variable frequency and voltage, utilizing a PWM sine-coded output to the motor. Motor noise at 60 Hz is less than 2 dB above the motor noise from across-the-line operation when measured at a distance of one meter.

1.4 POWER AND CONTROL ELECTRONIC HOUSINGS

- A. UL Type 1 wall-mounted enclosure: 208 V, 0.5 through 25 HP; 480 V, 0.5 through 60 HP
- B. Microprocessor-based control circuit
- C. Non-volatile memory (EEPROM); all programming memory is saved when the VFD is disconnected from power.
- D. Digital operator keypad and display provide local control and readout capability:
 - 1. Hand/Off/Auto commands
 - 2. Speed Reference command
 - 3. Reset command
- E. Easy to remove heat sink cooling fan with programmable on/off control.
- F. USB mini-B port for quick and easy PC connection

1.5 PROTECTION

- A. Output current overload rating of 110% for 60 seconds, 140% for 2 seconds, 175% instantaneous
- B. Output short circuit protection
- C. Current limited stall prevention (overload trip prevention) during acceleration, deceleration, and run conditions
- D. Optically isolated operator controls
- E. Fault display
- F. "Hunting" prevention logic
- G. Electronic ground fault protection
- H. Electronic motor overload relay protects the motor while operating in drive and bypass mode
- I. Motor current display in both drive and bypass modes of operation as well as verification that the motor is running
- J. Proof of flow/loss of flow detection in both drive and bypass modes
- K. DC bus charge indication
- L. Heatsink overtemperature protection
- M. Cooling fan operating hours recorded
- N. Input/output phase loss protection
- O. Line voltage sensors to monitor for brownout and blackout conditions with adjustable fault levels to ensure the proper settings pursuant to each application.
- P. Reverse prohibit selectability
- Q. Short circuit withstand rating of 100 KA RMS with customer provided branch circuit protection.
- R. Multiple emergency override modes (across-the-line or speed selectable via the drive)

1.6 OPERATION

- A. Output frequency and speed display can be programmed for other speed-related and control indications, including: RPM, CFM, GPM, PSI, in WC, % of maximum RPM, or custom.
- B. Power loss ride-through (2 seconds capable)
- C. Time delay on start; peak avoidance for smooth generator switchover
- D. VFD accepts either a direct acting or a reverse acting speed command signal.
- E. Bi-directional "Speed Search" capability to start into a rotating load. Two types: current detection and residual voltage detection
- F. DC injection braking, to prevent fan "windmilling"
- G. Remote Run/Stop command input
- H. Eight programmable HVAC specific application presets
- I. Over 100 programmable functions, resettable to factory HVAC presets
- J. User parameter initialization to re-establish project specific parameters
- K. Ramp-to-stop or coast-to-stop selection

- L. Auto restart capability: 0 to 10 attempts with adjustable delay time between attempts
- M. One custom selectable Volts/Hertz pattern and multiple preset Volts/Hertz patterns
- N. Auto speed reference input signal, adjustable for bias and gain
- O. While the VFD is running, operational changes in control and display functions are possible, including:
 - 1. Acceleration time (0 to 6000 seconds)
 - 2. Deceleration time (0 to 6000 seconds)
 - 3. Frequency reference command
 - 4. Hand/Off/Auto commands
 - 5. Monitor display
 - 6. Removable digital operator

1.7 Automatic energy saving, reduced voltage operation in VFD mode

PART 2 – PRODUCTS

2.1 UNIT FEATURES

- A. Unit shall be equipped with the following features:
 - 1. Provide rating as required to support connected equipment shown on plans.
 - 2. Provide all features indicated on plans.
 - 3. Coordinate with control vendor to ensure proper operation of drive for all required control sequences.
 - 4. Displacement power factor of .98 throughout the motor speed range
 - 5. Internal EMI/RFI filter complies with IEC 61800-3 restricted distribution for first environment
 - 6. Built-In real time clock for time and date stamping events along with timer functions for starting, stopping and speed changes without the need for external controls
 - 7. Voltmeter, ammeter, kilowatt meter, elapsed run time meter, and heatsink temperature monitoring functions
 - 8. Drive internal PI closed-loop control with selectable engineering units
 - 9. Independent PI control for use with external device
 - 10. Differential PID feedback feature
 - 11. Direct or reverse acting speed signal
 - 12. Sleep function in both closed loop and open loop control
 - 13. Feedback signal low pass filter
 - 14. Feedback signal loss detection and selectable response strategy
 - 15. Feedback signal inverse and square root capability
 - 16. 24 VDC, 150 mA transmitter power supply
 - 17. Eight programmable multi-function input terminals (24 VDC) providing 36+ programmable features, including:
 - 18. Customer Safeties
 - 19. BAS / Damper Interlock
 - 20. Emergency Override – BAS interlock mode
 - 21. min/max speed setting
 - 22. 16 preset speeds
 - 23. PI control enable / disable
 - 24. Two programmable 0 to 10 VDC or 4-20 ma analog outputs on VFD control board, proportional to drive monitor functions including output frequency, output current, output power, PI feedback, output voltage and others
 - 25. Four programmable multi-function output relays (Form C rated 2 amps @ 250 VAC & 30 VDC) providing 29+ functions, including: "Motor Run," "Damper Control," "Auto Transfer," "Drive Run," "Hand Mode," "Auto Mode," "System Fault," "Bypass Run," "Serial Com Run," "Ready/Run/Fault status," and numerous other options.
 - 26. Input and output terminal status indication
 - 27. Analog input speed reference on bypass printed circuit board
 - 28. Nine preset speeds

29. Diagnostic fault indication
30. VFD efficiency: 96% at half-speed; 98% at full-speed
31. "S-curve" soft start / soft stop capability
32. Run/Fault output contacts
33. Serial communication loss detection and selectable response strategy
34. Controlled speed range of 40:1
35. Critical frequency rejection capability: three selectable, adjustable bandwidths
36. 140% starting torque capability, available from 3 Hz to 60 Hz
37. Adjustable carrier frequency, from 2 kHz to 12.5 kHz
38. Analog/Digital Virtual I/O – internally sends an output to an input (no wiring needed)
39. Dynamic noise control for quiet motor operation
40. Programmable security code
41. Cloud service (Yaskawa Drive Cloud) for product registration and parameter storage
42. Store up to four additional parameter sets in keypad
43. Integrated PLC (DriveWorks EZ)
44. Rotational as well as Stationary motor auto-tuning
45. Temperature controlled fans
46. LCD keypad with Hand/Off/Auto and Copy keypad functions
47. Motor preheat function
48. Self-regulating lead/lag control for multiple drives (up to 4)
49. Drive/motor alternation control (share motor run time for lead drive/motor)
50. Up to four PID setpoints
51. Draw down level selection for PID setpoint
52. Anti-no-flow control for deadhead protection
53. Pre-charge pump functionality
54. Low city alarm digital input
55. State/de-state control – add/remove drive based on feedback or output frequency
56. Single phase foldback
57. Flash upgradeable firmware
58. Heatsink overtemperature speed fold-back feature
59. "Bumpless" transfer between Hand and Auto modes
60. Emergency override can be used as "smoke purge" function
61. Fan failure detection and selectable drive action
62. Programming and firmware upgrade without three-phase main power using DriveWizard HVAC software tool
63. Bypass and drive are factory assembled.
64. Input disconnect switch with a lockable, through-the-door operating mechanism
65. Drive output and Bypass contactors are both electrically and software interlocked.
66. BACnet, Siemens APOGEE FLN, Metasys N2, and Modbus RTU communication protocols as standard, with the ability to configure controller parameters, view controller monitors, control I/O, clear faults, and view controller status in both drive and bypass modes. EtherNet/IP, Modbus TCP/IP and LonWorks are optionally available.
67. BACnet Health monitors including Net Health, Tokens Received/Transmitted, Messages Received/Transmitted, Next/Previous Node Address, Max/Min Master Found, number of Nodes on Network, COV, MSTP Loop Time, CRC Errors, MSTP Tokens Lost/Retry, Deadtime Average.
68. Door mounted control keypad with HOA LCD display for "Control Power," "Drive Ready," "Drive Run," "Drive Selected," "Drive Fault," "Drive Test," "Bypass Selected," "Bypass Run," "Motor OL," "Safety Open" "BAS Interlock," "Auto Run", Auto Transfer," "Emergency Override," "Hand Mode," "Off Mode", and "Auto Mode."
69. Damper control circuit with end-of-travel feedback capability including two adjustable wait time functions. One is a run delay time, where the drive will operate at a preset speed before the damper opens to pressurize the system. The other time function is an interlock wait time, so if the damper has not fully opened within the specified time, a fault will be declared.
70. Selectable energy savings and harmonic reduction mode. Drive automatically switches to Bypass (across-the-line) when motor is running 60 Hz for a set time and automatically switches back when frequency reference changes.

71. Green Contactor mode when enabled will keep unneeded contactors from being closed when not needed.

FINAL REVIEW
NOT FOR
CONSTRUCTION

230519 – METERS AND GAUGES

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 INSTALLATION

- A. Install connector plugs with socket extending one-third of pipe diameter and in a vertical position in piping.
- B. Install connector plugs of sizes required to match thermometer connectors. Provide bushings if required to match sizes.
- C. Provide extension of thermowells as required for access beyond piping insulation.
- D. Install thermometers in thermowells and adjust position for readability.
- E. Install meters and gauges adjacent to machines and equipment to allow service and maintenance of meters, gauges, machines and equipment.
- F. After installation calibrate meters according to manufacturer's written instructions.

1.2 SCALE

- A. Provide scale range of meters and gauges as required for flow rates indicated on drawings and schedules.

PART 2 – PRODUCTS

2.1 BIMETALLIC DIAL THERMOMETER

- A. Thermometer shall have stainless steel case and stem, glass window, permanently etched scale markings on dial, dark metal pointer and bimetal coil temperature sensing element.
- B. Provide probe suitable for insertion in connector plug with length as required for insertion into gauge connector plug.
- C. Thermometer shall have accuracy of plus or minus one percent of scale range.
- D. Provide each thermometer with separable well for installation pipe connections.

2.2 THERMOWELL

- A. Thermowell shall be constructed in accordance with ASME B40.200 with pressure-tight, socket-type fitting made for insertion into piping tee fitting. Length shall match thermometer bulb or stem and extensions shall be provided to accommodate insulation.
- B. Provide thermowell bushings as required to convert internal screw thread to size of thermometer connection.

2.3 PRESSURE GAUGES

- A. Pressure gauge shall have stainless steel case and stem, glass window, permanently etched scale markings on dial, dark metal pointer and bourdon type pressure element assembly with copper alloy construction and brass tip.
- B. Gauge shall be equipped with mechanical link between pressure element and connection to pointer.
- C. Provide probe assembly suitable for insertion in connector plug.
- D. Gauge shall have grade 'A' accuracy plus or minus one percent of middle half of scale range.
- E. Gauge shall be furnished with snubber rated for pressure of system.

2.4 TURBINE FLOW METERS

- A. Provide impeller turbine type flow meter for installing in piping and measuring flow directly in gallons per minute
- B. Display shall show rate of flow with register to indicate total volume in gallons.
- C. Accuracy shall be plus or minus 1.5 percent of actual water flow.
- D. Provide meter suitable for gas or fluid conveyed through piping system in which meter is installed.

2.5 CONNECTOR PLUGS

- A. Provide connector plugs for all pressure gauges and thermometers rated for 500 psi and 200 degrees Fahrenheit. Plug shall be solid brass construction with two valve cores of neoprene.

FINAL REVIEW
NOT FOR
CONSTRUCTION

230523 – VALVES FOR HVAC PIPING

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 INSTALLATION REQUIREMENTS

- A. Prior to installation, examine valve interior for cleanliness. Operate valves to ensure proper operation. Examine guides, seats, threads and flanges to ensure there are no conditions that could cause valve malfunction or leakage. Do no attempt to repair defective valves; replace with new valves.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance and equipment removal without system shutdown. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in position to allow full stem movement. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install chain wheels on operators for valves 4" and larger and more than 96 inches above finished floor. Extend chains to 60 inches above finished floor.
- E. Install necessary valves within piping systems to provide required flow control and to allow isolation for inspection, maintenance and repair of each piece of equipment of fixture and on each main and branch service loop.
- F. Valves 2" and smaller have solder, socket weld flanged or screwed end connections as required by associated piping materials unless otherwise noted. Valves 2.5" and larger shall have flanged or butt weld ends as scheduled.
- G. Non-rising stem valves shall not be installed at any point in the piping systems unless space is restricted. If a restricted area is identified, contractor shall obtain A/E approval before installation of non-rising stem valve.
- H. Valves shall be the same size as adjacent piping. Reduced valve size will not be allowed unless specifically noted.
- I. Provide 2.5" and larger gate valves on steam supply line with by-pass valves. Bypass valves shall have same trim as is specified for main valve.
- J. Provide butterfly valves 6" and smaller with latch lock handles for shutoff service.
- K. Install globe valves with pressure on top of disc unless prohibited by code. Globe valves requiring drainage for inspection, maintenance or winterization shall be installed with stem in horizontal position to allow complete drainage of piping.

1.2 GENERAL VALVE APPLICATIONS

- A. If valve applications are not noted, use the following:
 - 1. Shutoff service: Ball, Butterfly or Gate valves
 - 2. Throttling Service: Balance Valves or butterfly valves
- B. Valves in Insulated Piping: (shall be provided with 2" stem extensions and the following)
 - 1. Gate Valves shall be provided with rising stem
 - 2. Ball Valves shall be provided with an extended operating handle of non-thermal-conductive material and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves shall be provided with extended neck

1.3 STEAM AND CONDENSATE VALVE APPLICATION:

- A. 2" and smaller:
 - 1. Shutoff: Bronze Gate Valve
 - 2. Check: Bronze Swing Check Valve
 - 3. Throttling: Bronze Globe Valve
- B. 2.5" and larger:

1. Shutoff: Cast Steel Gate Valve
2. Check: Iron Swing Check Valve
3. Throttling: Cast Steel Globe Valve

PART 2 – PRODUCTS

2.1 BALL VALVES

- A. Bronze Ball Valve: Valve shall conform to standard MSS SP-110. Body design shall be two piece, bronze with threaded ends, stainless steel ball and stem, Teflon seats and full porting.

2.2 BUTTERFLY VALVES

- A. Iron Single Flange Butterfly Valve (2.5" to 12"): 200 CWP rated. Valve shall conform to MSS SP-67, Type I. Body design shall be lug type suitable for bi-directional dead end service at rated pressure without use of downstream flange. Body material shall be ASTM A 126, cast iron or ASTM A 536 ductile iron. Valve shall be equipped with EPDM seat, stainless steel stem and aluminum bronze disc.
- B. Iron Single Flange Butterfly Valve (14" to 24"): 150 CWP rated. Valve shall conform to MSS SP-67, Type I. Body design shall be lug type suitable for bidirectional dead end service at rated pressure without use of downstream flange. Body material shall be ASTM A 126 cast iron or ASTM A 536 ductile iron. Valve shall be equipped with EPDM seat, stainless steel stem and aluminum bronze disc.

2.3 GATE VALVES

- A. Iron Gate Valve: Class 125, OS&Y valve. Conform to standard MSS SP-70, Type I. Body material shall be ASTM A 126, gray iron with bolted bonnet. Valve shall be equipped with flanged ends, bronze trim, solid wedge disc and asbestos free packing and gasket. Valve shall be designed for repacking under pressure when fully opened and back-seated.
- B. Cast Steel Globe Valve: Class 150 Cast Steel gate valve. Provide flanged connections. Valve body shall be constructed with Cast Steel. Equal to Crane CAT No 47XUF.
- C. Bronze Gate Valve: Class 150, rising stem valve. Conform to MSS SP-80, Type 2. Body material shall be ASTM B 62 bronze with integral seat and union ring bonnet. Valve shall be equipped with threaded ends, bronze stem, solid wedge bronze disc, asbestos free packing and malleable iron hand wheel. Valve shall be designed for repacking under pressure when fully opened and back-seated.

2.4 GLOBE VALVES

- A. Bronze Globe Valve: Class 125 Valve. Conform to MSS SP-80, Type I. Body material shall be ASTM B 62 bronze with integral seat and screw in bonnet. Valve shall be equipped with threaded ends, bronze stem and disc and asbestos free packing. Valve shall be designed for repacking under pressure when fully opened and back-seated.
- B. Cast Steel Globe Valve: Class 150 Cast Steel gate valve. Provide flanged connections. Valve body shall be constructed with Cast Steel.
- C. Iron Glove Valve: Class 125 Valve. Conform to MSS SP-85, Type I. Body Material shall be ASTM A 126, gray iron with bolted bonnet. Valve shall be equipped with flanged ends, bronze trim and asbestos free packing and gasket. Valve shall be designed for repacking under pressure when fully opened and back-seated.

2.5 BALANCE VALVES

- A. Bronze Circuit Setter Balance Valve: Body material shall be bronze. Valve shall be equipped with precision machined orifice calibrated position indicator, meter connections with built in flanged check valves. Provide complete with polyurethane insulation cover.
- B. Iron Circuit Setter Balance Valve: Body material shall be cast iron. Valve shall be equipped with bronze disc with EPDM insert, stainless steel stem, asbestos free packing and gasket, EPDM seal ring and zinc plated stainless steel bushing.

2.6 SWING CHECK VALVES

- A. Bronze swing Check Valve: Class 150 valve. Conform to standard MSS SP-80, Type 3. Valve shall have horizontal flow body design with threaded ends and bronze disc. Body material shall be ASTM B 62 bronze.
- B. Iron Swing Check Valve with Closure Control: Class 125 valve. Conform to standard MSS SP-71, Type I. Valve shall have full waterway design and shall be constructed with ASTM A 126 gray iron and bolted bonnet. Valve shall be equipped with flanged ends, bronze trim, asbestos free gasket and factory installed exterior lever and swing closure control.

FINAL REVIEW
NOT FOR
CONSTRUCTION

230529 – HANGERS, SUPPORTS AND VIBRATION ISOLATION FOR HVAC PIPING AND EQUIPMENT

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic restraint hangers and supports for piping and equipment. Obtain approval from authorities having jurisdiction where required by local requirements.

1.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers, supports, clamps and attachments to support piping properly from building structure. Do not attach to ceilings, equipment, ductwork, conduit or other non-structural elements such as floor or roof decking.
- B. Hangers, supports, clamps and attachments shall comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible. Install supports with maximum spacing specified within Division 23 piping sections. Where piping of various sizes is supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.
- C. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length specified in Division 23 piping sections. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping as specified in Division 23 piping sections. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through openings at top of inserts.
- D. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Provide two nuts on threaded supports to securely fasten the support.
- E. Field fabricated heavy duty steel trapeze supports shall be fabricated from steel shapes selected for loads required. Weld steel in accordance with AWS D-1.1.
- F. Install appropriate types of hangers and supports to allow control movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
- G. Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- H. Install hangers to provide indicated pipe slopes and so that maximum deflection of piping allowed by ASME B31.9 is not exceeded.
- I. Insulated piping:
 - 1. Riser Clamps: Attach riser clamps, including spacers, to piping with riser clamps projecting through insulation. Do not exceed pipe stresses allowed by ASME B31.9. Do not use riser clamps to support horizontal, insulated piping. Seal insulation for hot piping and protect vapor barrier for cold piping as specified in Division 23 "HVAC Insulation".
 - 2. Insulation protection shield: Install insulation protection shield and high density insulation, sized for the insulation thickness used as specified in insulation schedule. Install a minimum 8" long section at each support point, top and bottom halves or the pipe of same thickness of insulation used.
- J. Pre-engineered Support Strut Systems: Channel strut systems can be used at the Contractors option in lieu of individual hangers for horizontal pipes. Space channel strut systems at the required distance for the smallest pipe supported. Provide channel gauge and hanger rods per the manufacturer's recommendations for the piping supported. Where strut systems are attached to walls, install anchor bolts per manufacturer's recommendations.
 - 1. Uninsulated copper pipe: Install with plastic galvanic isolators.

2. Insulated Tube or Pipe: Install with 360 degree insulation protection shields or pre-engineered thermal hanger shield inserts.

1.3 INSTALLATION OF ANCHORS

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ASME B 31.9 and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install anchors by welding steel shapes, plates and bars to piping and to structure. Comply with ASME B 31.9 and with AWS Standards D1.1.
- C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions to control movement to compensators.
- D. Anchor spacing: Where not otherwise indicated, install anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

1.4 INSTALLATION OF PIPE ALIGNMENT GUIDES

- A. Install pipe alignment guides on piping that adjoins expansion joints as required by expansion joint manufacturer and elsewhere as indicated on plans and specification sections to eliminate binding and torsional stress on piping systems. Where not otherwise indicated, install guides as required by ASME B 31.9. Anchor guides to building substrate.

1.5 EQUIPMENT SUPPORTS

- A. Fabricate structural steel supports to suspend equipment from structure above or support equipment from floor. Place grout under supports for piping and equipment.

1.6 INSTALLATION OF VIBRATION ISOLATORS

- A. Mount mechanical equipment on vibration isolators as specified. Isolator manufacturer shall supply all unit isolators, complete rails, fan and motor bases as required, except for isolation system supplied for equipment by equipment manufacturer.
- B. Wherever rotational speed is the disturbing frequency (i.e. fans and pump impellers) the lowest such speed in the system shall be used. Isolation devices shall be selected for uniform deflections accounting for distribution of equipment weight.
- C. Piping runs connected to equipment requiring vibration isolation shall be isolated from building structure at connection to equipment using isolators inserted in supporting piping rods.
- D. Contractor shall have option to use isolation equipment custom designed by equipment manufacturer provided that the proposed equipment meets or exceeds all standards outlines in this specification.

1.7 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Clean all welds and touch up paint to match factory finish of all materials or color and finish of adjacent materials when supports and adjacent elements are painted.
- C. Adjust vibration isolators after piping system is at operating weight.
- D. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- E. Adjust active height of spring isolators and adjust restraints to permit free movement of equipment within normal mode of operation.

PART 2 – PRODUCTS

2.1 STEEL PIPE HANGERS AND SUPPORTS

- A. Comply with MSS SP-58 types 1-58 factory fabricated components. Hangers shall be pre-galvanized or hot dipped. Where non-metallic coatings area indicated provide plastic coating, jacket or liner.
- B. Where hangers are installed in a corrosive environment or outdoors, hangers and supports shall be type 304 stainless steel.

2.2 TRAPEZE PIPE HANGERS

- A. Trapeze hangers shall comply with MSS SP-69 and shall be type 59 shop or field fabricated pipe support assembly made from structural steel shapes with MSS SP-58 hanger rods, nuts, saddles and U-bolts.

2.3 THERMAL HANGER SHIELD INSERTS

- A. Inserts shall have 100 PSI minimum compressive strength and shall be encased in sheet metal shield.
- B. For trapeze and clamped systems, insert and shield shall cover entire circumference of pipe.
- C. For clevis hangers, insert and shield shall cover lower 180 degrees of pipe.
- D. Insert length shall extend 2" beyond sheet metal shield for piping operating below ambient air temperature.

2.4 EQUIPMENT SUPPORTS

- A. Provide welded, shop or field fabricated equipment supports made from structural steel shapes.

2.5 PIPE STANDS

- A. Pipe stands shall be shop or field fabricated assemblies made of manufactured corrosion resistant components to support roof mounted piping. Provide one piece plastic unit with integral rod roller, pipe clamps or V-Shaped cradle to support pipe. Pipe stand shall be suitable for roof installation without membrane protection.

2.6 VIBRATION ISOLATORS

- A. Pads: Pads shall be arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized steel baseplates and factory cut to sizes that match requirements of supported equipment.
- B. Mounts: Mounts shall be double deflection type with molded oil resistant rubber, hermetically sealed compressed fiberglass or neoprene isolator elements with factory drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Identify capacity range by color coding or other means.
- C. Free Standing Spring Isolators: Free standing spring isolators shall be laterally stable, open spring isolators. Outside diameter shall be not less than 80 percent of the compressed height of the spring at rated load. Minimum additional travel shall be 50 percent of the required deflection at rated load. Isolators shall be capable of supporting 200 percent of the rated load, fully compressed without deformation or failure. Provide factory drilled baseplates and top plates for bolting to equipment and structure.
- D. Housed Spring Mounts: Housed spring isolators shall be equipped with ductile iron or steel housing. Mounts shall be equipped with vertically adjustable snubbers allowing 1/4" travel up or down before contacting a resilient collar. Base and top shall have factory drilled holes for bolting to equipment and structure.
- E. Elastomeric Hangers: Elastomeric Hangers shall be single or double deflection type fitted with molded, oil resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Identify capacity range by color coding or other means.
- F. Spring Hangers: Spring hangers shall be combination coil-spring and elastomeric insert hanger with spring and insert in compression. Frame shall be steel and shall be fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency. Outside spring diameter shall be not less than 80 percent of the compressed height of the spring at rated load. Hanger shall be capable of supporting 200 percent of the rated load, fully compressed, without deformation or failure and shall be equipped with self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- G. Steel Equipment Base: Equipment Base isolators shall be constructed of factory fabricated welded structural steel. Bases shall have shape to accommodate supported equipment. Support brackets shall be factory welded steel

brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support. Bases shall use steel shapes, plates, and bars complying with ASTM A 32/A 36M.

FINAL REVIEW
NOT FOR
CONSTRUCTION

230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 VALVE IDENTIFICATION

- A. Provide valve tag on every valve, cock and control devices in each piping system. Exclude check valves, valves within factory fabricated equipment units, HVAC terminal devices and similar rough-in connections of end-use fixtures and units.
- B. List each tagged valve in valve schedule for each piping system. And provide valve schedule to owner in operations and maintenance manuals.

1.2 MECHANICAL EQUIPMENT IDENTIFICATION

- A. Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
 - 1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - 2. Meters, gauges, thermometers and similar units.
 - 3. Fuel burning units including boilers, furnaces, heaters, stills and absorption units.
 - 4. Pumps, compressors, chillers, condensers and similar motor driven units.
 - 5. Heat exchangers, coils, evaporators, cooling towers, heat recovery units and similar equipment.
 - 6. Fans, blowers, primary balancing dampers mixing boxes and air terminal units.
 - 7. Packaged HVAC units.
 - 8. Duct heaters and terminal heating and cooling units.
 - 9. Tanks and pressure vessels.
 - 10. Strainers, filters, humidifiers, water treatment systems and similar equipment.
- B. Where lettering larger than 1" height is needed for proper identification because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved sign at contractor's option.
- C. Lettering shall be minimum 1/4" high where viewing distance is less than 2'-0"; 1/2" high for distances up to 6'-0" and proportionately larger for greater distances. Secondary lettering shall be 2/3 to 3/4 of size of the principal lettering.

1.3 PIPING IDENTIFICATION

- A. Install pipe markers on each piping system and include arrows to show normal direction of flow.
- B. Install pipe markers where piping is exposed to view, concealed by only a removable ceiling system, installed in machine rooms, installed in accessible maintenance spaces and exterior non-concealed locations.
 - 1. Within 5 feet of each valve and control device.
 - 2. Within 5 feet of each branch, excluding take-offs less than 25 feet in length for fixtures or terminal heating and cooling units; mark flow direction of each pipe at branch connection.
 - 3. Within 5 feet where pipes pass through walls, floors or ceilings or enter non-accessible enclosures. Provide identification on each side of wall, floor or ceiling.
 - 4. At access doors, manholes and similar access points which permit view of concealed piping.
 - 5. Within 5 feet of major equipment items and other points of origination and termination.
 - 6. Spaced intermediately at maximum spacing or 50' along each piping run. Spacing shall be reduced to 25' in congested areas of piping and equipment where there are more than two piping systems or pieces of equipment.

PART 2 – PRODUCTS

2.1 ENGRAVED LAMINATE SIGN

- A. Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thickness indicated, engraved with the engravers standard letter style of the sizes and wording indicated. Signs shall be black with white core except as otherwise noted and shall be punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
- B. Thickness shall be 1/16" for units up to 20 square inches or 8" in length and 1/8" for larger units.
- C. Signs shall be fastened with self-tapping stainless steel screws, except contact type permanent adhesive where screws cannot or should not penetrate the substrate.

2.2 PLASTIC VALVE TAGS

- A. Provide manufacturer's standard solid plastic valve tags with printed enamel lettering with system abbreviation in approximately 3/16" high letters and sequenced valve numbers approximately 3/8" high and with 5/32" hole for fastener
- B. Tags shall be 1-1/8" square white tags with black lettering.

2.3 PAINTED IDENTIFICATION

- A. Painting where allowed shall be performed using standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping and similar applications. Minimum letter height shall be 1.25" high for ductwork and equipment and 0.75" high for access door signs and similar operational instructions.
- B. Paint shall be exterior type, oil based, black paint.

2.4 PLASTIC TAPE PIPE MARKERS

- A. Provide manufacturer's standard color-coded pressure sensitive vinyl tape not less than 3 mils thick.
- B. Tape width shall be 1.5" for pipes less than 6" in diameter and 2.5" wide for larger pipes.
- C. Colors shall comply with ANSI A13.1 except where noted otherwise.
- D. Lettering shall be manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by A/E in cases of variance with names shown or specified. Abbreviate system names only as necessary for each application length.
- E. Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering or as a separate unit of plastic.

230593 – TESTING AND BALANCING

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 QUALITY ASSURANCE

- A. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.
- B. The independent testing, adjusting, and balancing agency shall be certified by National Environmental Balancing Bureau (NEBB) or the Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project. The project shall be staffed at all times by qualified personnel.
- C. Balance all air system individual terminal devices and branch lines to +/- 10 percent and main ducts and air handling equipment to +/- 5 percent of specified airflow.
- D. Balance water systems to +/- 5 percent of specified airflow.

1.2 PROJECT CONDITIONS

- A. Systems shall be fully operational prior to beginning procedures.

1.3 SEQUENCE AND SCHEDULING

- A. Test, adjust and balance the air systems before hydronic, steam and refrigerant systems.

1.4 PRELIMINARY PROCEDURES

- A. In the event that the test and balance contractor is independently contracted with the owner, the division 23 contractor shall assist the test and balance contractor in performing all of these procedures. No extras shall be paid for additional labor or materials required to perform these procedures. Test and balance contractor shall in all cases ensure that these procedures are met to a satisfactory level to perform his work.
- B. Before operating the air system, perform these steps:
 - 1. Obtain design drawings and specifications and become thoroughly acquainted with the design intent.
 - 2. Obtain copies of approved shop drawings of air handling equipment, supply, return and exhaust outlets, and temperature control diagrams.
 - 3. Compare design to installed equipment and field installations.
 - 4. Walk the system from the system air handling equipment to terminal units to determine variations of installation from design.
 - 5. Check filters for cleanliness.
 - 6. Check volume and fire dampers for correct and locked position and temperature control system for complete installation before starting fans.
 - 7. Verify volume dampers are installed at locations needed for balancing the air systems.
 - 8. Prepare test report sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.
 - 9. Determine best locations in main and branch ductwork for most accurate duct traverses.
 - 10. Place outlet dampers in the full open position.
 - 11. Lubricate all motors and bearings.
 - 12. Check fan belt tension

13. Check fan rotation.
- C. Before operating the hydronic system, perform these steps:
1. Open valves to full open position. Close coil bypass valves.
 2. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices and balancing valves and fittings are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
 3. Remove and clean all strainers
 4. Examine hydronic systems and determine if water has been treated and cleaned.
 5. Check pump rotation
 6. Clean and set automatic fill valves for required system pressure.
 7. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.
 8. Check air vents at high points of systems and determine if all are installed and operating freely or to bleed air completely.
 9. Set temperature controls so all coils are calling for full flow.
 10. Check operation of automatic bypass valves.
 11. Check and set operating temperatures of chillers to design requirements.
 12. Lubricate all motors and bearings.

1.5 PERFORMING TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system identified in accordance with the detailed procedures outlined in the referenced standard.
- B. Cut insulation, ductwork and piping for installation of test probes to the minimum extent necessary to allow adequate adjustment performance of procedures.
- C. Patch insulation, ductwork and housings using materials identical to those being removed.
- D. Seal ducts and piping and test for and repair leaks.
- E. Seal insulation to re-establish integrity of the vapor barrier.
- F. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers and similar controls and devices to show final settings. Mark with paint or other suitable, permanent identification materials.
- G. Energize motors, verify proper operation of motor, drive system and wheel/impeller. Adjust to indicated RPM. Replace motor pulley or impeller as required to achieve design conditions.
- H. Test and adjust mechanical systems for sound and vibration in accordance with the detailed instructions of the referenced standards.

1.6 REPORTS

- A. Reports shall be submitted on standard AABC or NEBB forms.
- B. Reports shall include Initial, Design and Final readings of the following parameters:
 1. Fan Airflow
 2. Diffuser and Grille Airflow
 3. Outside Airflow
 4. External Static Pressure (Supply, Return and Exhaust)

5. Total Static Pressure
6. Motor Amps (Each Phase)
7. Motor Volts (Each Phase)
8. Fan Speed Setting
9. Motor Sheave Diameter/Bore
10. Sheave Centerline Distance
11. Belt Quantity, Make and Size
12. Fan Sheave Make
13. Fan Sheave Diameter/Bore
14. Fan RPM
15. Motor HP
16. Motor RPM
17. Discharge Air Temperature from each piece of Mechanical Equipment.
18. Discharge Air Relative Humidity from each piece of Mechanical Equipment.
19. Outside Air Temperature at Time of Test
20. Outside Air Humidity at Time of Test
21. Sample Space Temperature at Time of Test (minimum 15% of Zones)
22. Sample Space Humidity at Time of Test (minimum 15% of Zones)
23. Pump RPM
24. Pump Flow Rates
25. Equipment Water Flow Rates
26. Pump Inlet and outlet Pressures
27. Total Pump Head
28. Water temperatures in all piping systems.

230700 – HVAC INSULATION

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 INSTALLATION REQUIREMENTS

- A. Schedule insulation application after pressure testing systems and where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Install insulation materials accessories and finishes with smooth straight and even surfaces, free of voids throughout the length of equipment, ducts and fittings and piping including fittings valves and specialties.
- C. Install insulation materials, forms, vapor barriers or retarders, jackets and thicknesses required for each item of equipment, duct system and pipe system specified in insulation system schedules.
- D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode soften or otherwise attack insulation or jacket in either wet or dry state.
- E. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- F. Install multiple layers of insulation with longitudinal seams staggered.
- G. Do not weld brackets, clips or other attachment devices to piping, fittings and specialties.
- H. Keep insulation materials dry during application and finishing.
- I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- J. Install insulation with least number of joints practical.
- K. Where vapor barrier is indicated, seal joints, seams and penetrations in insulation at hangers, supports, anchors and other projections with vapor-barrier mastic.
- L. Install insulation continuously through hangers and around anchor attachments.
- M. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor barrier mastic.
- N. For insulation with factory applied jackets cover circumferential joints with 3" wide strips of same material insulation jacket. Secure strips per manufacturer's recommendations. Overlap jacket longitudinal seams at least 1.5". Install longitudinal seams at bottom of ductwork.
- O. Cut insulation in manner to avoid compressing insulation more than 75 percent of it's nominal thickness.
- P. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- Q. Install insulation continuously through roof penetrations.
- R. For wall penetrations, seal penetrations with flashing sealant.
- S. Install insulation continuously through penetrations of fire rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2".
- T. For all fire rated duct, insulate access panels and doors to achieve same fire rating as duct.

1.2 DUCT INSULATION APPLICATION SCHEDULE

- | | | |
|----|---|----------------|
| A. | Rectangular Supply Return and Exhaust Ductwork (<2000 FPM): FDW | 1.5" Thickness |
| B. | Rectangular Supply Return and Exhaust Ductwork (>2000 FPM): FDW | 1.5" Thickness |
| C. | Rectangular Exposed Ductwork (<2000 FPM) LVL | 0.5" Thickness |
| D. | Rectangular Exposed Ductwork (>2000 FPM) HVL | 0.5" Thickness |

E.	Rectangular Transfer Air Ductwork	LVL	0.5" Thickness
F.	Round Supply Return and Exhaust Ductwork:	FDW	1.5" Thickness
G.	Round Exposed Supply	Double Wall Spiral. See Duct Specification	
H.	Round Exposed Return and Exhaust	Single Wall Spiral. Uninsulated.	
I.	Return Air Boot Ductwork	LVL	0.5" Thickness
J.	Outdoor Air Ductwork:	FDW	1.5" Thickness

PART 2 – PRODUCTS

2.1 EXTERNAL DUCT INSULATION

- A. Foil Faced Duct Wrap (FDW): Insulation shall comply with ASTM C 1290 and ASTM C 553 and shall have 1.0 pound per cubic foot density with thermal conductivity of 0.26 Btuh maximum when rated at 75 degrees Fahrenheit mean temperature. Insulation shall be equipped with Foil facing compliant with ASTM C1136 with a maximum vapor transmission rate of 0.02 perms. Provide joint sealants and tapes according to manufacturer's recommendations.

2.2 INTERNAL DUCT INSULATION

- A. Low Velocity Duct Liner (LVL): Insulation shall comply with ASTM C 1071 and shall have 2.0 pound per cubic foot density with maximum thermal conductivity of 0.24 Btuh when rated at 75 degrees mean temperature. Facing shall have maximum water vapor sorption rate of 4% by weight.
- B. High Velocity Duct Liner (HVL): Insulation shall comply with ASTM C 1071 and shall have 2.0 pound per cubic foot density with maximum thermal conductivity of 0.24 Btuh when rated at 75 degrees mean temperature. Facing shall have maximum water vapor sorption rate of 2% by weight.

2.3 INTEGRAL INSULATION

- A. Non-Fibrous Closed Cell Outdoor Ductwork (NFCC): Minimum insulation value of R12. See Ductwork specification section for more information.

2.4 ADHESIVES

- A. Duct Liner Adhesive (LVL and HDL): Solvent Based Liner Adhesive. Comply with ASTM C 916. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR, Subpart D (EPA Method 24).
- B. Duct Wrap Adhesive (FDW and EDW): Solvent based resin adhesive with a service temperature range of -75 degrees F to +300 degrees F. Adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

230701 – HVAC PIPING INSULATION

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 GENERAL

- A. Provide necessary materials and accessories for installation of insulation for plumbing and mechanical systems as specified and/or detailed on drawings. Insulation type, jacket, and thickness for specific piping systems or equipment shall be as listed in this specification section.
- B. Products or their shipping cartons shall bear label indicating their flame and smoke ratings. Treatments of jackets or facings for impart flame and smoke safety shall be permanent. Use of water soluble treatments such as corn paste or wheat paste is prohibited. This does not exclude approved lagging adhesives.
- C. Install insulation over clean dry surfaces with joints firmly butted together. Insulation at equipment, flanges, fittings, etc. shall have straight edges with box type joints with corner beads as required. Where plumbing and heating insulation terminates at equipment or unions, taper insulation at 30 degree angle to pipe with one coat finishing cement and finish same as fittings. Total insulation system shall have neat smooth appearance with no wrinkles, or folds in jackets, joint strips, or fitting covers. Seal butt joints at maximum intervals of 45 feet to prevent vapor barrier failures from being transmitted to adjoining insulations sections.
- D. Undamaged insulation systems on cold surface piping and equipment shall perform their intended functions as vapor barriers and thermal insulation without premature deterioration or vapor barrier. Contractor shall take every reasonable precaution to provide insulation systems with continuous unbroken vapor barriers.
- E. Products shall not contain asbestos, lead, mercury or mercury compounds.

1.2 QUALITY ASSURANCE

- A. Flame/Smoke Ratings: Provide composite Plumbing insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.
 - 1. Exception: Outdoor Piping insulation may have flame spread index of 75 and smoke developed index of 150.
- B. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- C. Insulation installer shall advise contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

1.3 INSULATION INSTALLATION REQUIREMENTS

- A. Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps.
- C. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.
- D. Maintain integrity of vapor-barrier jackets on cold pipe insulation, and protect insulation with shields to prevent puncture or other damage. Provide high density insulation of material as specified herein and of length equivalent to pipe shield. Provide pipe hangers sized for the pipe outside diameter plus insulation thickness. Seal butt joint between insulation and high density insulation with wet coat of vapor barrier lap cement.
 - 1. Exception for vertical piping: Provide clamps sized for the outside diameter of the vertical pipe and extend clamp through insulation. Seal penetrations of insulation and vapor barrier with wet coat of vapor barrier lap cement.
- E. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- F. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- G. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with

insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

- H. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.
- I. Exterior Piping Protection:
 - 1. Provide an aluminum jacket over all exterior piping insulation. UV paint is not required.

1.4 EQUIPMENT INSULATION REQUIREMENTS

- A. Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.
- B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.
- C. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.
- D. Do not apply insulation to equipment, breechings, or stacks while hot.
- E. Apply insulation using the staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.
- F. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving a smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.
- G. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2". Apply over vapor barrier where applicable.
- H. Do not insulate boiler manholes, handholes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.
- I. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.
- J. Equipment Exposed to Weather: Protect outdoor insulation from weather by installation of weather-barrier mastic protective finish, or jacketing, as recommended by the manufacturer.

1.5 INSULATION APPLICATION SCHEDULE:

A. Steam Piping (All Sizes)	Fiberglass	5" Thickness
B. Steam System Condensate Piping (All Sizes)	Fiberglass	5" Thickness
C. Hot Water Piping (Up to 1.25")	Fiberglass	1.5" Thickness
D. Hot Water Piping (Above 1.25")	Fiberglass	2" Thickness
E. Condensate Drain Piping	Fiberglass	0.5" Thickness
F. Cold Surface Equipment	Elastomeric	1" Thickness
G. Hot Surface Equipment	Fiberglass	1" Thickness

PART 2 - PRODUCTS

2.1 ELASTOMERIC INSULATION:

- A. Flexible Elastomeric insulation shall be closed-cell, sponge or expanded-rubber materials and comply with ASTM C 534, type I for tubular materials and type II for sheet products. Insulation values shall comply with energy code minimum requirements. See common work results for current code edition.

2.2 FIBERGLASS INSULATION:

- A. Knauf Earthwool 1000 Fiberglass insulation shall be mineral-fiber blanket insulation with mineral or fiber glass fibers bonded with a thermosetting resin and comply with ASTM C 553, type V, without factory applied jacket. Insulation values shall comply with energy code minimum requirements. See common work results for current code edition.

2.3 ADHESIVES AND TAPES:

- A. Insulating cements and adhesives shall be compatible with the insulation materials, jackets and substrates for bonding insulation to itself and to surfaces to be insulated.
- B. Mastics shall be compatible with insulation materials, jackets, and substrates and shall comply with MIL-A-24179A Type II. Vapor-barrier mastic shall be water based suitable for indoor and outdoor use on below ambient services.
- C. Tapes shall be white, vapor-retarder tape matching factory-applied jacket with acrylic adhesive and shall comply with ASTM C 1136.
- D. All insulation finishes shall be compatible with the insulation product being finished and shall be in a color as selected by architect.

FINAL REVIEW
NOT FOR
CONSTRUCTION

SECTION 230800 - COMMISSIONING OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes
 - 1. Commissioning of HVAC Systems
 - 2. Commissioning Building HVAC Systems Automation Controls
 - 3. Commissioning Testing, Adjusting and Balancing (TAB)

1.2 RELATED DOCUMENTS

- A. Section 019113 – General Commissioning Requirements
- B. Section 220800 – Commissioning of Plumbing Systems
- C. Section 260800 – Commissioning of Electrical Systems

1.3 DEFINITIONS

- A. CxA: Commissioning Agent
- B. GC: Contractor; General Contractor, not a Subcontractor
- C. O&M: operations and Maintenance

1.4 DESCRIPTION

- A. Conform to commissioning requirements and the commissioning plan.

1.5 RESPONSIBILITIES

- A. Mechanical, Electrical, Plumbing, Controls, and TAB Contractors: The commissioning responsibilities applicable to each of the mechanical, controls, and TAB contractors of CSI Masterformat Division 23 (all references apply to commissioned equipment only):
 - 1. Construction and Acceptance Phases
 - a. Include the cost of participating in commissioning in the contract price. Commissioned equipment is defined in section 019113.
 - b. In each purchase order or subcontract written, include requirements for submittal data, completion of commissioning documentation, O&M data and training.

- c. Attend and actively participate in a commissioning scope meeting and other meetings necessary to facilitate the Commissioning process.
 - d. Provide requested documentation to the CxA for development of the functional testing procedures.
 - e. Complete CxA furnished functional performance tests and procedures. Subs shall review test procedures to ensure feasibility, safety and equipment protection, and provide necessary written alarm limits to be used during the tests.
 - f. Complete a start-up and initial checkout plan using manufacturer's start-up procedures and the CxA furnished Pre-functional checklists for all commissioned equipment. Submit to GC for review prior to startup. CxA will verify plan for compliance. Refer to Section 01 91 13 for further details related to start-up.
 - g. During the startup and initial checkout process, execute the mechanical-related portions of the pre-functional checklists for all commissioned equipment.
 - h. Correct system deficiencies before functional testing. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air-or water-related systems.
 - i. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the GC.
 - j. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments, and problem-solving.
 - k. Provide all test equipment necessary to fulfill specified testing requirements.
 - l. Perform functional performance testing under the direction of the CxA for specified equipment. Assist the CxA in interpreting the monitored data, as necessary
 - m. Correct deficiencies (differences between specified and observed performance) as interpreted by the CxA and A/E and retest the equipment.
 - n. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions. O&M's to be consistent with the final tested condition of all installed systems.
 - o. During construction, maintain as-built red-line mark-ups for all drawings. Update as needed following functional testing.
 - p. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
2. Operation Manuals shall include:
- a. A table of all setpoints and implications when changing them.

- b. Schedules.
 - c. Instructions for operation of each piece of equipment for emergencies.
 - d. Startup and shutdown procedures.
 - e. Recommendations for re-commissioning frequency by equipment type.
 - f. Recommended maintenance schedules.
- 3. Warranty Period
 - a. Participate in deferred functional performance testing, organized by the CxA, according to the specifications.
 - b. Correct deficiencies and make necessary adjustments to O&M Manuals and as-built drawings for applicable issues identified in any seasonal testing.
- B. Mechanical Contractor: The commissioning responsibilities of the HVAC mechanical contractor, during construction and acceptance phases, in addition to those listed in Paragraph A, above, are:
 - 1. Participate in the Commissioning of the mechanical systems listed in Section 019113 and the Commissioning Plan.
 - 2. Provide submittals as required by A/E and those listed on the Pre-functional checklist.
 - 3. Provide startup for all HVAC equipment, except for the building automation control system. Clearly document all completed startup and system operational checkout procedures, providing a copy to the CxA.
 - 4. Provide all test equipment necessary to fulfill specified testing requirements. Data Loggers and test equipment not specified in equipment or system sections excluded.
 - 5. Assist and cooperate with the TAB contractor and CxA by:
 - a. Putting all HVAC equipment and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.
 - b. Including cost of sheaves and belts that may be required by TAB.
 - c. Providing test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing. Providing an approved plug.
 - d. Providing temperature and pressure taps according to the Construction Documents for TAB and commissioning testing.
 - 6. Install a P/T plug at water sensors which is an input point to the control system.
 - 7. List and clearly identify on the as-built drawings the location of all air-flow stations (if applicable).
 - 8. Prepare a preliminary schedule for CSI Masterformat Division 23 pipe and duct system testing,

flushing and cleaning, equipment start-up, and TAB start and completion for use by the CxA. Update the schedule as appropriate.

9. Notify the GC when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment, and TAB will occur. Be responsible to notify the GC ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed and that the CxA has the scheduling information needed to efficiently execute the commissioning process.
 10. Refer to Section 01 91 13 for specific details on non-conformance issues relating to pre-functional checklists and tests and for issues relating to functional performance tests.
 11. The training shall consist of a review of the O&M manuals and hands-on training. Hands-on training shall include start-up, operation in all modes possible, including manual, shutdown and any emergency procedures and preventative maintenance for all pieces of equipment. The mechanical contractor shall fully explain and demonstrate the operation, function and overrides of any local packages controls, not controlled by the central control system. Training shall occur after functional testing is complete, unless approved otherwise by the GC. Contractor and vendor training will be as specified for the product of system. Training will be scheduled by the GC and monitored by the GC and CxA.
- C. Controls Contractor: The commissioning responsibilities of the controls contractor, during construction and acceptance phases in addition to those listed in Paragraph A, above, are:
1. Sequences of Operation Submittals: The Controls Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment based on the approved project equipment, regardless of the completeness and clarity of the sequences in the construction documents specifications. They shall include:
 - a. An overview narrative of the system (1 or 2 paragraphs) generally describing its purpose, components, and function.
 - b. All interactions and interlocks with other systems.
 - c. Detailed delineation of control between any packaged controls and the building automation system, listing what points the BAS monitors only and what BAS points are control points and are adjustable.
 - d. Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included but will generally require additional narrative).
 - e. Start-up sequences.
 - f. Warm-up mode sequences.
 - g. Normal operating mode sequences.
 - h. Unoccupied mode sequences.
 - i. Shutdown sequences.

- j. Capacity control sequences and equipment staging.
 - k. Temperature and pressure control: setbacks, setups, resets, etc.
 - l. Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
 - m. Effects of power or equipment failure with all standby component functions.
 - n. Sequences for all alarms and emergency shutdowns.
 - o. Seasonal operational differences and recommendations.
 - p. Initial and recommended values for all adjustable settings, setpoints, and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
 - q. Schedules, if known.
 - r. To facilitate referencing in testing procedures, all sequences shall be written in small statements, each with a number for reference. For a given system, numbers shall not repeat for different sequence sections, unless the sections are numbered.
2. Control Drawings Submittal
- a. The control drawings shall have a key to all abbreviations.
 - b. The control drawings shall contain graphic schematic depictions of the systems and each component.
 - c. The schematics shall include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
3. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls O&M Manual submittal.
4. CxA shall utilize a DDC functional testing tool that is a Native BACnet-based system hosted on the EMCS server. This system will collect EMCS data on all building controllers, application controllers, and all input/output devices and shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135–2004, BACnet. Gateways provided by the CxA shall be used for communication to systems and controllers installed under this section. Gateways may be used for communication to existing systems or to systems installed under other sections.

The Energy Management and Control System (EMCS) application program provided by the controls contractor in DDC specification 230902 shall be written to communicate specifically utilizing BACnet protocols. The use of the DDC functional testing tool and the building energy management control system (EMCS) communication protocol requires that the system devices and communication networks be uniquely identified. This is to ensure that messages are correctly sent and received within the network, and between devices.

To achieve a unique BACnet system identification regime, three sets of numbers are required to be allocated within a system. These numbers are respectively allocated to; a device connected to a particular LAN, a device located in a particular building, and a network within the building on which the device is installed. The numbers are described as follows:

- a. MAC Address
 - b. Device Instance
 - c. Network Number
5. Assist and cooperate with TAB contractor in the following manner:
- a. Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB. Provide the TAB contractor any unique instruments needed for setting terminal unit boxes and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.).
 - b. For a given area, have all required pre-functional checklists, calibration, startup, and selected functional tests of the system completed prior to TAB.
 - c. Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB or provide sufficient training for TAB to operate the system without assistance.
6. Assist and cooperate with the CxA in the following manner:
- a. Using a skilled technician who is familiar with the installed systems in this building, execute the functional testing of the controls system during both initial functional testing and seasonal functional testing. Assist in the functional testing of all equipment. Provide 2-way radios during the testing.
 - b. Execute all control system trend logs.
7. Provide a signed and dated certification to the GC upon completion of the checkout of each controlled device, equipment and system prior to functional testing for each piece of equipment or system, that all system programming is complete as to all respects of the Contract Documents, except functional testing requirements.
8. Beyond the control points necessary to execute all documented control sequences, provide monitoring, control, and virtual points.
9. List and clearly identify on the as-built duct and piping drawings the locations of all monitoring and control sensors.
10. Provide all test equipment necessary to fulfill specified testing requirements.
- D. TAB Contractor: The duties of the TAB contractor, in addition to those listed in Paragraph A, above, are:
1. Submit the outline of the TAB plan and approach for each system and component to the CxA, QC, and the controls contractor 6 weeks prior to starting the TAB. This plan shall be developed after the TAB has met with the GC and become familiar with the control system.
 2. The submitted plan shall include:

- a. Certification that the TAB contractor has reviewed the construction documents and the systems with the design engineers and contractors to sufficiently understand the design intent for each system.
- b. An explanation of the intended use of the building control system. The controls contractor shall comment on feasibility of the plan.
- c. All field checkout sheets and logs to be used that list each piece of equipment to be tested, adjusted, and balanced with the data cells to be gathered for each.
- d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
- e. Final test report forms to be used.
- f. Submit NEBB or AABC procedural standards or provide detailed step-by-step procedures for TAB work for each system and issue: terminal flow calibration (for each terminal type), diffuser proportioning, branch/sub-main proportioning, total flow calculations, rechecking, diversity issues, expected problems and solutions, etc. Criteria for using air flow straighteners or relocating flow stations and sensors shall be discussed. Provide the analogous explanations for the waterside.
- g. List of all airflow, water flow, system capacity, and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
- h. Details of how total flow will be determined (Air: sum of terminal flows via BAS calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations. Water: pump curves, circuit setter, flow station, ultrasonic, etc.). (Describe in Narrative and submit in final reports).
- i. The identification and types of measurement instruments to be used and their most recent calibration date.
- j. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and provide methods to verify this.
- k. Confirmation that TAB understands the outside air ventilation criteria under all conditions.
- l. Details of whether and how minimum outside air cfm will be verified and set, and for what level (total building, zone, etc.).
- m. Details of how building static and exhaust fan/relief damper capacity will be checked.
- n. Details of methods for making any specified coil or other system plant capacity measurements.
- o. Details of any TAB work to be done in phases (by floor, etc.), or of areas to be built out later.
- p. Details regarding specified deferred or seasonal TAB work.
- q. Details of all exhaust fan balancing and capacity verifications, including any required room pressure differentials.

- r. Details of any required interstitial cavity differential pressure measurements and calculations.
 - s. Plan for hand-written field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
 - t. Plan for formal progress reports (scope and frequency).
 - u. Plan for formal deficiency reports (scope, frequency, and distribution).
- 3. The TAB field technicians shall keep a running log of events and issues. Submit hand-written reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests to the CA and GC at least twice a week.
 - 4. Communicate in writing to the controls contractor all setpoint and parameter changes made, or problems and discrepancies identified during TAB which affect the control system setup and operation.
 - 5. Provide a draft copy of the TAB report to the CxA within 2 weeks of completion. The report shall contain a full explanation of the methodology, assumptions, and the results in a clear format with designations of all uncommon abbreviations and column headings. The report should follow the latest and most rigorous reporting recommendations by AABC, NEBB, or ASHRAE Standard 111.
 - 6. Provide the CxA with any updates because of A/E review.
 - 7. Provide all test equipment necessary to fulfill specified testing requirements.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 STARTUP

- A. The mechanical and controls contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in Section 019113. CSI Masterformat Division 23 has start-up responsibility and is required to complete systems and sub-systems, so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the Commissioning Agent or Owner.
- B. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the GC. Beginning system testing before full completion, does not relieve the Contractor from fully completing the system, including all pre-functional checklists as soon as possible.

3.2 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. The following O&M Manual requirements do not replace O&M Manual documentation requirements elsewhere in these specifications.
- B. Special Control System O&M Manual Requirements: In addition to documentation that may be specified

elsewhere, the controls contractor shall compile and organize at a minimum the following data on the control system in a labeled 3-ring binders with indexed tabs.

1. 3 copies of the controls training manuals in a separate manual from the O&M Manuals.
2. Operation and Maintenance Manuals containing:
 - a. Specific instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. These instructions shall be step-by-step. Indexes and clear tables of contents shall be included. The detailed technical manual for programming and customizing control loops and algorithms shall be included.
 - b. Full as-built set of control drawings.
 - c. Full as-built sequence of operations for each piece of equipment.
 - d. Full print out of all schedules and set points after testing and acceptance of the system.
 - e. Full as-built print out of any custom software programs.
 - f. Electronic copy on disk of the entire program for this facility.
 - g. Marking of all system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.
 - h. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
 - i. Control equipment component submittals, parts lists, etc.
 - j. Warranty requirements.
 - k. Copies of all checkout tests, other than commissioning tests, and calibrations performed by the Contractor.
3. Field checkout sheets and trend logs should be provided to the GC for inclusion in the on-site Commissioning filing system.

C. Special TAB Documentation requirements: The TAB contractor shall compile and submit the following with other documentation that may be specified elsewhere in the Specifications.

1. The TAB contractor shall mark on the drawings where all traverse and other critical measurements were taken and cross reference the location in the TAB report.

3.3 TRAINING OF OWNER PERSONNEL

- A. The GC shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed.

- B. The GC shall be responsible for reviewing the content and adequacy of the training of Owner personnel for commissioned equipment or systems. CxA will verify compliance.
- C. Mechanical and Plumbing Contractor: The mechanical and plumbing contractors shall have the following training responsibilities for their commissioned systems:
 - 1. Provide the GC with a training plan 4 weeks before the planned training.
 - 2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of commissioned equipment.
 - 3. Training shall start with classroom sessions followed by hands on training on each piece of equipment.
 - 4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M Manual or sequence of operations, the system will be repaired or adjusted as necessary, and the demonstration repeated.
 - 5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment is required. More than 1 party may be required to execute the training.
 - 6. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.
 - 7. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M Manuals for reference.
 - 8. Training shall include:
 - a. Use the printed installation, operation, and maintenance instruction material included in the O&M Manuals.
 - b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
 - c. Discussion of relevant health and safety issues and concerns.
 - d. Discussion of warranties and guarantees.
 - e. Common troubleshooting problems and solutions.
 - f. Explanation of information included in the O&M Manuals.
 - g. Discussion of any peculiarities of equipment installation or operation.

- h. Classroom sessions shall include the use of overhead projections, slides, video/audio taped material as might be appropriate.
 - 9. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and maintenance of all pieces of equipment.
 - 10. Fully explain and demonstrate the operation, function, and overrides of any local packaged controls, not controlled by the central control system.
 - 11. Training shall occur after functional testing is complete, unless approved otherwise by the GC.
- D. Controls Contractor: The controls contractor shall have the following training responsibilities for their commissioned systems:
- 1. Provide the GC with a training plan 4 weeks before the planned training.
 - 2. The controls contractor shall provide designated Owner personnel training on the control system in this facility. The intent is to clearly and completely instruct the Owner on all the capabilities of the control system.
 - 3. Training manuals: The standard operating manual for the system and any special training manuals shall be provided for each trainee. In addition, copies of the system technical manual shall be demonstrated during training. Manuals shall include detailed description of the subject matter for each session. The manuals shall cover all control sequences and have a definitions section that fully describes all relevant words used in the manuals and in all software displays. Copies of audiovisuals shall be delivered to the Owner.
 - 4. The training sessions shall be tailored to the needs and skill-level of the trainees.
 - 5. The trainers shall be knowledgeable on the system and its use in buildings.
 - 6. Provide 2 training sessions structured as follows:
 - a. Building Systems: The first session shall be held on-site and consist of two (2) 4-hour sessions of actual hands-on training after the completion of system commissioning. The session shall include instruction on
 - 1) Specific hardware configuration of installed systems in this building and specific instruction for operating the installed system, including HVAC systems, lighting controls and any interface with security and communication systems.
 - 2) Security levels, alarms, system start-up, shut-down, power outage, and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
 - 3) All trending and monitoring features (values, change of state, totalization, etc.) including setting up, executing, downloading, viewing both tabular and graphically and printing trends. Trainees shall set-up trends in the presence of the trainer.

- 4) Every screen shall be completely discussed, allowing time for questions.
 - 5) Use of keypad or plug-in laptop computer via phone lines or networks.
 - 6) Use of remote access to the system via phone lines or networks.
 - 7) Setting up and changing an air terminal unit controller.
 - 8) Graphics generation.
 - 9) Point database entry and modifications.
 - 10) Understanding DDC field panel operating programming (when applicable).
- b. The second training will be conducted on-site 6 months after occupancy and will consist of 4 hours of training. The session shall be structured to address specific topics that trainees need to discuss and to answer questions concerning operation of the system.
- E. The TAB contractor shall have the following training responsibilities:
1. TAB shall meet for 2 hours with facility staff after completion of TAB and instruct them on the following:
 - a. Go over the final TAB report, explaining the layout and meanings of each data type.
 - b. Discuss any outstanding deficient items in control, ducting, or design that may affect the proper delivery of air or water.
 - c. Identify and discuss any terminal units, duct runs, diffusers, coils, fans, and pumps that are close to or are not meeting their design capacity.
 - d. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
 - e. Other salient information that may be useful for facility operations, relative to TAB.

END OF SECTION **230800**

230902 – BUILDING MANAGEMENT CONTROLS SYSTEM

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 MECHANICAL GENERAL PROVISIONS

- A. Control system shall be compatible with all related systems installed in the project including HVAC equipment, electrical wiring, fire alarm devices, campus LAN, Variable Frequency Drives, etc.
- B. Contractor shall coordinate with other trades to install complete operational system. Costs to correct any deficiencies in other work divisions shall be included in bid, unless A/E are notified in writing prior to bid. Examples of deficiencies shall include line voltage power, HVAC equipment controllers, etc.
- C. Contractor shall be qualified to install system and shall carry all factory certifications as recommended by manufacturer.
- D. Control system start-up shall be a required service to be completed by the manufacturer or a duly authorized, competent representative that has been factory trained in controls system configuration and operation. This service shall be equipment and system count dependent and shall be a minimum of one (1) eight (8) hour period to be completed during normal working hours.

1.2 INSTALLATION REQUIREMENTS

- A. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.
- B. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by the Control System Contractor in accordance with these specifications.
- C. Equipment furnished by the Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the Control System Contractor.
- D. All control devices mounted on the face of control panels shall be clearly identified as to function and system served with permanently engraved phenolic labels.

1.3 WIRING REQUIREMENTS

- A. All electrical control wiring to the control panels shall be the responsibility of the Installing Contractor.
- B. All wiring shall be in accordance with the Project Electrical Specifications (Division 26), the National Electrical Code and any applicable local codes. All control wiring shall be installed in raceways or plenum cable in concealed accessible or occupied locations.

1.4 SUMMARY

- A. Contractor shall modify existing building control system to accommodate new equipment shown on plans.
- B. Provide programming of existing campus JCI Metasys system to allow control of all new control points included in this project scope at existing campus front end interface.
- C. Scope: Furnish all labor, materials and equipment necessary for a complete and operating Building Management System (BMS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only. All controllers furnished in this section shall communicate with the Central Controller.
 - 1. System architecture shall fully support a multi-vendor environment and be able to integrate third party systems via existing vendor protocols including, as a minimum, BACnet, and Modbus.
 - 2. System architecture shall provide secure Web access using MS Internet Explorer from any computer on the owner's LAN or via remote access with secure login from web connected computer
 - 3. The BMS server shall host all graphic files for the control system.

1.5 SOFTWARE OWNERSHIP

- A. The Owner shall have full ownership and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BMS.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Maintain integrity of shipping cartons for each piece of equipment and control device through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.7 JOB CONDITIONS

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to insure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and architectural features.

1.8 QUALITY ASSURANCE

- A. The manufacturer of the BMS digital controllers shall, if requested, provide documentation supporting compliance with ISO-9001 (Model for Quality Assurance in Design/Development, Production, Installation and Servicing).
- B. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in the production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.

1.9 SPECIFICATION NOMENCLATURE - Acronyms used in this specification are as follows:

- | | | |
|----|------------|---|
| A. | Actuator: | Control device that opens or closes valve or damper in response to control signal. |
| B. | AI | Analog Input |
| C. | AO | Analog Output |
| D. | Analog | Continuously variable state over stated range of values |
| E. | BMS | Building Management System |
| F. | DDC | Direct Digital Control |
| G. | Discrete | Binary or digital state |
| H. | DI | Discrete Input |
| I. | DO | Discrete Output |
| J. | FC | Fail Closed position of control device or actuator. Device moves to closed position on loss of control signal or energy source. |
| K. | FO | Fail open (position of control device or actuator). Device moves to open position on loss of control signal or energy source. |
| L. | GUI | Graphical User Interface |
| M. | HVAC | Heating, Ventilating and Air Conditioning |
| N. | IDC | Interoperable Digital Controller |
| O. | ILC | Interoperable Lon Controller |
| P. | LAN | Local Area Network |
| Q. | Modulating | Movement of a control device through an entire range of values, proportional to an infinitely variable input value. |
| R. | Motorized | Control device with actuator |
| S. | NAC | Network Area Controller |

T.	NC	Normally closed position of switch after control signal is removed or normally closed position of manually operated valves or dampers.
U.	NO	Normally open position of switch after control signal is removed; or the open position of a controlled valve or damper after the control signal is removed; or the usual position of a manually operated valve.
V.	OSS	Operating System Server, host for system graphics, alarms, trends, etc.
W.	Operator	Same as actuator
X.	PC	Personal Computer
Y.	Peer-to-Peer	Mode of communication between controllers in which each device connected to network has equal status and each shares its database values with all other devices connected to network
Z.	P	Proportional control; control mode with continuous linear relationship between observed input signal and final controlled output element.
AA.	PI	Proportional-Integral control, control mode with continuous proportional output plus additional change in output based on both amount and duration of change in controller variable (reset control).
BB.	PICS	BACnet Product Interoperability Compliance Statement
CC.	PID	Proportional-Integral-Derivative control, control mode with continuous correction of final controller output element versus input signal based on proportional error, its time history (reset) and rate at which it's changing (derivative).
DD.	Point	Analog or discrete instrument with addressable database value
EE.	SNC	System Network Controller
FF.	WAN	Wide Area Network

PART 2 – PRODUCTS

2.1 GENERAL

- A. The Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, a network area controller, graphics and programming, and other control devices for a complete system as specified herein.
- B. The installed system shall provide secure password access to all features, functions and data contained in the overall BMS.

2.2 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURE

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system utilizing various communication protocols in one open, interoperable system.
- B. The supplied system must incorporate the ability to access all data using standard web browsers without requiring proprietary operator interface and configuration programs. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on the Operating System Server provided by the controls contractor. Systems requiring proprietary database and user interface programs shall not be acceptable. All data stored will be through the use of a standard data base platform: Microsoft SQL Server Express or Microsoft SQL Server.
- C. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
 1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.

2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or connected user interfaces.

2.3 SYSTEM NETWORK CONTROLLER (SNC)

- A. These controllers are designed to manage communications between the programmable equipment controllers (PEC), application specific controllers (ASC), and advanced unitary controllers (AUC), and central controllers (CC) which are connected to its communications trunks, manage communications between itself and other system network controllers (SNC) and with any operator workstations (OWS) that are part of the BAS, and perform control and operating strategies for the system based on information from any controller connected to the BAS.
- B. The controllers must be fully programmable to meet the unique requirements of the facility it must control.
- C. The controllers must be capable of peer-to-peer communications with other SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via modem or connected via the Internet.
- D. The communication protocols utilized for peer-to-peer communications between SNC's will be BACnet, TCP/IP and SNMP. Use of a proprietary communication protocol for peer-to-peer communications between SNC's is not allowed.
- E. The SNC shall be capable of executing application control programs to provide:
 1. Calendar functions
 2. Scheduling
 3. Trending
 4. Alarm monitoring and routing
 5. Time synchronization
 6. Integration of BACnet, and ModBus controller data
 7. Network management functions for all SNC, PEC and ASC based devices
- F. The SNC must provide the following hardware features as a minimum:
 1. One Ethernet Port-10/100 Mbps
 2. One RS-232/485 port
 3. Battery Backup
 4. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
 5. Network connection to all HVAC equipment so that all input and output points used by HVAC equipment and specified on plans are communicated to/from SNC.
 6. 120V, power supply with NEMA 5-20P or NEMA 5-15P cord and plug.
- G. The SNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.
- H. The SNC shall provide alarm recognition, storage, routing, management and analysis to supplement distributed capabilities of equipment or application specific controllers.
- I. The SNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via wide-area network.
 1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
 - a. Alarm.
 - b. Return to normal.

- c. To default.
- 2. Alarms shall be annunciated in any of the following manners as defined by the user:
 - a. Screen message text.
 - b. Email or SMS text message of complete alarm message to multiple recipients.
 - c. Pagers via paging services that initiate a page on receipt of email message.
 - d. Graphics with flashing alarm object(s).
- 3. The following shall be recorded by the SNC for each alarm (at a minimum):
 - a. Time and date
 - b. Equipment (air handler #, auditorium, etc.)
 - c. Acknowledge time, date, and user who issued acknowledgement.
- J. Programming software and all controller "Setup Wizards" shall be embedded into the SNC.

2.4 CENTRAL CONTROLLER (CC)

- A. The control system shall consist of a low voltage communication network of unitary built-in controllers with on-board communications and a web-based operator interface. A web controller with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.
- B. System controls and control components shall be installed in accordance with the manufacturer's written installation instructions.
- C. Furnish energy conservation features such as optimal start, night setback, request-based logic, and demand level adjustment of overall system capacity as specified in the sequence.
- D. System shall provide direct and reverse-acting on and off algorithms based on an input condition or group conditions to cycle a binary output or multiple binary outputs.
- E. Provide capability for future system expansion to include monitoring and use of occupant card access, lighting control and general equipment control.
- F. System shall be capable of email generation for remote alarm annunciation.

PART 3 BAS SERVER & WEB BROWSER GUI

3.1 SYSTEM OVERVIEW

- A. The BAS Contractor shall provide system software based on server/thin-client architecture, designed around the open standards of web technology. The BAS server shall communicate using Ethernet and TCP/IP. Server shall be accessed using a web browser over Owner intranet and remotely over the Internet.
- B. The intent of the thin-client architecture is to provide the operator(s) complete access to the BAS system via a web browser. The thin-client web browser Graphical User Interface (GUI) shall be browser and operating system agnostic, meaning it will support Microsoft browsers, and Windows as well as non-Windows operating systems.
- C. The BAS server software shall be developed and tested by the manufacturer of the system stand-alone controllers and network controllers/routers.
- D. The web browser GUI shall provide a completely interactive user interface and must offer and be configured with the following features as a minimum:
 - 1. Trending
 - 2. Scheduling
 - 3. Electrical demand limiting

4. Duty Cycling
 5. Downloading Memory to field devices
 6. Real time 'live' Graphic Programs
 7. Tree Navigation
 8. Parameter change of properties
 9. Setpoint Adjustments
 10. Alarm / Event information
 11. Configuration of operators
 12. Execution of global commands
 13. Add, delete, and modify graphics and displayed data
- E. Software Components: All software shall be the most current version. All software components of the BAS system software shall be provided and installed as part of this project. BAS software components shall include:
1. Server Software, Database and Web Browser Graphical User Interface
 2. System Configuration Utilities for future modifications to the system, and controllers.
 3. Graphical Programming Tools
 4. Direct Digital Control software
 5. Application Software
 6. Any required third party software
 7. If licensing credits are required provide a minimum of 10% additional to as built control system requires.
- F. BAS Server Database: BAS systems written to Non -Standard and/or Proprietary databases are NOT acceptable.
- G. Database Open Connectivity: The BAS server database shall allow real time access of data via the following standard mechanisms:
1. Open protocol standard like SOAP
 2. OLE/OPC (for Microsoft Client's/Server platform only)
 3. Import/Export of the database from or to XML (eXtensible Mark-up Language)
- H. Communication Protocol(s): The native protocol for the BAS server software shall be TCP/IP over Ethernet.
- I. Thin Client – Web Browser Based: The GUI shall be thin client or browser based and shall meet the following criteria:
1. Web Browser's for PC's: Only a 5.5 or later browser (Explorer/Navigator) will be required as the GUI, and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet.
 2. Secure Socket Layers: Communication between the Web Browser GUI and BAS server shall offer encryption using 128-bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper-Text Transfer Protocol (HTTP)

3.2 WEB BROWSER GRAPHICAL USER INTERFACE

- A. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application, and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish requirements of this specification. The Web Browser GUI shall (as a minimum) provide for navigation, and for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic setpoint controls, configuration menus for operator access, reports, and reporting actions for events.

- B. Login: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and password. Navigation in the system shall be dependent on the operator's role privileges, and geographic area of responsibility.
- C. Navigation: Navigation through the GUI shall be accomplished by clicking on or by selecting dynamic links to other system graphics. Both the navigation and action pane shall be displayed simultaneously, enabling the operator to select a specific system or equipment, and view the corresponding graphic. The navigation shall as a minimum provide the following views: Geographic, Principal Systems, Users, Trends and Alarms.
1. Geographic View shall display a logical geographic hierarchy of the system including: cities, sites, buildings, building systems, floors, equipment and objects.
- D. Action Pane: The Action Pane shall provide several functional views for each HVAC or mechanical/electrical subsystem specified. A functional view shall be accessed by clicking on the corresponding button:
1. Graphics: Using graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color 3D building floor-plans, equipment drawings, active graphic setpoint controls, web content, and other valid HTML elements. The data on each graphic page shall automatically refresh.
 2. Properties: Shall include graphic controls and text for the following: Locking or overriding objects, demand strategies, Setback, Alarm Settings, Set Temperature Range Limits, Schedule options, Equipment error codes, Wall Controller lock outs, and any other valid data required for setup.
 3. Schedules: Shall be used to create, modify/edit and view schedules based on the systems geographical hierarchy or site specific schedules.
 4. Alarms: Shall be used to view alarm information, acknowledge alarms, sort alarms by category, actions and verify reporting actions.
 5. Trends: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling
- E. Color Graphics: The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to setpoints and comfort. Animated .gifs or .jpg, vector scalable, active setpoint graphic controls shall be used to enhance usability. Graphics tools used to create Web Browser graphics shall be non-proprietary and conform to the following basic criteria:
1. Display Size: The GUI workstation software shall graphically display in 1900 by 1080 (minimum) pixels 24 bit True Color.
 2. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.
 3. Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, as selected by Owner. Provide a visual display of temperature relative to their respective setpoints. The colors shall be updated dynamically as a zone's actual comfort condition changes.
 4. Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability.
 5. Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:
 - a. Each piece of equipment monitored or controlled including each terminal unit
 - b. Each building
 - c. Each floor and zone controlled
- F. Hierarchical Schedules: Utilizing the Navigation page displayed in the web browser GUI, an operator (with password access) shall be able to define a Normal, Holiday or Override schedule for an individual piece of equipment or room, or choose to apply a hierarchical schedule to the entire system, site or floor area. For example, Independence Day 'Holiday' for every level in the system would be created by clicking at the top of the

geographic hierarchy defined in the Navigation page. No further operator intervention would be required and every control module in the system would be automatically downloaded with the 'Independence Day' Holiday. All schedules that affect the system/area/equipment highlighted in the Navigation page shall be shown in a summary schedule table and graph.

1. Schedules: Schedules shall comply with the following features:
 - a. Types of schedule shall be Normal, Holiday or Override
 - b. A specific date,
 - c. A range of dates,
 - d. Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any)
 - e. Wildcard (example, allow combinations like second Tuesday of every month).
 2. Schedule Categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include: name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.
 3. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional Schedule Groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the operator shall be able to define an 'individual tenant' group – who may occupy different areas within a building or buildings. Schedules applied to the 'tenant group' shall automatically be downloaded to control modules affecting spaces occupied by the 'tenant group'
 4. Partial Day Exceptions: Schedule events shall be able to accommodate a time range specified by the operator (ex: board meeting from 6 pm to 9 pm overrides Normal schedule for conference room).
- G. Alarms: Alarms associated with a specific system, area, or equipment selected in the Navigation Tree, shall be displayed in the Action Pane by selecting an 'Alarms' view. Alarms, and reporting actions shall have the following capabilities:
1. Alarms View: Each Alarm shall display an Alarms Category (using a different icon for each alarm category), date/time of occurrence, current status, alarm report, and a bold URL link to the associated graphic for the selected system, area or equipment. The URL link shall indicate the system location, address and other pertinent information. An operator shall easily be able to sort events, edit event templates and categories, acknowledge or force a return to normal in the Events View as specified in this section.
 2. Alarm Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.
 3. Alarm Configuration: Operators shall be able to define the type of Alarm generated per object. A 'network' view of the Navigation shall expose all objects and their respective Alarm Configuration. Configuration shall include assignment of Alarm, type of Acknowledgement and notification for return to normal or fault status.
 4. Alarm Summary Counter: The view of Alarm in the Graphic Pane shall provide a numeric counter, indicating how many Alarms are active (in alarm), require acknowledgement, and total number of Alarms in the BAS Server database.
 5. Alarm Auto-Deletion: Alarms that are acknowledged and closed shall be auto-deleted from the database and archived to a text file after an operator defined period.
 6. Alarm Reporting Actions: Alarm Reporting Actions specified shall be automatically launched (under certain conditions) after an Alarm is received by the BAS server software. Operators shall be able to easily define these Reporting Actions using the Navigation Tree and Graphic Pane through the web browser GUI. Reporting Actions shall be as follows:
 - a. Print: Alarm information shall be printed to the BAS server's PC or a networked printer.

- b. Email: Email shall be sent via any POP3-compatible e-mail server (most Internet Service Providers use POP3). Email messages may be copied to several email accounts. Note: Email reporting action shall also be used to support alphanumeric paging services, where email servers support pagers.
 - c. File Write: The ASCII File write reporting action shall enable the operator to append operator defined alarm information to any alarm through a text file. The alarm information that is written to the file shall be completely definable by the operator. The operator may enter text or attach other data point information (such as AHU discharge temperature and fan condition upon a high room temperature alarm).
 - d. Write Property: The write property reporting action updates a property value in a hardware module.
 - e. SNMP: The Simple Network Management Protocol (SNMP) reporting action sends an SNMP trap to a network in response to receiving an alarm.
 - f. Run External Program: The Run External Program reporting action launches specified program in response to an event.
- H. Trends: Trends shall both be displayed and user configurable through the Web Browser GUI. Trends shall comprise analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.
 - 1. Contractor shall provide hard drive storage space for storage of trends. Trend settings shall be customizable, but hard drive storage shall be based upon the following values.
 - a. 6 Months of Historical Trending
 - b. 15 Minute Sample Intervals
 - c. Thermostat Setpoints
 - d. Equipment Run Status
 - e. Equipment Fan Status
 - f. Space Temperature
 - g. Space Humidity
 - h. Outside Air Temperature
 - i. Outside Air Humidity
 - j. Equipment Discharge Air Temperature (Where point is specified on Plans)
 - 2. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Tree and selecting a Trends button in the Graphic Pane. The system shall allow y- and x-axis maximum ranges to be specified and shall be able to simultaneously graphically display multiple trends per graph.
 - 3. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the BAS server if historical trending is enabled for the object. Trend data, including run time hours and start time date shall be retained in non-volatile module memory. Systems that rely on a gateway/router to run trends are NOT acceptable.
 - 4. Resolution. Sample intervals shall be as small as one second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for displays that have different trend intervals, the system will automatically scale the axis.
 - 5. Dynamic Update. Trends shall be able to dynamically update at operator-defined intervals.
 - 6. Zoom/Pan. It shall be possible to zoom-in on a particular section of a trend for more detailed examination and 'pan through' historical data by simply scrolling the mouse.
 - 7. Numeric Value Display. It shall be possible to pick any sample on a trend and have the numerical value displayed.

8. Copy/Paste. The operator must have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard keystrokes (i.e. CTRL+C, CTRL+V).
- I. Security Access: Systems that Security access from the web browser GUI to BAS server shall require a Login Name and Password. Access to different areas of the BAS system shall be defined in terms of Roles, Privileges and geographic area of responsibility as specified:
 1. Roles: Roles shall reflect the actual roles of different types of operators. Each role shall comprise a set of 'easily understood English language' privileges. Roles shall be defined in terms of View, Edit and Function Privileges.
 - a. View Privileges shall comprise: Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.
 - b. Edit Privileges shall comprise: Setpoint, Tuning and Logic, Manual Override, and Point Assignment Parameters.
 - c. Function Privileges shall comprise: Alarm/Event Acknowledgement, Control Module Memory Download, Upload, Schedules, Schedule Groups, Manual Commands, Print, and Alarm/Event Maintenance.
 2. Geographic Assignment of Roles: Roles shall be geographically assigned using a similar expandable/collapsible navigation tree. For example, it shall be possible to assign two HVAC Technicians with similar competencies (and the same operator defined HVAC Role) to different areas of the system.

3.3 GRAPHICAL PROGRAMMING

- A. The system software shall include a Graphic Programming Language (GPL) for all DDC control algorithms resident in all control modules. Any system that does not use a drag and drop method of graphical icon programming shall not be accepted. All systems shall use a GPL is a method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence. Microblocks represent common logical control devices used in conventional control systems, such as relays, switches, high signal selectors, etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents.
- B. Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.
- C. Graphic Sequence: The clarity of the graphic sequence must be such that the operator has the ability to verify that system programming meets the specifications, without having to learn or interpret a manufacturer's unique programming language. The graphic programming must be self-documenting and provide the operator with an understandable and exact representation of each sequence of operation.
- D. GPL Capabilities: The following is a minimum definition of the capabilities of the Graphic Programming software:
 1. Function Block (FB): Shall be a collection of points, microblocks and wires which have been connected together for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.
 2. Logical I/O: Input/Output points shall interface with the control modules in order to read various signals and/or values or to transmit signal or values to controlled devices.
 3. Microblocks: Shall be software devices that are represented graphically and may be connected together to perform a specified sequence. A library of microblocks shall be submitted with the control contractors bid.
 4. Wires: Shall be Graphical elements used to form logical connections between microblocks and between logical I/O.

5. Reference Labels: Labels shall be similar to wires in that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection, i.e. two points labeled 'A' on a drawing are logically connected even though there is no wire between them.
6. Parameter: A parameter shall be a value that may be tied to the input of a microblock.
7. Properties: Dialog boxes shall appear after a microblock has been inserted which has editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields, and shall contain 'push buttons' for the purpose of selecting default parameter settings.
8. Icon: An icon shall be graphic representation of a software program. Each graphic microblock has an icon associated with it that graphically describes its function.
9. Menu-bar Icon: Shall be an icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.
10. Live Graphical Programs: The Graphic Programming software must support a 'live' mode, where all input/output data, calculated data, and setpoints shall be displayed in a 'live' real-time mode.

PART 4 PROJECT CLOSEOUT

4.1 ACCEPTANCE TESTING

- A. Upon completion of the installation, the Control System Contractor shall load all system software and start-up the system. The Control System Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.
- B. The Control System Contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.
- C. System Acceptance: Satisfactory completion is when the Control System Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

4.2 OPERATOR TRAINING

- A. During system commissioning and at such time acceptable performance of the Control System hardware and software has been established, the Control System Contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.
- B. The Control System Contractor shall provide comprehensive training for system orientation, product maintenance and troubleshooting, programming and engineering, if not provided under a previous contract at the site using the same brand and type of controllers within the previous 3 years.
- C. The Control System Contractor shall provide instruction to the owner's designated personnel on the operation of the BMS and describe its intended use with respect to the programmed functions specified. Operator orientation of the BMS shall include, but not be limited to; the overall operation program, equipment functions (both individually and as part of the total integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the System's operation

4.3 WARRANTY PERIOD SERVICES

- A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.
- B. Within this period, upon notice by the Owner, any defects in the BMS due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the Installing Contractor at no expense to the Owner

- C. Maintenance of Computer Software Programs: The Installing Contractor shall maintain all software during the warranty period. In addition, all factory or sub-vendor upgrades to software shall be added to the systems, when they become available, at no additional cost. New products are not considered upgrades in this context.
- D. Maintenance of Control Hardware: The Installing Contractor shall inspect, repair, replace, adjust, and calibrate, as required, the controllers, control devices and associated peripheral units during the warranty period. The Installing Contractor shall then furnish a report describing the status of the equipment, problem areas (if any) noticed during service work, and description of the corrective actions taken. The report shall clearly certify that all software is functioning correctly.
- E. Service Period: Calls for warranty service by the Owner shall be honored within 24 hours, during business time, and are not to be considered as part of routine maintenance.
- F. Service Documentation: A copy of the service report associated with each owner-initiated warranty service call shall be provided to the owner.

4.4 WARRANTY ACCESS

- A. The Owner shall grant Controls Contractor remote access to the BMS. Remote access to the BMS will be provided for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period.

4.5 OPERATION & MAINTENANCE MANUALS

- A. See Division 1 for requirements. O&M manuals shall include the following elements, as a minimum:
 - 1. As-built control drawings for all equipment.
 - 2. As-built Network Communications Diagram.
 - 3. General description and specifications for all components.
 - 4. Completed Performance Verification sheets.
 - 5. Completed Controller Checkout/Calibration Sheets.

232113 – HVAC PIPING AND SPECIALTIES

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 PIPING INSTALLATIONS

- A. Provide piping material for use as listed in piping materials schedule shown on plans.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve services
- F. Install piping free from sags and bends
- G. Install fittings for changes in direction and branch connections.
- H. Install piping to allow application of insulation.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install groups of pipes parallel to each other spaced to permit application of insulation and servicing of valves.
- K. Install drains, consisting of a tee fitting, NPS 0.75" ball valve and short NPS 0.75" threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- L. Install piping at uniform grade of 0.2 percent upward in direction of flow.
- M. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- N. Install branch connections to mains using mechanically formed tee fittings in main pipe with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- O. Install unions in piping 2" and smaller, adjacent to valves, at final connections of equipment and at other locations noted on plans.
- P. Install flanges in piping 2.5" and larger at final connections of equipment and elsewhere as indicated
- Q. Install strainers on inlet side of each control valve, pressure reducing valve, solenoid valve, in-line pump and at other locations noted on plans. Install 0.75" nipple and ball valve in blowdown connection of strainers 2" and larger. Match size of strainer blowoff connection for strainers smaller than 2".
- R. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment".

1.2 STEAM SPECIFIC SYSTEM INSTALLATION REQUIREMENTS

- A. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers and ahead of pressure regulators and control valves. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 300 feet. Size drip legs at the same size as main. In steam mains 6" and larger, drip leg size can be reduced, but to no less than 4".
- B. Flash Tank:
 - 1. Pitch condensate piping down toward utility tunnel
 - 2. Install thermostatic air vent at top of system.
 - 3. Install safety valve at top of system.
 - 4. Install full port ball valve and swing check valve on condensate outlet.
 - 5. Install inverted bucked trap at low pressure condensate outlet, sized for three times the rated heat load.
 - 6. Install pressure gauge on steam outlet.

- C. Steam Traps shall be installed in accessible locations as close as possible to connected equipment. Install full port ball valve downstream from trap unless otherwise indicated.

1.3 HANGERS AND SUPPORTS

- A. Copper and Steel Pipe hangers and pipe supports shall be installed with the following maximum spacing and minimum rod sizes.

1.	0.75" Pipe	- Max Span 5'	- Minimum Rod Size 3/8"
2.	1" Pipe	- Max Span 6'	- Minimum Rod Size 3/8"
3.	1.25" Pipe	- Max Span 7'	- Minimum Rod Size 3/8"
4.	1.5" Pipe	- Max Span 8'	- Minimum Rod Size 3/8"
5.	2" Pipe	- Max Span 8'	- Minimum Rod Size 3/8"
6.	2.5" Pipe	- Max Span 9'	- Minimum Rod Size 1/2"
7.	3" Pipe	- Max Span 10'	- Minimum Rod Size 1/2"
8.	4" Pipe	- Max Span 14'	- Minimum Rod Size 5/8"
9.	5" Pipe	- Max Span 16'	- Minimum Rod Size 5/8"
10.	6" Pipe	- Max Span 17'	- Minimum Rod Size 3/4"
11.	8" Pipe	- Max Span 19'	- Minimum Rod Size 3/4"

- B. Support vertical piping runs at roof, each floor and at 10 foot intervals between floors.

1.4 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered joints: Apply ASTM B813 water-flushable flux to tube end unless otherwise indicated. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook." Using lead free solder allow complying with ASTM B 32.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook", "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full interior diameter. Join pipe fittings as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Welded Joints: Construct joints according to ASW D10.12/D10.12M, using qualified processes and welding operators according to specified quality assurance requirements.
- G. Flanged Joints: Select appropriate gasket material, size, type and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. Plastic Piping Solvent Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following.
1. Comply with ASTM F402 for safe handling practice of cleaners, primers and solvent cements.
 2. CPVC piping: Join according to ASTM D 2846/D 2846M Appendix.
 3. PVC Pressure Piping: Join schedule 40, 80 and 120 according to ASTM D 2672. Join other-than-schedule number 40, 80 and 120 PVC pipe and socket fittings according to ASTM D 2855.

4. 4.PVC Non-pressure Piping: Join according to ASTM D 2855.

- I. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions

1.5 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils and elsewhere as required for system venting. Provide 0.5" copper drain line run to nearest floor drain, drain line or coil drain pan. Provide tee handle cock in air vent line located in an accessible unfinished area. Where air vent above ceilings cannot be made accessible to an exposed location a 12" inch by 12" inch access panel shall be provided at drain cock.
- B. Install piping from boiler air outlet, air separator or air purger to expansion tank with a 2 percent upward slope toward tank.
- C. Install tangential air separator in pump suction. Install blowdown piping with gate or full port ball valve, extend full size drain to nearest floor drain.
- D. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48" above finished floor. Install feeder in minimum 0.75" bypass line, from main with full size, full port ball valve in the main between bypass connections. Install 0.75" pipe from chemical feeder drain to nearest equipment drain and include a full size, full port ball valve.
- E. Suspended Expansion Tank: Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
 - 1. Install tank fittings that are shipped loose.
 - 2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components or structural members.
- F. Floor mounted Expansion Tank: Install expansion tank on floor. Vent and purge air from hydronic system and ensure tank is properly charged with air to suit system requirements.

1.6 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gauges and thermometers at coil inlet as outlet connections.

1.7 PIPE EXPANSION

- A. Provide expansion joints, expansion loops, anchors and guides as required for proper control of expansion and contraction of piping. Piping from mains to equipment branches and risers shall be provided with swing, swivel joints or offsets to relieve stresses due to expansion or contraction of piping.
- B. Provide pipe loops as shown on drawings or specified. Where pipe loop dimensions are not shown on plans they shall be as recommended by pipe manufacturer based on thermal expansion.
- C. Expansion Joints Specified below shall comply with the following:
 - 1. Install expansion joints of sizes matching sizes of piping in which they are installed
 - 2. Install packed type expansion joints with packing suitable for fluid service
 - 3. Install metal bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturer's Association, Inc."
 - 4. Install rubber packless joints according to FSA-NMEJ-702.
 - 5. Install grooved joint expansion joints to grooved-end steel piping.
- D. Expansion loops shall comply with the following:

1. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- E. Alignment guide anchors specified below shall comply with the following:
1. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
 2. Install two guides on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
 3. Install anchors at locations required to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of location and stresses to connected equipment.

1.8 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
1. Leave joints, including welds, uninsulated and exposed for examination during test.
 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 3. Flush hydronic piping systems with clean water, then remove and clean or replace strainer screens.
 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on all piping:
1. Hydrostatic Test:
 - a. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - b. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 - c. Isolate expansion tanks and determine that hydronic system is full of water.
 - d. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 - e. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 2. Procedures required by authority having jurisdiction that exceed requirements of tests listed above shall be performed by contractor to obtain system acceptance.
- C. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. Inspect air vents at high points of system and determine if all are installed and bleed air completely.
 5. Set temperature controls so all coils are calling for full flow.

6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 7. Verify lubrication of motors and bearings.
- D. After testing:
1. Adjust set point temperature of all HVAC equipment to system design temperatures. Temperatures shall be as listed on drawings or as directed by owner.

PART 2 – PRODUCTS

2.1 PIPING

A. Copper Tube:

1. Provide hard temper copper water tubing conforming to ASTM B 88. Tubing shall be type K, L or M as listed in schedule.
2. Tubing joints shall be soldered or brazed as indicated in schedule.

B. DWV Copper Tube:

1. Type M DWV copper tubing shall conform to ASTM B 306, type DWV.

C. ACR Copper Tubing:

1. Provide hard temper nitrogenized seamless copper refrigerant tubing conforming to ASTM B 88. Tube shall be L or K as listed in schedule.
2. Tubing shall be brazed or grooved joints manufactured to copper tube dimensions. Flaring tubing ends to accommodate alternate sized couplings is not allowed.
3. Type ACR soft copper tubing conforming to ASTM B 280 shall be allowed for connection between VRF air handlers nominal size 0 to 5 tons, and branch selector/controller boxes, as allowed by air handler manufacturer.

D. Steel Pipe:

1. Steel pipe shall conform to ASTM A53 and shall be black steel with plain ends. Type, grade and wall thickness shall be as indicated in piping materials schedule.

E. Plastic Pipe:

1. PVC Plastic pipe shall conform to ASTM D 1785. Piping shall be schedule 40 or schedule 80 as listed in schedule.
2. CPVC Plastic pipe shall conform to ASTM F 438 for schedule 40 pipe and ASTM F 439 schedule 80 pipe.

F. Polyethylene (PE) Pipe:

1. Conform to ASTM D 2239, with SDR numbers 5.3, 7, 9 or 11.5 with PE compound number required to achieve required system working pressure.
2. U-Bend Assembly shall be factory fabricated with embossed depth stamp every 36" from U-Bend.

2.2 FITTINGS

A. Wrought Copper Fittings:

1. Provide wrought solder joint copper tube fitting conforming to ANSI B 16.22

B. Cast Iron Threaded Fittings:

1. Conform to ASME B 16.4 with classes as indicated on piping material schedule.

C. Nickel Copper Alloy Steel Welding Fittings:

1. Provide nickel copper alloy steel welding fittings conforming to ANSI B16.9 and ASTM A234.

- D. Steel piping fittings:
1. Wrought Steel Fittings:
 - a. Provide carbon steel fittings conforming to ASTM A 234/A 2345M with wall thickness to match adjoining pipe.
 2. Wrought Cast and Forged Steel Flanges:
 - a. Fittings shall conform to ASME B 16.5 including bolts nuts and gaskets of material group 1.1. End connections shall be butt welded and facings shall be raised face type.
- E. Cast Bronze Fittings:
1. Cast bronze fittings shall be solder joint type conforming to ANSI B 16.18.
- F. Plastic piping Fittings:
1. PVC Plastic Pipe
 - a. Socket type fittings conforming to ASTM D 2466 for schedule 40 and ASTM D 2467 for schedule 80.
 2. CPVC Plastic Pipe
 - a. Socket type fittings conforming to ASTM F 438 for Schedule 40 and ASTM F 439 for Schedule 80.
- G. Polyethylene (PE) fittings:
1. Molded PE fittings conforming to ASTM D 2683 or ASTM D 3261 made with PE resin and socket or butt fusion type made to match PE pipe dimensions and class.

2.3 JOINING MATERIALS

- A. Pipe flange gasket materials shall be suitable for chemical and thermal conditions of piping system contents. Provide 1/8" maximum thickness, nonmetallic, flat, asbestos free material conforming to ASME B 16.21.
- B. Flange bolts and nuts shall conform to ASME B18.2.1 and shall be carbon steel unless otherwise noted.
- C. Plastic pipe flange gasket bolts and nuts shall be type and material recommended by piping system manufacturer.
- D. Solder filler metals shall conform to ASTM B 32 and shall be lead free alloys that include water flushable flux according to ASTM B 813.
- E. Brazing filler metals shall conform to AWS A 5.8 BCuP series and shall be copper phosphorus alloys for joining copper with copper or Bag-1 silver alloy for joining copper with bronze or steel.
- F. Welding filler materials shall comply with ASW D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements for Joining Plastic Pipe:
1. CPVC piping cements shall conform to ASTM F 493.
 2. PVC piping solvent cements shall conform to ASTM D 2564. Include primer complying with ASTM F 656.
- H. Gasket material thickness, material and type shall be suitable for fluid to be handled and working temperatures and pressures.

2.4 TRANSITION FITTINGS

- A. Plastic to Metal Transition Fittings:
1. Provide one piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.
- B. Plastic to Metal Transition Unions:
1. Provide MSS SP-107 union. Include brass or copper end, schedule 80 solvent cement joint end, rubber gasket and threaded union.

2.5 DIELECTRIC FITTINGS

- A. Fittings shall be combination fitting of copper alloy and ferrous materials with threaded solder joint plain or weld neck end connections that match piping system materials.
- B. Insulating material shall be suitable for system fluid, pressure and temperature
- C. Dielectric unions:
 - 1. Provide factory fabricated union assembly with pressure and temperature rating suitable for system operating range.
- D. Dielectric Flanges:
 - 1. Provide factory fabricated companion flange assembly with pressure and temperature rating suitable for system operating range.
- E. Dielectric Coupling:
 - 1. Provide galvanized steel coupling with inert and non-corrosive thermoplastic lining and threaded ends. Coupling shall have pressure and temperature rating suitable for system operating range.
- F. Dielectric Nipples:
 - 1. Provide electroplated steel nipple with inert and noncorrosive, thermoplastic lining, plain, threaded or grooved ends. Nipples shall have pressure and temperature rating suitable for system operating range.

2.6 AIR CONTROL DEVICES

- A. Air Vents: Manual air vents shall be equipped with bronze body, non-ferrous material for all internal parts, thumbscrew operator, 0.5" inlet connection, 1/8" discharge connection, 150 PSI CWP rating and 225 degree F maximum operating temperature.
- B. Air Separator: Tangential type air separator shall be welded steel ASME constructed tank labeled for 125 PSI minimum working pressure and 375 degree F maximum operating temperature. Air collector tube shall be stainless steel constructed to release air into expansion tank.
- C. Air Purger: Air purgers shall have one-piece cast iron tank with an integral weir constructed to decelerate system flow to maximize air separation. Maximum working pressure shall be up to 175 PSI and maximum operating temperature shall be up to 300 degrees.
- D. Vacuum Breakers: Vacuum breakers shall have cast iron body, threaded end connections, stainless steel sealing ball, EPR O-Ring and pressure and temperature rating suitable for system operating range.

2.7 EXPANSION TANK

- A. Tank shall be welded steel rated for 125 PSI working pressure and 240 degree F maximum operating temperature. Tank shall be factory tested with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII Division I.
- B. Diaphragm shall be securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
- C. Tank shall be equipped with Schrader valve, stainless steel air charge fitting with EPDM seats.

2.8 HYDRONIC PIPING SPECIALTIES

- A. Basket Strainers: Basket strainers shall have cast iron body with bolted cover and bottom drain connection. Provide threaded connection for 2" and smaller and flanged connection for 2.5" connection and larger. Provide mesh strainer screen and perforated stainless steel basket. Strainer shall be rated for operating pressure of system.
- B. Flexible Connection: Flexible connections shall be stainless steel bellows type connections with woven, flexible bronze, wire reinforcing protective jacket. Provide threaded or flanged connections to match equipment connected. Connection shall be capable of 0.75" misalignment with maximum operating temperature of 250 degrees F. Connection shall be rated for operating pressure of system.

2.9 PACKLESS EXPANSION JOINTS

- A. Metal Compensator: Expansion joints shall have 2-ply phosphor bronze bellows, brass shrouds and end fittings for copper piping systems and 2-ply stainless steel bellows, carbon steel shrouds and end fittings for steel piping systems. Expansion compensators shall have internal guides, anti-torque device and removable end clip for proper positioning.

2.10 EXPANSION LOOPS

- A. Provide pipe expansion loop constructed of main pipe material. Acceptable methods include use of elbows in a U or Z shape as defined by ASHRAE or ASME; or a detailed stress analysis may be utilized to define areas of expansion.

2.11 ALIGNMENT GUIDES AND ANCHORS

- A. Provide steel, factory fabricated alignment guide with bolted two-section outer cylinder and base for attaching to structure; with two section guiding spider for bolting to pipe.
- B. Anchors shall be mechanically fastened with tension and shear capacities appropriate for application.

FINAL REVIEW
NOT FOR
CONSTRUCTION

233113 – HVAC DUCTWORK

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 INSTALLATION REQUIREMENTS

- A. Install ducts according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible" unless otherwise indicated.
- B. Protect all ducts and fittings from exposure to moisture prior to installation.
- C. Exposed round ductwork shall be double wall spiral.
- D. Install round or flat oval ducts in maximum practical lengths.
- E. Install ducts with fewest possible joints.
- F. Flat oval ducts: Indicated dimensions are the duct width and diameter of the round sides connecting the flat portions of the duct.
- G. In the event that a conflict is identified between duct size shown on plans, and building structure or finish ceiling, contractor shall modify duct routing and length-width ratio as required to resolve conflict. Contractor shall have option to modify exact duct configuration for this purpose provided the static pressure, and duct velocity matches performance of specified duct. All modifications shall be clearly marked on as built documents.
- H. Install shop or factory fabricated fittings for changes in direction, size and shape and for branch connections.
- I. Unless otherwise noted, install ducts vertically and horizontally and parallel and perpendicular to building lines.
- J. Install ducts close to walls, overhead construction, columns and other structural and permanent enclosure elements of building.
- K. Install ducts with a clearance of 1" plus allowance for insulation thickness. Sizes noted on plans indicate free area of duct for airflow. Add additional thickness for insulation as noted in duct insulation schedule.
- L. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures, unless specifically noted on plans. Ducts shall not be allowed to pass over electrical panels.
- M. Where ducts pass through non-fire-rated partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1.5 inches.
- N. Where ducts pass through fire rated interior partitions and exterior walls, install fire dampers.
- O. During construction, protect duct interiors from moisture, construction debris and dust and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."
- P. Visually inspect duct system to ensure that no visible contaminants are present after installation is complete.

1.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched or damaged.
- B. All exposed ducts shall be painted to match adjacent building finishes.
- C. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- D. Grind welds to provide smooth surface free of burrs, sharp edges and weld splatter. Remove all discoloration caused by welding.
- E. Maintain consistency, symmetry and uniformity in the arrangement and fabrication of fittings hangers and supports, duct accessories and air outlets.

1.3 DUCT SEALING

- A. Ducts shall be sealed in accordance with table 1.2 of SMACNA's "HVAC Duct Construction Standards – Metal and Flexible". The allowable air leakage shall be in compliance with SMACNA standards for each respective duct pressure class and duct seal class.
- B. All duct pressure classes shall be equal or greater to the external static pressure of the equipment supply the duct. The applicable pressure class shall be maintained throughout entire system.
- C. Spiral lock seams in round or flat oval ducts are not required to be sealed.
- D. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible"
 - 1. Outdoor Supply Air Ducts: Seal Class A
 - 2. Outdoor Exhaust Air Ducts: Seal Class C
 - 3. Outdoor Return Air Ducts: Seal Class C
 - 4. Unconditioned Space Supply Air Ducts, Pressure Class 2" and Lower: Seal Class B
 - 5. Unconditioned Space Supply Air Ducts, Pressure Class higher than 2": Seal Class A
 - 6. Unconditioned Space Exhaust Ducts: Seal Class C
 - 7. Unconditioned Space Return Air Ducts: Seal Class B
 - 8. Conditioned Space Supply Air Ducts, Pressure Class 2" and lower: Seal Class C
 - 9. Conditioned Space Supply Air Ducts, Pressure class higher than 2": Seal Class B
 - 10. Conditioned Space Exhaust Ducts: Seal Class B
 - 11. Conditioned Space Fresh/Return Air Ducts: Seal Class C

PART 2 – PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

- A. Select transverse joints, longitudinal seams, elbows, transitions, offsets, branch connections and other duct constructions and fabricate according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible" as follows:
 - 1. Minimum duct thickness shall be 26 gauge.
 - 2. Use static pressure class, applicable sealing requirements, materials involved, duct support intervals and all other provisions as specified in SMACNA manual.
 - 3. Transverse joints: Figure 1-4 "Transverse (Girth) Joints"
 - 4. Longitudinal Seams: Figure 1-5 "Longitudinal Seams - Rectangular Ducts"
 - 5. All elbows of 20 degrees or greater shall be equipped with turning vanes. Turning vanes shall be 26 gauge, high efficiency profile, airfoil type mounted at 2.125" on center on 25 gauge runners.
 - 6. Elbows, Transitions, Offsets, Branch Connections and other duct construction: Chapter 2 "Fittings and other construction"

2.2 ROUND AND FLAT OVAL DUCTS AND FITTINGS

- A. Select transverse joints, longitudinal seams, tees, laterals and other duct constructions and fabricate according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible" as follows:
 - 1. Minimum duct thickness shall be 26 gauge.
 - 2. Use static pressure class, applicable sealing requirements, materials involved, duct support intervals and all other provisions as specified in SMACNA manual.

3. Transverse joints:
 - a. Figure 3-2 "Transverse (Girth) Joints"
 - b. In ducts larger than 90" in diameter, transverse joints shall be flanged.
4. Longitudinal Seams:
 - a. Figure 3-1 "Seams – Round duct and Fittings"
 - b. Fabricate round ducts larger than 90 " in diameter with butt welded longitudinal seams.
 - c. Fabricate flat oval ducts larger than 72" in width with butt-welded longitudinal seams.
5. Tees and Laterals: Figure 3-4 "90 degree Tees and Laterals" and Figure 3-5 "Conical Tees"

2.3 DOUBLE WALL SPIRAL

- A. Outer Duct: Select transverse joints, longitudinal seams, tees, laterals and other duct constructions and fabricate according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible" as follows:
 1. Use static pressure class, applicable sealing requirements, materials involved, duct support intervals and all other provisions as specified in SMACNA manual.
 2. Transverse joints:
 - a. Figure 3-2 "Transverse (Girth) Joints"
 - b. In ducts larger than 90" in diameter, transverse joints shall be flanged.
 3. Longitudinal Seams:
 - a. Figure 3-1 "Seams – Round Duct and Fittings"
 - b. Fabricate round ducts larger than 90 " in diameter with butt welded longitudinal seams.
 - c. Fabricate flat oval ducts larger than 72" in width with butt-welded longitudinal seams.
 4. Tees and Laterals: Figure 3-4 "90 degree Tees and Laterals" and Figure 3-5 "Conical Tees"
- B. Inner Duct: Perforated galvanized sheet steel duct having overall open area of 23 percent.
- C. Interstitial Insulation: Fibrous glass liner complying with ASTM C 1071, NFPA 90A or NFPA 90B and with NAIMA AH124 "Fibrous Glass Duct Liner Standard"

2.4 FLEX DUCT

- A. Duct shall comply with NFPA, BOA, NFPA 90B and UL 181, class I Air duct
- B. Duct shall be factory insulated with flexible fiberglass insulation with a minimum R-Value of 5.0 at a mean temperature of 75 degrees F.
- C. Insulation shall be covered with reinforced aluminum pigmented vapor barrier jacket having a permeance of not greater than 0.05 perms when tested in accordance with ASTM E 96, procedure A.
- D. Flexible duct shall be rated for a velocity of at least 4000 feet per minute and shall be suitable for operating temperatures of at least 250 degrees F.
- E. Internal working pressure:
 1. Low Pressure Duct Class: Minimum of 6" WC positive and 4" WC negative.
 2. Medium Pressure Duct Class: Minimum of 10" WC positive and 6" WC negative.

2.5 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible" for acceptable materials, material thickness and duct construction methods unless otherwise indicated.
- B. See above for minimum duct thicknesses.

- C. Sheet metal materials shall be free from pitting, seam marks, roller marks, stains, discolorations or other imperfections.
- D. Galvanized sheet steel shall comply with ASTM A 653/A 653M. Finishes for surfaces exposed to view shall be mill phosphatized.
- E. Stainless steel sheets shall comply with ASTM A 480/A 480M Sheet steel shall be type 304 unless otherwise noted, cold rolled, annealed sheet

FINAL REVIEW
NOT FOR
CONSTRUCTION

233300 – AIR DUCT ACCESSORIES

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 INSTALLATION REQUIREMENTS

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct construction Standards – Metal and Flexible" for metal ducts and in NAIMA AH116 "Fibrous Glass Duct Construction Standards" for fibrous glass ducts.
- B. Balancing dampers shall be provided in each supply air branch duct and all return and exhaust ducts required for complete balancing of air distribution system. Contractor shall provide remote damper adjustment method for all dampers located above drywall ceiling. All direct duct mounted grilles and registers shall be provided with volume damper.
- C. Install duct accessories of materials to match duct materials.
- D. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- E. Install volume dampers at all points on supply, return and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner and terminate liner with nosing hat channel.
- F. Set dampers to fully open position before testing, adjusting and balancing.
- G. Install test holes at fan inlets and outlets and elsewhere as indicated. Install duct test holes where required for testing and balancing purposes.
- H. Install fire and smoke dampers according to UL listing.
- I. Install flexible connections at all connections of ducts to equipment. For fans developing more than 5" WC cover flexible connectors with loaded vinyl sheet held in place with metal straps.

1.2 FIRE DAMPERS

- A. Fire dampers and ceiling fire dampers shall be provided at all penetrations in fire rated assemblies shown on architectural plans.
- B. Fire dampers rated for wall or floor installation shall not be used where ceiling fire dampers are indicated on plans, due to the fact that they do not provide the necessary heat barrier.
- C. Fire damper installation shall be in accordance with all manufacturer's requirements and requirements of UL 555

PART 2 – PRODUCTS

2.1 BACKDRAFT DAMPERS

- A. Dampers shall be gravity balanced suitable for maximum air velocity of 2000 feet per minute, unless otherwise noted on plans. Maximum system pressure rating shall be 1" WC. Dampers shall have extruded aluminum frame with multiple center pivoted single piece blades with a maximum blade width of 6 inches. Blade action shall be parallel and blades shall be equipped with nylon seals. Damper shall be equipped with adjustable tension return spring. Provide accessories as noted on plans.

2.2 MANUAL VOLUME DAMPERS

- A. Dampers shall be rated for standard leakage rating with linkage outside of airstream. Damper shall be suitable for horizontal or vertical application. Damper frame shall be galvanized steel channel with mitered and welded corners. Damper shall be provided with flanges for attaching to walls or flangeless frames for installing in ducts, where applicable. Blade design shall be parallel or opposed blade design with galvanized steel damper blades. Provide galvanized steel blade axles. Dampers in ducts with pressure class of 3" WC or less shall have axles full length of damper blades and bearings at both ends of operating shaft. Provide 2" extended stand off bracket and locking hand quadrant. When applications require more than one damper section to fill opening, sections shall be interconnected by appropriate jack shafting.

2.3 CONTROL DAMPERS

- A. Damper shall have low leakage rating with linkage outside of airstream and shall bear AMCA's certified ratings seal for both air performance and air leakage. Damper frame shall be constructed from galvanized steel channels with mitered and welded corners. Damper shall have parallel and opposed blade design with multiple dampers blades with a maximum blade width of 8". Blade axles shall be galvanized steel with blade linkage hardware of zinc plated steel and brass. Damper shall be rated for operation from -40 degrees to 200 degrees Fahrenheit.

2.4 FIRE DAMPERS

- A. Fire rating shall match rating of fire separation indicated on architectural plans. See architectural plans for assembly rating requirements. Damper shall be dynamic type, rated and labeled according to UL 555 by a national rating and testing laboratory. Fusible links shall be rated for 212 degrees Fahrenheit and shall include a UL label in accordance with established UL labeling procedures. Dampers shall be suitable for vertical or horizontal installation as required by location shown. Fire dampers shall be installed in wall and floor openings utilizing steel sleeves, angles and other materials and practices as required to provide an installation equivalent to that utilized by the manufacturer when dampers were tested at UL. Damper shall be curtain type with blades outside of airstream, fabricated with roll formed galvanized steel with mitered and interlocking corners. Mounting sleeve shall be factory or field installed and constructed from galvanized sheet steel. Sleeve may be omitted where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements. Damper blades shall be roll formed, interlocking galvanized sheet steel. Contractor shall have option to use full length, galvanized steel blade connectors in place of interlocking blades. Horizontal dampers shall be equipped with blade lock and stainless steel closure spring.
 - 1. Low Velocity: Dampers installed in low velocity ductwork shall be rated for air velocities of up to 2000 feet per minute at 4" WC static pressure.
 - 2. Medium/High Velocity Dampers: Dampers installed in medium/high velocity ductwork shall be rated for air velocities of up to 4000 feet per minute at 8" WC static pressure. Dampers shall be equipped with airflow blades. Provide round or oval transitions as required per the routing shown on plans.

2.5 DUCT MOUNTED ACCESS DOORS

- A. Access panels shall be fabricated according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible" Figures 2-10 "Duct Access Doors and Panels" and 2-11 "Access Panels – Round Duct".
 - 1. Door shall be double wall, rectangular constructed of galvanized sheet metal with insulation fill and thickness as indicated on duct insulation schedule. Door shall be hinged with cam latch and shall be fabricated air tight, suitable for duct pressure class. Frame shall be galvanized sheet steel with bend over tabs and foam gaskets.
 - 2. Pressure relief access doors shall open outward for positive pressure and inward for negative pressure ducts. Doors shall be factory set for operation at 10" WC and shall be equipped with neoprene or foam rubber seam.

2.6 DUCT ACCESS PANEL ASSEMBLIES

- A. Assemblies shall be rated and labeled according to UL 1978 by a national rating and testing laboratory. Panel and frame shall be carbon steel with carbon steel fasteners. Panel fasteners shall not penetrate duct wall. Gasket shall comply with NFPA 96 and shall be constructed with grease tight, high temperature ceramic fiber rated for minimum 2000 degree Fahrenheit. Minimum pressure rating shall be 10" WC positive or negative.

2.7 FLEXIBLE CONNECTORS

- A. Connectors shall be constructed with flame retardant treated or non-combustible fabrics. Coatings and adhesives shall comply with UL 181, class I. Connectors shall be metal edged, factory fabricated with a fabric strip 3.5" wide attached to 2 strips of 2.75" wide galvanized sheet steel or aluminum sheets to match duct construction material. Strips shall be stainless steel when used in corrosive environments. Indoor system flexible connector fabric shall be glass fabric, double coated with neoprene. Outdoor system flexible connector fabric shall be glass fabric, double coated with weatherproof, synthetic rubber resistant to UV rays and ozone. High corrosive flexible connector fabric shall be glass fabric with chemical resistant coating.

233600 – AIR TERMINAL UNITS

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 CONNECTIONS

- A. Install piping adjacent to air terminal unit to allow service and maintenance.
- B. Hot-Water Piping: In addition to requirements in Division 23 Section, connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- C. Connect ducts to air terminal units according to Division 23.
- D. Make connections to air terminal units with flexible connectors complying with requirements in Division 23.

1.2 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Division 23.

1.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

1.4 STARTUP SERVICE

- A. Perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions.
- C. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
- D. Verify that controls and control enclosure are accessible.
- E. Verify that control connections are complete.
- F. Verify that nameplate and identification tag are visible.
- G. Verify that controls respond to inputs as specified.

1.5 DEMONSTRATION

- A. Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

PART 2 – PRODUCTS

2.1 TIME SWITCHES

- A. Provide units as shown in schedule.
 - 1. Electronic time switches:
 - a. Electronic solid state unit with alphanumeric display complying with UL 917.
 - b. Astronomic time shall be available on all channels.
 - c. Unit shall be equipped with battery backup to maintain program upon loss of utility power.
 - 2. Electromechanical Dial Switches:
 - a. Provide astronomic time dial.
 - b. Unit shall be equipped with wound spring reverse carryover mechanism to keep time during power failures.

2.2 SINGLE-DUCT AIR TERMINAL

- A. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- B. Casing: Single wall.
- C. Casing Lining: Adhesive attached, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84. Cover liner with nonporous foil.
- D. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
- E. Air Outlet: S-slip and drive connections[, size matching inlet size].
- F. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
- G. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- H. Regulator Assembly: System-air-powered bellows section incorporating polypropylene bellows for volume regulation and thermostatic control. Bellows shall operate at temperatures from 0 to 140 deg F (minus 18 to plus 60 deg C), shall be impervious to moisture and fungus, shall be suitable for 10-inch wg (2500-Pa) static pressure, and shall be factory tested for leaks.
- I. Volume Damper: Galvanized steel with peripheral gasket.
- J. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
- K. Damper Position: Normally open.
- L. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), and rated for a minimum working pressure of 200 psig (1380 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain valve.
- M. Controls as specified and scheduled, single-point electrical connection to power source, control transformer, disconnect switch and all other accessories listed in schedule.

233713 – GRILLES, REGISTERS AND DIFFUSERS

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 INSTALLATION REQUIREMENTS

- A. Install diffusers, registers and grilles level and plumb.
- B. Drawings indicate general arrangement of ducts, fittings and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay in ceiling panels, locate units in center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers and grilles with airtight connections to ducts and allow service and maintenance of dampers, air extractors and fire dampers.
- D. Adjust diffusers, registers and grilles to air patterns indicated, or as directed, before starting air balancing.
- E. Install all registers with curve of louver away from line of sight to eliminate sight lines into space behind louver.
- F. Registers installed in masonry shall be installed so that bottom of register is aligned with masonry joint.
- G. Support all grilles, registers and diffusers from T-Bars or structure so that weight of unit is not transferred to ceiling tile.
- H. Provide proper mounting accessories for mounting method required in area in which diffuser is shown. See architectural plans for ceiling or wall type.
- I. All registers and grilles shall have angled blades.

PART 2 – PRODUCTS

2.1 CEILING DIFFUSERS

- A. Diffuser shall be constructed of steel.
- B. Diffuser shall be specifically designed for variable volume air flows.
- C. Finish shall be baked enamel with color as indicated in diffuser schedule.
- D. Diffuser airflow pattern shall be adjustable in field.
- E. Volume dampers, where indicated on schedule shall be radial opposed blade or butterfly type.

2.2 LINEAR SLOT DIFFUSERS

- A. Diffuser shall be constructed of aluminum.
- B. Diffuser shall be specifically designed for variable volume air flow.
- C. Slots, width and unit length shall be as indicated on plans.

2.3 DUCT MOUNTED DIFFUSER

- A. Diffuser shall be constructed of heavy gauge aluminum.
- B. Finish shall be baked acrylic suitable for paint. Or color as indicated in diffuser schedule.
- C. Blades shall be individually adjustable in the horizontal direction.
- D. Diffuser shall be furnished with opposed blade steel damper and adjustable air extractor.
- E. Furnish diffuser with duct mounting collar.

2.4 REGISTERS AND GRILLES

- A. Units shall be constructed as follows:

1. Where unit is indicated to be furnished with white finish, or to receive paint, unit shall be constructed of steel.
 2. Where unit is to be located in corrosive environment, or is indicated to have a “matte” finish, unit shall be constructed of aluminum.
- B. Register shall be equipped with adjustable opposed blade damper.
- C. Mounting screws shall be concealed.

FINAL REVIEW
NOT FOR
CONSTRUCTION

237200 – ENERGY RECOVERY UNITS

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 INSTALLATION REQUIREMENTS

- A. Verify that all airflows are properly connected and arranged so that supply and exhaust airstreams flow in opposite directions and wheel rotation, where applicable, is away from exhaust side to purge section to supply side.
- B. Provide all access doors in ductwork as required for access to wheel surfaces, drive motor and seals.
- C. Provide concrete housekeeping pad for all floor mounted units.
- D. Provide threaded rods, spring hangers and building attachments for suspended units and install units with all clearances for service and maintenance.
- E. Install new filters at completion of equipment installation before testing and balancing.
- F. Pipe all drains from units and drain pans to nearest floor drain.

PART 2 – PRODUCTS

2.1 AIR TO AIR ENERGY RECOVERY UNIT

- A. Provide units with all capacities and accessories as shown in schedule.
- B. Unit shall be equipped with steel casing and factory painted finish.
- C. Heat exchangers shall be total heat type unless otherwise noted.
- D. Heat Transfer Coil:
 - 1. Run Around Coil: Coil equipped filled with Propylene Glycol solution. See equipment schedule for required minimum performance.

260500 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 CODE SECTIONS

- A. 2011 National Electrical Code, NFPA 70
- B. 2012 International Building Code
- C. 2012 International Plumbing Code
- D. ADA – American Disabilities Act
- E. ANSI – American National Standards Institute
- F. ASTM – American Society of Testing Materials
- G. NFPA – National Fire Protection Association
- H. NEMA – National Electrical Manufacturers Association
- I. OSHA – Occupational Safety and Health Act
- J. UL – Underwriter's Laboratories
- K. All codes listed on architectural Code Reference Sheet or project cover sheet.

1.2 GENERAL

- A. Provide all work in accordance with applicable codes, rules, ordinances, and regulations of local, State, and Federal Governments and other Authorities Having Jurisdiction (AHJ).
- B. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the drawings and specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system functioning as indicated by the design and the equipment specified. Elements of the work include materials, supervision, supplies, equipment, transportation, and utilities.
- C. The drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, piping, etc. without showing all the exact details as to elevations, offsets, control lines, and other installation requirements. The contractor shall use the drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system. Plans shall not be scaled.
- D. Contractor shall coordinate with all other trades to ensure that all required project components are included in project bid.
- E. If in any case the plans or specifications conflict with either manufacturer's requirements or minimum code requirements the information on plans and specifications shall be superseded by manufacturers and code requirements.
- F. If in any case the plans or specifications conflict with themselves, the most stringent of the conflicting information shall be the basis for bid. Contractor shall seek clarification of all conflicts prior to bid.
- G. All change order requests shall be accompanied with itemized tabular breakdown of all materials and labor associated with installation of all associated materials for review of the design team. Lump sum pricing will not be accepted.
- H. Contractor shall refer to each drawing and specification section in construction document set. No bids shall be submitted without review of all construction documents.

1.3 LOCAL CONDITIONS

- A. Visit site and determine existing local conditions affecting work in contract.
- B. Failure to determine site conditions or nature of existing or new construction will not be considered a basis for granting additional compensation.

1.4 ALLOWABLE MANUFACTURERS

- A. Allowable manufactures for all products listed in division 26 are listed in "Schedule of Manufacturers" on plans.

1.5 SUBMITTAL REQUIREMENTS

- A. Submittals for products in division 26 shall include the following items.
 - 1. Product data showing type, model and construction characteristics of product
 - 2. Layout drawings for any systems requiring interconnection of various system components
 - 3. All other documentation required to show compliance with the specifications.
- B. The contractor shall provide a schedule of submittals indicating dates on which each submittal will be provided to design team for review. Schedule shall be submitted 10 working days in advance of delivery of first submittal for review.
- C. Contractor shall allow a minimum of ten working days for design team of review of submittals.

1.6 CIRCUIT LABELS

- A. Contractor shall provide typed circuit directories indicating the use of each circuit breaker for new and existing panels that are affected in the project scope. Existing directories shall be replaced with new typed directories reflecting all modifications to circuit arrangements in each panel.

1.7 WARRANTY REQUIREMENTS

- A. Unless noted elsewhere in the specifications, all work shall be warranted for a period of not less than one year from the date of substantial completion. The contractor shall provide work at no additional cost to correct any deficiencies in their work that were identified to have been present during the warranted period.

1.8 DEMOLITION

- A. All equipment to be removed and reinstalled shall be disconnected, with services capped, cleaned and stored for reconnection.
- B. Information on drawings represents information from old drawings and limited site inspection. Contractor shall field verify existing conditions prior to submitting bid. No extras shall be paid due to unanticipated conditions.
- C. Contractor shall be responsible for all coring, patching and repair of all wall and floor systems as required due to new construction. Maintain all fire ratings of existing building elements.
- D. For all existing fixtures, receptacles, wiring, equipment, etc. shown to be removed, the owner shall have the first right of refusal.
- E. Contractor shall be responsible for removal of all electrical devices and wiring in all demolished walls, whether specifically indicated or not.
- F. Where demolished devices are part of a circuit that is thru-wired, or has additional devices on the circuit that are to remain unchanged, the contractor is responsible for maintaining the integrity of the existing circuit. Any additional conduit, conductors, boxes, etc. needed to modify the existing circuit to maintain the integrity are the responsibility of the electrical contractor and shall be included in bid.
- G. When a fixture, device or pieces of equipment is noted for removal along with associated wiring or associated wiring and conduit, contractor shall remove wiring and conduit back to nearest junction box so that no conduit or wiring is exposed in occupied area. Wiring shall be disconnected upstream of removed fixture, device or piece of equipment so that wiring termination cannot be accidentally energized.

- H. Where demolition process has caused damage to equipment, fixtures, conduit, wiring and other devices to remain, these items shall be repaired or replaced at contractor's expense to the approval of the Architect.

1.9 INSTALLATION

- A. All raceways and wiring shall be installed so that they are concealed from view unless otherwise noted. Exposed conduit shall be allowed at structural level in areas in which there is no ceiling installed. All conduit shall be routed perpendicular or parallel to building lines and structure.
- B. No combustible materials shall be allowed in return air plenum regardless of indication on plans.
- C. Installation shall comply with NECA 1
- D. Measure mounting heights indicated on plans to bottom of unit for suspended items and to center of unit for wall mounted items.
- E. If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- F. Install all equipment to facilitate service, maintenance and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- G. Apply firestopping to penetrations of fire rated floor and wall assemblies for electrical installations to restore original fire resistance rating of assembly.
- H. Contractor shall relocate all circuit breakers to balance electrical load between each panel phase.
- I. All exposed conduit shall be painted to match surface installed adjacent to. Verify all paint colors with architect prior to installation.

1.10 TEMPORARY FACILITIES

- A. Contractor shall provide temporary facilities as required for construction of the project. Temporary facilities shall include temporary water service and distribution, electrical power and lighting service, heating cooling and ventilation, telephone and data service, and sanitary facilities including drinking water.
- B. Permanent HVAC equipment shall not be used to heat, cool or ventilate the facility during construction.
- C. Whether during a renovation or a phased construction project, the contractor shall include all temporary facilities to maintain functionality and suitable space conditions in all areas of a building that are occupied by the owner while construction activities are underway.
- D. The contractor shall provide temporary facilities as required to maintain a safe working environment and to protect all building materials and provide space conditions within range required for material installation.
- E. 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. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- F. Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Relocate temporary services and facilities as the Work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist on-site.

PART 2 – PRODUCTS

2.1 HOUSEKEEPING PADS

- A. All equipment shall be installed on concrete housekeeping pads. Pad shall extend beyond equipment perimeter 4" and shall elevate equipment off of finish floor 4".
- B. Contractor shall have option to provide prefabricated housekeeping pad or pour pad in place.

2.2 SLEEVES

- A. Sleeves shall be constructed from the following materials at contractor's option.
1. Galvanized steel round tubing, closed with welded longitudinal joint.
 2. Schedule 40 Steel Pipe.
 3. DUCTED RETURN ONLY – Schedule 40 PVC pipe.

FINAL REVIEW
NOT FOR
CONSTRUCTION

260519 – CONDUCTORS AND CABLES

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 INSTALLATION REQUIREMENTS

- A. Follow circuiting shown on drawings for lighting, power and equipment connections.
- B. Shared neutrals and grounds are not allowed.
- C. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- D. Route conductors in raceway continuous between outlets and junction boxes with no splices or taps pulled into conduits.
- E. Terminate solid conductors at equipment terminal strips and other similar terminal points with insulated solderless terminal connectors. Terminate all stranded conductor terminal points with insulated solderless terminal connectors.
- F. Neatly route tie and support conductors terminating at switchboards, motor control centers, panelboards, and audio-visual equipment with cable ties and clamps.
- G. Use manufacturer approved pulling compound or lubricant where necessary. Do not exceed manufacturer's recommended maximum pulling tension and sidewall pressure values.
- H. Use pulling means including fish tape, cable, rope and basked weave wire/cable grips that will not damage cable or raceway.
- I. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- J. Identify and color code conductors and cables according to Division 26 "Identification for Electrical Systems."
- K. Support Cables according to Division 26, "Hangers and Supports for Electrical Systems."
- L. Tighten electrical connections and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B
- M. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- N. Make fixture taps with self-stripping electrical tap connectors.
- O. Install conductor at each outlet with at least 6" of slack.
- P. Apply firestopping to electrical penetrations of fire rated floor and wall assemblies to restore original fire-resistance rating of assembly according.
- Q. No conductors smaller than #12 AWG are allowed unless specifically noted on plans.
- R. All circuits in patient care areas shall be equipped with redundant grounding patch in accordance with requirements of the National Electrical Code.
- S. Conductor size shall be provided so that voltage drop in branch circuit does not exceed 3%. Conductor size shall be provided so that voltage drop in panel feeders does not exceed 2%. Combined voltage drop of branch circuit and panel feeders shall not exceed 5%. Conductor sizes shown on drawings represent the minimum conductor size. Increase size as required to comply with voltage drop requirements according to requirements of National Electrical Code.
- T. In some cases, tick marks are omitted for clarity or in cases in which insufficient space is available to display on plans. If contractor cannot determine correct number of wires to be included in conduit, contact A/E for assistance.

1.2 CONDUCTOR APPLICATION

- A. All conductors shall be installed in rigid raceway unless otherwise noted.

- B. MC cable shall be allowed in the following cases.
 - 1. Flexible equipment connection. Maximum MC cable length shall be 4'-0"
 - 2. Flexible light fixture whip. Maximum MC cable length shall be 6'-0" Whip shall originate from junction box. MC cable shall not be installed in a fashion that connects fixtures directly to each other.

PART 2 – PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Conductors shall be Copper and shall comply with NEMA WC 70.
- B. Conductors shall be rated for 600 volts at conductor temperatures not to exceed 105 degrees Celsius.
- C. Conductors shall be UL listed.
- D. Conductor insulation shall be THHN-THWN installed in raceway.
- E. Conductors shall be solid for size #10 AWG and smaller and shall be stranded for #8 AWG and larger.
- F. Multi-conductor cable shall comply with NEMA WC 70 for metal clad cable with ground wire.

260533 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 RACEWAY APPLICATION

- A. Outdoors:
 - 1. Exposed Conduit: Rigid Steel Conduit.
 - 2. Concealed Conduit Above Grade: EMT
 - 3. Underground Conduit: RNC, Type EPC – 40 – PVC direct buried.
 - 4. Connection to Vibrating Equipment (Including Transformers, and Hydraulic, Pneumatic, Electric Solenoid or Motor Driven Equipment): LFNC
- B. Indoors:
 - 1. Exposed, not subject to physical damage: EMT
 - 2. Exposed, subject to physical damage: Rigid Steel Conduit
 - a. Includes raceways in the following locations:
 - i. Loading Dock
 - ii. Corridors used for traffic of mechanized carts, forklifts and pallet handling units.
 - iii. Mechanical Rooms
 - iv. Bottom Feed panel board conduit entries.
 - 3. Concealed in ceilings and interior walls and partitions: EMT
 - 4. Connection to vibrating equipment (Including Transformers, and Hydraulic, Pneumatic, Electric Solenoid or Motor Driven Equipment):
 - a. Dry locations: FMC
 - b. Wet or Damp Locations: LFMC
 - 5. Conduit for fire alarm wiring: EMT colored Red.
- C. All conduits shall be a minimum size of 0.75”.
- D. All underground conduits shall transition from PVC to metallic at sweep prior to penetrating building slab or finished grade so that no PVC conduit is exposed above grade. See Sections above for locations that require EMT or Rigid Steel Conduit.

1.2 BOXES ENCLOSURES AND CABINETS APPLICATION

- A. Electrical Service Outlets (including plug receptacles, lamp receptacles, lighting fixtures and switches): 4” code gauge Sheet Metal Outlet Box
- B. Light Fixture Boxes: 4” code gauge sheet metal outlet box with 0.375” inch or larger fixture stud in each outlet box to receive lighting fixture. Select covers with proper opening for device installed in outlet box.
- C. Surface Mounted Exterior Boxes: Cast Metal Outlet Box
- D. Surface Mounted boxes installed above kitchen floor: Cast Metal Outlet Box

1.3 OUTLET BOX AND RACEWAY INSTALLATION REQUIREMENTS

- A. Use of utility or handy boxes shall only be allowed when box is flush mounted in masonry wall with dead end conduit entry from end or back.
- B. Locate outlet boxes generally from column centers and finished wall lines. Install ceiling outlet boxes at suspended ceiling elevations.

- C. Provide bracing straps spanning studs for support of all junction boxes installed in new walls.
- D. Accurately locate lighting fixtures and appliance outlet boxes mounted in concrete or in plaster finish on concrete. Install outlet boxes in forms to dimensions taken from bench marks, columns walls or floors. Rough-in light fixtures and appliance outlet boxes to general locations before installation of walls and furring and reset to exact dimensions as walls and furring are constructed. Set outlet boxes true to horizontal and vertical finish lines of building. If outlet is shown to be installed in or on a column, outlet shall be centered on column.
- E. Install outlet boxes accessible. Provide outlet boxes above piping or ductwork with extension stems or offsets as required to clear piping and ductwork.
- F. When light fixtures are shown above a mirror, center fixture above mirror and install fixture with 2" of clearance between bottom of fixture and top of mirror.
- G. Install boxes to maintain all fire ratings. In accordance with requirements of building code, include fire rated sealing assemblies, putty pads and offset boxes where back to back.
- H. Provide coverplates for all unused data devices.
- I. All conduit elbows shall be long radius type. E/C shall review with A/E any instance in which a short radius elbow is required for coordination with field installation conditions.
- J. All raceways, cables and boxes shall be recessed unless otherwise noted. Where shown in existing walls, contractor shall remove and replace wall finishes as required for installation or shall fish flexible cabling into wall cavity.
- K. Unless otherwise noted, conduit connected to exterior building disconnect switches, C/T cabinets, meters, distribution panels, transfer switches and other equipment shall not be routed vertically and exposed on exterior of building. Route all conduit on interior of building concealed in wall. Notify A/E if construction type does not facilitate concealed conduit installation for clarification of routing.

PART 2 – PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. EMT (Electrical Metallic Tubing): Comply with ANSI C80.3
- B. Rigid Steel: Comply with ANSI C80.1
- C. FMC (Flexible Metal Conduit): Conduit shall be Zinc Coated Steel or Aluminum.
- D. Fittings for conduit including all types and flexible and liquid tight, EMT, and cable shall comply with NEMA FB 1 and shall be listed for type and size raceway with which used and for application and environment in which installed.
 - 1. Provide Steel, set screw or compression type conduit fittings.
 - 2. Conduit fittings for hazardous locations shall comply with UL 886.

2.2 NON METALLIC CONDUIT AND TUBING

- A. LFNC (Liquidtight Flexible Metal Conduit): Comply with UL 360.
- B. RNC (Rigid Non-Metallic Conduit): Comply with NEMA TC2. Conduit shall be type EPC-40-PVC, unless otherwise noted.
- C. Fittings for RNC shall comply with NEMA TC 3 and shall match conduit or tubing type and size to which applied.
- D. Fittings for LFNC shall comply with UL 514B.

2.3 METAL WIREWAYS AND GUTTERS

- A. Wireways shall be constructed of sheet metal sized and shaped as indicated in NEMA 250. Wireways shall be bear NEMA rating for application and location in which they are used. Include couplings offsets, elbows, expansion joints, adapters, hold down straps, end caps and other fittings to match and mate with wireways as required for complete system. Wireway cover shall be hinged type. Finish shall be manufacturer's standard enamel finish.

- B. Items may be fabricated locally to same specifications as manufacturer's specified. Provide locally fabricated items free of burrs, sharp edges, un-reamed holes, exposed screw points or bolts and finished with one coat of suitable enamel inside and out, prior to mounting.
- C. Provide sectional covers to maximize ease of removal.

2.4 SURFACE RACEWAYS

- A. Provide non-metallic type surface raceway with two piece construction, manufactured of rigid PVC with texture and color selected by Architect.

2.5 BOXES, ENCLOSURES AND CABINETS

- A. No sectional outlet boxes are allowed.
- B. Raised Cover: Provide code gauge galvanized steel raised covers on outlet boxes installed in plaster finish. Set to plaster grounds with outside edge of cover flush with plaster finish.
- C. Sheet Metal Outlet Boxes: Steel, sheet metal knockout outlet box, complying with NEMA OS 1. Provide required depth for service or device.
- D. Cast Metal Outlet Boxes: comply with NEMA FB 1 provide cast type FS or FD box with device cover and gasket. Provide blank cover and gasket when used as a junction box. Provide required depth for service or device.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2. See application schedule for size.
- F. Concealed Service Metal Floor Boxes for Concrete Floors: Steel, rectangular box with four compartment, shallow stamped construction. Maximum Box depth shall be 2.5" with conduit entry size up to 1.25". Provide device brackets as required to install devices shown on plans. Box shall be designed for feed through tunneling to adjacent compartments. Provide cover assembly with flanged cover for use in tile or carpeted installation. Cover shall be equipped with insert in lid to allow for carpet or tile cutouts to match finished floor. Provide black cover unless otherwise noted.
- G. Surface Service Floor Box for Slab on Grade Installation: Round box with PVC construction box shall be equipped with 1" and 1.5" entry hubs. Provide concrete cap, and universal cover. Provide device brackets and cover plate as required to install devices shown on plans. Cover plate shall be black unless otherwise noted.
- H. Surface Service Floor Box for Concrete Installation in Elevated Slab: Round box with steel poke through construction. Box shall be fire rated and UL listed for use in 1-4 hour rated floors. Box shall be adjustable for concrete floor thickness between 2.25" and 7" floor thickness and shall be equipped with (2) 1" EMT conduit entries minimum. Provide concrete cap, and universal cover. Provide device brackets and cover plate as required to install devices shown on plans. Cover plate shall be black unless otherwise noted.

2.6 CABLE TRAY

- A. Cable tray shall be metal suitable for indoor installation and protected against corrosion. Provide type (Basket, Trough, Ladder, Channel, Solid Bottom) and size of cable tray indicated on plans. Additional requirements for each type are listed below where applicable:
- B. Basket Trays shall be wire mesh type with mesh spacing not to exceed 2"x4"
- C. Ladder Tray: Rung spacing shall not exceed 12"

260553 – IDENTIFICATION FOR ELECTRICAL AND EQUIPMENT AND WIRING

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- E. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- F. Non-metallic Color Coded Tape or Marker Tape: Secure tight to surface of conductor or cable with non-metallic tie wraps or adhesive, as specified, at a location with high visibility and accessibility; and, in all enclosures with exposed energized parts.
- G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
- H. Painted Identification: Prepare surface and apply paint according to Division 09 painting Sections.

1.2 ELECTRICAL EQUIPMENT IDENTIFICATION

- A. Install engraved plastic laminate sign or plastic equipment marker on or near each major item of electrical equipment and each operational device as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
 - 1. Disconnect Switches
 - 2. Enclosed Circuit Breakers
 - 3. Lighting Contactors
 - 4. Motor Starters
 - 5. Variable Frequency Drives
- B. Where lettering larger than 1" height is needed for proper identification because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved sign at contractor's option.
- C. Lettering shall be minimum 1/4" high where viewing distance is less than 2'-0"; 1/2" high for distances up to 6'-0" and proportionately larger for greater distances. Secondary lettering shall be 2/3 to 3/4 of size of the principal lettering.

1.3 WIRING IDENTIFICATION

- A. Install wiring tape on each conductor in accordance with the following color scheme.
 - 1. 120/208V Systems
 - a. Phase A: Black
 - b. Phase B: Red
 - c. Phase C: Blue (Where Applicable)

- d. Neutral: White
- e. Ground: Green

PART 2 – PRODUCTS

2.1 ENGRAVED LAMINATE SIGN

- A. Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thickness indicated, engraved with the engravers standard letter style of the sizes and wording indicated. Signs shall be black with white core except as otherwise noted and shall be punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
- B. Thickness shall be 1/16" for units up to 20 square inches or 8" in length and 1/8" for larger units.

2.2 PAINTED IDENTIFICATION

- A. Painting where allowed shall be performed using standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping and similar applications. Minimum letter height shall be 1.25" high for ductwork and equipment and 0.75" high for access door signs and similar operational instructions.
- B. Paint shall be exterior type, oil based, black paint.

2.3 CABLE IDENTIFICATION MATERIALS

- A. Color Coded Tape: Self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1" to 2" wide, colored as noted above.
- B. Marker tapes: Vinyl or vinyl cloth, self-adhesive, wraparound type with circuit identification legend machine printed by thermal transfer or equivalent process.

2.4 UNDERGROUND WARNING TAPE

- A. Provide bright colored, red, continuous printed, polyethylene tape compounded for permanent direct burial service and alkali and acid resistant. Provide embedded continuous metallic strip or core. Printed legend shall indicate type of underground line.

SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Commissioning of Electrical Systems

1.2 RELATED REQUIREMENTS

- A. Section 019113 – General Commissioning Requirements
- B. Section 220800 – Commissioning of Plumbing Systems
- C. Section 230800 – Commissioning of HVAC Systems

1.3 DEFINITIONS

- A. CxA: Commissioning Agent
- B. GC: Contractor; General Contractor, not a Subcontractor
- C. O&M: Operations and Maintenance

1.4 DESCRIPTION

- A. This Section describes commissioning requirements applicable to commissioned items and systems specified in CSI Masterformat Division 26 to ensure that all systems are operating in a manner consistent with the Contract Documents.
- B. Conform to commissioning requirements and the commissioning plan.

1.5 RESPONSIBILITIES

- A. Construction and Acceptance Phases
 - 1. Include the cost of commissioning in the contract price. Commissioned equipment is defined in section 019113.
 - 2. In each purchase order or subcontract written, include requirements for submittal data, O&M data and training.
 - 3. Conduct a commissioning scoping meeting and other meetings necessary to facilitate the Commissioning process.
 - 4. Provide requested documentation to the CxA, developed for functional testing procedures.

5. Assist in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
 6. Assist with developing functional performance test procedures. Subs shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
 7. Develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the pre-functional checklists for all commissioned equipment. Submit to GC for review prior to startup. CxA will verify plan for compliance. Refer to Section 019113 for further details related to start-up.
 8. During the startup and initial checkout process, execute and document the electrical-related portions of the pre-functional checklists provided by the CxA for all commissioned equipment.
 9. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the GC.
 10. Address current A/E punch list items before functional testing. Systems shall be completed with discrepancies and problems remedied before functional testing of the respective systems.
 11. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
 12. Provide all test equipment necessary to fulfill specified testing requirements.
 13. Perform functional performance testing under the direction of the CxA for specified equipment. Assist the CxA in interpreting the monitoring data, as necessary.
 14. Correct deficiencies (differences between specified and observed performance) as interpreted by the CxA and A/E and retest the equipment.
 15. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
 16. During construction, maintain as-built red-line drawings for all drawings and final CAD as-builts for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing). Prepare red-line as-built drawings for all drawings and final as-builts for contractor-generated coordination drawings.
 17. Provide training of the Owner's operating personnel as specified.
 18. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
- B. Operation Manuals shall include:
1. A table of all set-points and implications when changing them.
 2. Schedules.

3. Instructions for operation of each piece of equipment for emergencies.
4. Startup and shutdown.
5. Recommendations for re-commissioning frequency by equipment type.

C. Warranty Period

1. Execute deferred functional performance testing, witnessed by the CxA, according to the specifications.
2. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

1.6 SUBMITTALS

- A. Provide submittal documentation relative to commissioning as required in this Section, Section 019113 and other specified requirements.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 STARTUP

- A. The electrical contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in 019113. CSI Masterformat Division 26 has start-up responsibility and is required to complete systems and sub-systems, so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the Commissioning Agent or Owner.
- B. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems, or sub-systems at the discretion of the CxA and GC. Beginning system testing before full completion, does not relieve the Contractor from fully completing the system, including all pre-functional checklists as soon as possible.

3.2 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. See Section 019113 for documentation requirements.

3.3 TRAINING OF OWNER PERSONNEL

- A. The GC shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed.
- B. The GC shall be responsible for reviewing the content and adequacy of the training of Owner personnel for commissioned equipment or systems. CxA will verify compliance.
- C. Electrical Contractor - the electrical contractor shall have the following training responsibilities:

1. Provide the GC with a training plan four weeks before the planned training.
2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each major piece of commissioned electrical equipment or system.
3. Training shall start with classroom sessions, if necessary, followed by hands on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shut-down, power failure, etc.
4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary, and the demonstration repeated.
5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
6. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
7. Training shall include:
 - a. Use the printed installation, operation and maintenance instruction material included in the O&M manuals.
 - b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
 - c. Discussion of relevant health and safety issues and concerns.
 - d. Discussion of warranties and guarantees.
 - e. Common troubleshooting problems and solutions.
 - f. Explanation of information included in the O&M manuals.
 - g. Discussion of any peculiarities of equipment installation or operation.
 - h. Classroom sessions shall include the use of overhead projections, slides, video and audio taped material as might be appropriate.
8. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and maintenance of all pieces of equipment.
9. Training shall occur after functional testing is complete, unless approved otherwise by the GC.

10. Minimum Duration of Training: The electrical contractor shall provide training on each piece of equipment according to the periods indicated in the individual CSI Masterformat Division 26. Provide a 4-hour training session to cover, As-builts, O&M's, and systems installed.

END OF SECTION **260800**

260923 – LIGHTING CONTROL DEVICES

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 INSTALLATION REQUIREMENTS

- A. Install all devices plumb and level.
- B. Contractor shall calibrate all sensors and time switches per owner requirements.
- C. Contractor shall provide training for owner on programming and use of lighting control devices.

PART 2 – PRODUCTS

2.1 TIME SWITCHES

- A. Provide units as shown in schedule.
 - 1. Electronic time switches:
 - a. Electronic solid state unit with alphanumeric display complying with UL 917.
 - b. Astronomic time shall be available on all channels.
 - c. Unit shall be equipped with battery backup to maintain program upon loss of utility power.
 - 2. Electromechanical Dial Switches:
 - a. Provide astronomic time dial.
 - b. Unit shall be equipped with wound spring reverse carryover mechanism to keep time during power failures.

2.2 PHOTOCELLS

- A. Provide unit as shown in schedule.
- B. Provide with solid state contacts rated to operate connected relay, contactor coils, or microprocessor input. Unit shall comply with UL 773A.
- C. Light level monitoring range shall be from 1.5 fc to 10 fc with an adjustment for turn on and turn off between those levels.
- D. Unit shall be equipped with 15 second time delay to prevent false operation.
- E. Unit shall be suitable for installation indoors or outdoors depending on location shown on plans.

2.3 LIGHTING CONTACTORS

- A. Provide unit as shown on schedule.
- B. Listing shall be consistent with type of load served.
- C. Fault current withstand rating shall be equal to or greater than the available fault current at the point of installation.
- D. Enclosure shall comply with NEMA 250.
- E. Provide with control and pilot devices as scheduled.
- F. Where control points are called for in control drawings and specifications, provide hardware interface to enable the BAS to monitor and control lighting contactors.

262416 – PANELBOARDS

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 INSTALLATION REQUIREMENTS

- A. Do not interrupt electric service to facilities occupied by owner or others unless coordinated with owner and architect.
- B. Install panelboards and accessories according to NEMA PB 1.1.
- C. Mount top of trim 90" above finished floor unless otherwise noted.
- D. Mount panel board cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install all overcurrent protective devices and controllers not already factory installed. Set field adjustable circuit breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- H. Installation shall comply with NECA 1.
- I. After substantial completion, but not more than 60 days after final acceptance, measure load balancing and make circuit changes.
 - 1. Measure during period of normal system loading.
 - 2. Coordinate scheduling of load balancing circuit changes with owner and perform changes outside normal occupancy/working schedule of the facility.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.
- J. Provide temporary heat to maintain temperature according to manufacturer's written instructions.

1.2 BREAKER COORDINATION

- A. All circuit breakers including load side branch breaker shall be selectively coordinated and rated for available fault current listed in panel schedule or calculated at feeder connection of panel. Series rating is not allowed.
- B. All circuit breakers feeding equipment such as, transfer switches, HVAC equipment, owner installed process equipment, elevators or other building equipment shall be coordinated with requirements of equipment manufacturer to ensure proper coordination and fault protection.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures:
 - 1. Enclosures shall be flush and surface type as shown on plans. Panels shall be rated for environmental conditions at installed locations.
 - 2. Front shall be secured to box with concealed trim clamps. For surface mounted fronts, match box dimensions. For flush mounted fronts, overlap box.
 - 3. Skirt for surface mounted panelboards shall be same gauge and finish as panelboard front with flanges for attachment to panelboard, wall and ceiling or floor.
 - 4. Finishes:

- a. Panels and Trim: Steel, factory finished with manufacturer's standard two coat, rust inhibitor primer and baked on finish.
 - b. Back boxes: Galvanized steel
 - c. Provide permanent fungicidal treatment for overcurrent protective devices and other components.
- 5. Inside panelboard provide directory card mounted in transparent card holder with typed circuit directory listing all circuit numbers and loads served.
- B. Phase Neutral and Ground Buses:
 - 1. Material Tin plated copper.
 - 2. Equipment ground bus: Adequate for feeder and branch circuit equipment grounding conductors; bonded to box.
 - 3. Isolated Ground Bus: Adequate for branch circuit isolated ground conductors; insulated from box.
 - 4. Neutral bus: UL rated for nonlinear loads.
 - 5. Rating: Bus structure shall be rated by heat tests conducted in accordance with UL 67. The use of conductor dimensions will not be accepted in lieu of actual heat tests.
- C. Conductor Connectors:
 - 1. Material: Tin Plated Copper.
 - 2. Main and Neutral Lugs: Suitable for connection to Copper or Aluminum Conductors
 - 3. Feed Through Lugs: Suitable for use with Copper or Aluminum conductors. Locate at opposite end of bus from incoming lugs or main device.
 - 4. Subfeed Lugs: Suitable for use with aluminum or copper conductors. Locate at same end of bus as incoming lugs or main device.
- D. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers when shown with one or more main service disconnecting means and overcurrent protective devices.
- E. Future Devices: Provide mounting brackets, bus connections, filler plates and necessary appurtenances required for future installation of devices.
- F. Panelboard Short-Circuit Rating: Panelboard shall be fully rated for available fault current listed on plans or as calculated based on actual field installed conditions.
- G. All panelboards and load centers shall be keyed alike.
- H. Include tools and miscellaneous items required for overcurrent protective device test, maintenance and operation.

2.2 DISCONNECTION AND OVERCURRENT PROTECTIVE DEVICES

- A. Circuit Breakers: Circuit breakers shall be rated for size and amperage indicated on plans. Breakers shall be standard construction. All circuit breakers shall be UL and CSA listed, IEC 157-1 rated, meet NEMA AB1 and federal specification W-C 375B/GEN when applicable. Molded case circuit breakers shall have over center toggle type mechanisms, providing quick make, quick break action. Breakers shall be calibrated for operation in an ambient temperature of 40°C. Each circuit breaker shall have trip indication by handle position and shall be trip free. Two and three pole breakers shall be common trip. Each circuit breaker shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole. Circuit breaker frame sizes greater than 100 amperes shall have variable magnetic trip elements that are set by a single adjustment so that tripping characteristics are uniform in each pole. A push to trip button shall be provided on the cover for mechanically tripping the circuit breaker. The circuit breaker shall have reverse connection capability and be suitable for mounting and operating in any position. Unless otherwise indicated, branch circuit breakers rated for up to 100 amperes shall have 10,000 RMS short circuit amperes symmetrical interrupting capacity. Circuit breakers above 100 amperes shall have 42,000 RMS short circuit amperes capacity.

262726 – WIRING DEVICES

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 INSTALLATION REQUIREMENTS

- A. Comply with NECA 1, install devices at mounting heights as indicated on plans.
- B. Install wiring devices after all wall preparation including painting is complete.
- C. Do not strip insulation from conductors until just before they are spliced or terminated.
- D. Strip insulation evenly around conductor using tools designed for that purpose.
- E. Existing Conductors:
 - 1. Cut back and pigtail or replace all damaged conductors.
 - 2. Straighten conductors that remain and remove corrosion and foreign matter.
 - 3. Pigtailling existing conductors is permitted provided the outlet box is large enough.
- F. Replace all devices that have been in temporary use during construction of that show signs that they were installed before building finishing operations were complete.
- G. Keep each wiring device in its package or otherwise protected before it is time to connect conductors.
- H. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes allowing metal to metal contact.
- I. Do not use oversized or extra deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- J. All light switches shown side by side shall be ganged together and mounted under single faceplate.
- K. Contractor shall adjust all occupancy sensors, for time delay, sensitivity and occupancy/vacancy operation as directed by owner. Contractor shall include visit to site after occupancy of the building by owner to adjust sensors.

1.2 FIELD QUALITY CONTROL

- A. In healthcare facilities prepare reports that comply with recommendations in NFPA 99.
- B. Test straight blade convenience outlets in patient care areas for the retention force of the grounding blade according to NFPA 99. Retention force shall not be less than 4 oz.

PART 2 – PRODUCTS

2.1 COLOR

- A. Receptacle and Switch color shall be white unless otherwise noted below or on plans.
- B. Faceplates finish shall be stainless steel unless otherwise noted below or on plans.
- C. Isolated ground receptacles shall be orange.
- D. Receptacles connected to emergency power system shall be red.
- E. Where new devices are installed adjacent to existing devices to remain, new device and faceplate colors shall match existing.

2.2 RECEPTACLES

- A. Receptacles shall be rated for voltage and amperage as shown on drawings. Unless otherwise noted, receptacles shall be rated for 125 V and 20 A. For devices rated other than 125 V and 20 A provide equivalent grade construction as devices listed below.
- B. Wiring devices shall comply with NEMA WD1, NEMA WD6 for configuration noted and UL 498.
- C. All receptacles installed within 6' horizontally of the top of a sink shall be GFCI protected.

D. Basis of Design:

1. **Receptacles:** Tamper Resistant Hubbell HBL 8300SG (duplex)
2. Isolated-Ground, Convenience Receptacles: Hubbell CR 5253IG (duplex)
3. Tamper Resistant Convenience Receptacles: Hubbell HBL **8300SG (duplex)**
4. GFCI Convenience Receptacle: Hubbell GF 20 (duplex)
5. GFCI Hospital Grade Convenience Receptacle: Hubbell HGF **8300**
6. Twist Lock Convenience Receptacles: Hubbell HBL 2310
7. Clock Hanger or TV: Hubbell HBL 5235
 - a. Provide when receptacle is indicated for use for wall mounted TV or wall mounted clock.

2.3 SWITCHES

- A. Switches shall be rated for 20 A, and 120/277 V.
- B. Switches shall comply with NEMA W1 and UL 20.
- C. Basis of Design:
 1. Single Pole Switch: Hubbell CS 1221
 2. Two Pole: Hubbell CS 1222
 3. Three Way: Hubbell CS 1223
 4. Four Way: Hubbell CS 1224
 5. Pilot Light Switch: Hubbell 1221 PL
 6. Keyed Switch: Hubbell HBL 1221L
 7. Single Pole, Double throw Momentary Contact: Hubbell HBL 1557
 8. Keyed Single Pole, Double Throw Momentary Contact: Hubbell 1557L

2.4 ELECTRIC TIMER SWITCH

- A. Switch shall be rated for 20 A, and 120/277 V.
- B. Switch shall be equipped with multiple run time option each controlled by separate push button ranging from ten minutes to a maximum of two hours.

2.5 WALL BOX DIMMERS

- A. Dimmer switches shall be modular full wave, solid state units with integral quiet on-off switches with audible frequency and EMI/RFI suppression filters.
- B. Control shall be continuously adjustable slider with single pole, or three way switching as required by circuiting shown on plans.
- C. Incandescent Lamp Dimmers: Rated for 120/277 V, control shall follow square law dimming curve. On off positions shall bypass dimmer module. Dimmers shall be rated for 2000W.
- D. Fluorescent Lamp Dimmers: Rated for 120/277V, Modular, compatible with dimmer ballasts and trim potentiometer to adjust low end dimming. Dimmer ballast combination shall be capable of consistent dimming with low end not greater than 20 percent of full brightness.
- E. LED Lamp Dimmers: Rated for 120/277V, Compatible with LED driver or self-ballasted lamp specified in light fixture schedule.

2.6 OCCUPANCY SENSORS

- A. Line Voltage Wall Switch Sensor: Dual Technology type, 120/277 V adjustable time delay up to 20 minutes, 180 degree field of view, with a minimum coverage area of 1200 square feet. Sensor shall be equipped with off override controls. Sensor shall be adjustable between occupancy and vacancy sensing operation.
- B. Line Voltage Ceiling Sensor: Dual Technology type, 120/277 V adjustable time delay up to 20 minutes, 360 degree field of view, with a minimum coverage area of 1000 square feet.
- C. Line Voltage Wall Sensor for Elevated Mounting Heights: Dual Technology type, 120/277 V adjustable time delay up to 20 minutes, 110 degree field of view with a minimum coverage area of 1200 square feet.
- D. Low Voltage Ceiling Sensor: Dual Technology type, voltage compatible with power pack, 360 degree field of view with a minimum coverage area of 1000 square feet.
- E. Low Voltage Wall Sensor for Elevated Mounting Heights: Dual Technology type, voltage compatible with power pack, 110 degree field of view with a minimum coverage area of 1200 square feet.
- F. Power Pack for Low Voltage Occupancy Sensors: Rated for 20 A and 120 V/277 V, adjustable time delay up to 20 minutes. When quantity of occupancy sensors shown in space to control single power pack exceeds maximum rating of power pack, contractor shall provide additional power pack to accommodate quantity of occupancy sensors specified.

2.7 PENDANT CORD CONNECTOR DEVICES

- A. Provide matching locking type plug and receptacle body connector with NEMA WD6 configuration shown on plans. Construction grade shall be heavy duty.
- B. Body shall be nylon with screw open cable gripping jaws and provision for attaching external cable grip.
- C. External cable grip shall be woven wire mesh type constructed of high strength galvanized steel wire strand matched to cable diameter and with attachment provision to corresponding connector.

2.8 CORD AND PLUG SETS

- A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
- B. Cord shall be rubber insulated, stranded copper conductors with type SOW-A jacket with green insulated grounding conductor and equipment rating ampacity plus a minimum of 30 percent.
- C. Plug shall be nylon body with internal cable clamping jaws. Match cord and receptacle type for required connection.

2.9 WALL PLATES

- A. Plate securing screws shall be metal with head color to match plate finish.
- B. Material shall be as indicated in Color Section above.
- C. When wall plates are furnished by device manufacturer. Color and material shall comply with requirements of this specification.
- D. Weatherproof Wall Plates:
 - 1. Weatherproof wall plates shall be "while-in-use" type.
 - 2. Wall plates shall be expandable with 1" protrusion from wall while in collapsed position and 3.5" protrusion when expanded.
 - 3. Wet location, Weatherproof while in-use cover plates shall comply with NEMA 250, type 3R requirements for weatherproof while in-use.
 - 4. Wall plate shall be UL listed and compliant with NEC 406

2.10 MULTIOUTLET ASSEMBLIES

- A. Products shall be from a single manufacturer designed for use as a complete matching assembly of raceways and receptacles.

- B. Raceway material shall be as specified in section for conduit and raceways.
- C. Wire shall be #12 AWG.
- D. Provide devices as shown on plans.

FINAL REVIEW
NOT FOR
CONSTRUCTION

265100 – LIGHT FIXTURES

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 GENERAL REQUIREMENTS

- A. Provide fixtures complete with lamps and accessories required for hanging. Clean lamps, reflectors, lenses and fixture trims at time of final inspection. Mount recessed fixtures with trim flush to ceilings free of gaps or cracks.
- B. Coordinate mounting of ceiling mounted light fixtures with other trades. Where additional ceiling or fixtures supports are required due to fixture location or weight they shall be provided by electrical contractor unless otherwise specified under ceiling specifications.
- C. Provide 10 spare lamps for every 100 of each type and rating installed. Furnish at least one of each type.
- D. For all light fixtures in food preparation areas, fixtures shall be provided with lensed covers or lamps that are coated and labeled as shatter resistant.
- E. Coordinate ceiling types with architectural plans and provide recessed fixtures and mounting components as required for compatibility with ceiling type regardless of trim types specified on plans.
- F. All light fixtures installed in fire rated ceiling shall comply with UL listing for rated assembly.
- G. Fixture supports shall comply with NEC 410-15 and 410-16. Provide fixture securing clips as required.
- H. All fluorescent and double ended lamp light fixtures shall be equipped with linear disconnecting means complying with NEC 410.73.
- I. Contractor shall replace all lamps that are not operational or burn out within 30 days of substantial completion.
- J. Dimming ballasts where required shall be two wire line voltage type compatible with wall box dimmer, or lighting control system as applicable. Provide all required wiring between ballast and wall switch regardless of number of wires indicated on plans.
- K. Set fixtures plumb and square with ceilings and walls.
- L. For fixtures installed in a grid ceiling, use a minimum of four ceiling support system rods or wires for each fixture. Locate fixtures not more than 6" from fixture corners.
- M. For fixtures installed in grid ceiling of sizes less than ceiling grid, install fixtures as indicated on ceiling plan or center in ceiling tile and support fixtures independently with at least two metal channels spanning and secured to ceiling tees.
- N. Adjust all aimable light fixtures per owner's requirements.
- O. Test all emergency light fixtures by interrupting power to ensure proper operation.

PART 2 – PRODUCTS

2.1 FIXTURES

- A. See light fixture schedule on plans for fixture model number, mounting type, lamp type and equivalent manufacturers.
- B. Fixture manufacturers shall be represented by factory authorized representative located in the state in which the project is to be constructed.
- C. Fixtures shall be listed by UL or ETL for use in the United States. Fixtures that are tested to UL standards but not listed will not be accepted.
- D. Door frames and other internal access shall be smooth operating free from light leakage under operating conditions, and designed to permit relamping without the use of tools unless otherwise noted for vandal resistant operation. Doors frames and other internal devices shall be hinged.
- E. All light fixtures with a painted surface exposed in occupied area shall be painted after fabrication.

- F. All exposed fasteners in exterior location fixtures shall be captive type fasteners constructed with 316 Stainless Steel.

2.2 LAMPS

- A. Provide lamp type as indicated in schedule. When information is not listed in schedule, comply with the following specifications.
- B. Led system: Led modules integral to light fixtures shall be tested and rated in compliance with IESNA LM-79 and IESNA LM-80. Luminaires shall be rated for 50,000 hours lamp life. Color temperature and CRI shall be as noted in light fixture schedule. LED Modules and driver shall be capable of replacement without replacement of entire luminaire.
- C. Medium Base LED: Fixture shall have manufacturer's advertised incandescent wattage equivalent equal to maximum wattage of light fixture. Color temperature and CRI shall be as noted in light fixture schedule.

2.3 DRIVERS

- A. Integral Driver: Driver shall be equipped with lamp end-of-life detection and shutdown circuit, sound rating A, total harmonic distortion of less than 20%, transient voltage protection IEEE C62.41, category A or better, ballast factor of 0.95 or higher, power factor of 0.95 or higher.
- B. Dimmer controlled light fixture drivers: Dimming range shall be 100 to 5 percent of rated lamp lumens. Driver input watts shall be capable of being reduced to 20 percent of normal. Driver shall be certified by manufacturer for use with specific dimming control system and lamp type indicated.
- C. Emergency Power Unit: Where indicated on plans, or required by design intent to meet code emergency lighting requirements, provide self-contained, modular, battery inverter unit, factory mounted or field mounted as required to operate lamps as described on schedule. Battery shall be sealed maintenance free nickel cadmium type. Charger shall be fully automatic, solid state, constant current type with sealed power transfer relay. Unit shall be equipped with factory or field installed electronic device to automatically initiate code required test of unit emergency operation at required intervals; test failure shall be annunciated by an integral flashing red LED.

280500 – COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 CODE SECTIONS

- A. 2011 National Electrical Code, NFPA 70
- B. 2012 International Building Code
- C. 2012 International Plumbing Code
- D. ADA – American Disabilities Act
- E. ANSI – American National Standards Institute
- F. ASTM – American Society of Testing Materials
- G. NFPA – National Fire Protection Association
- H. NEMA – National Electrical Manufacturers Association
- I. OSHA – Occupational Safety and Health Act
- J. UL – Underwriter's Laboratories
- K. All codes listed on architectural Code Reference Sheet or project cover sheet.

1.2 GENERAL

- A. Provide all work in accordance with applicable codes, rules, ordinances, and regulations of local, State, and Federal Governments and other Authorities Having Jurisdiction (AHJ).
- B. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the drawings and specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system functioning as indicated by the design and the equipment specified. Elements of the work include materials, supervision, supplies, equipment, transportation, and utilities.
- C. The drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, piping, etc. without showing all the exact details as to elevations, offsets, control lines, and other installation requirements. The contractor shall use the drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system. Plans shall not be scaled.
- D. Contractor shall coordinate with all other trades to ensure that all required project components are included in project bid.
- E. If in any case the plans or specifications conflict with either manufacturer's requirements or minimum code requirements the information on plans and specifications shall be superseded by manufacturers and code requirements.
- F. If in any case the plans or specifications conflict with themselves, the most stringent of the conflicting information shall be the basis for bid. Contractor shall seek clarification of all conflicts prior to bid.
- G. All change order requests shall be accompanied with itemized tabular breakdown of all materials and labor associated with installation of all associated materials for review of the design team. Lump sum pricing will not be accepted.
- H. Contractor shall refer to each drawing and specification section in construction document set. No bids shall be submitted without review of all construction documents.

1.3 ALLOWABLE MANUFACTURERS

- A. Allowable manufactures for all products listed in division 26 are listed in "Schedule of Manufacturers" on plans.

1.4 SUBMITTAL REQUIREMENTS

- A. Submittals for products in division 26 shall include the following items.
 - 1. Product data showing type, model and construction characteristics of product
 - 2. Layout drawings for any systems requiring interconnection of various system components
 - 3. All other documentation required to show compliance with the specifications.
- B. The contractor shall provide a schedule of submittals indicating dates on which each submittal will be provided to design team for review. Schedule shall be submitted 10 working days in advance of delivery of first submittal for review.
- C. Contractor shall allow a minimum of ten working days for design team of review of submittals.

1.5 WARRANTY REQUIREMENTS

- A. Unless noted elsewhere in the specifications, all work shall be warranted for a period of not less than one year from the date of substantial completion. The contractor shall provide work at no additional cost to correct any deficiencies in their work that were identified to have been present during the warranted period.

1.6 DEMOLITION

- A. Where demolition work is required contractor shall disconnect, demolish and remove wiring, systems, equipment and components indicated to be removed.
- B. All equipment to be removed and reinstalled shall be disconnected, with services capped, cleaned and stored for reconnection.
- C. Owner shall have first right of refusal for all materials being removed.
- D. If equipment, wiring or systems to remain are damaged or unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

1.7 INSTALLATION

- A. All equipment in division 28 shall be installed according to manufacturer's requirements and minimum code requirements. If in any case the plans or specifications are in conflict with either manufacturer's requirements or minimum code requirements the information on plans and specifications shall be superseded by manufacturers and code requirements.
- B. No combustible materials shall be allowed in return air plenum regardless of indication on plans.
- C. Installation shall comply with NECA 1
- D. Measure mounting heights indicated on plans to bottom of unit for suspended items and to center of unit for wall mounted items.
- E. If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- F. Install all equipment to facilitate service, maintenance and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- G. Apply firestopping to penetrations of fire rated floor and wall assemblies for electrical installations to restore original fire resistance rating of assembly.

1.8 TEMPORARY FACILITIES

- A. Contractor shall provide temporary facilities as required for construction of the project. Temporary facilities shall include temporary water service and distribution, electrical power and lighting service, heating cooling and ventilation, telephone and data service, and sanitary facilities including drinking water.

- B. Permanent HVAC equipment shall not be used to heat, cool or ventilate the facility during construction.
- C. Whether during a renovation or a phased construction project, the contractor shall include all temporary facilities to maintain functionality and suitable space conditions in all areas of a building that are occupied by the owner while construction activities are underway.
- D. The contractor shall provide temporary facilities as required to maintain a safe working environment and to protect all building materials and provide space conditions within range required for material installation.
- E. 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. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- F. Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Relocate temporary services and facilities as the Work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist on-site.

PART 2 – PRODUCTS

2.1 HOUSEKEEPING PADS

- A. All equipment shall be installed on concrete housekeeping pads. Pad shall extend beyond equipment perimeter 4" and shall elevate equipment off of finish floor 4".
- B. Contractor shall have option to provide prefabricated housekeeping pad or pour pad in place.

2.2 SLEEVES

- A. Sleeves shall be constructed from the following materials at contractor's option.
 - 1. Galvanized steel round tubing, closed with welded longitudinal joint.
 - 2. Schedule 40 Steel Pipe.
 - 3. DUCTED RETURN ONLY – Schedule 40 PVC pipe.

283111 – ADDRESSABLE FIRE ALARM SYSTEM

PART 1 – GENERAL REQUIREMENTS AND EXECUTION REQUIREMENTS

1.1 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864
- B. Beginning with substantial completion, provide software support for a period of two years.
- C. Update software to latest version at project completion. Install and program software updates that become available within one year from the date of substantial completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software. Provide 14 days notice to owner when updates are required to coordinate access to system and to allow owner to upgrade computer equipment if necessary.

1.2 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. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, minimum 1.
 - 2. Keys and Tools: One extra set for access to locked and tamperproof components.
 - 3. Fuses: Two of each type installed in system.

1.3 INSTALLATION REQUIREMENTS

- A. System design and installation shall comply with NFPA 72. Fire alarm contractor is responsible to verify layout shown on plans with performance of proposed devices and revise as required for complete protection of building based on requirements of NFPA 72 and other applicable codes.
- B. Connection to Existing Equipment:
 - 1. Connect new equipment to existing control panel in existing part of the building.
 - 2. Connect new equipment to existing monitoring equipment at the supervising station.
 - 3. Expand, modify and supplement existing equipment as necessary to extend existing functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
- C. Smoke or Heat Detector Spacing:
 - 1. Comply with NFPA 72.
 - 2. Smooth ceiling spacing shall not exceed 30'.
 - 3. Spacing of detectors for irregular areas, for irregular ceiling construction and for high ceiling areas shall be determined according to appendix A or appendix B in NFPA 72 as applicable.
 - 4. Locate detectors not closer than 12" from any part of a light fixture.
 - 5. Locate detectors not closer than 36" from and air supply diffuser or return air opening.
- D. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of the duct.
- E. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
- F. Remote Status and Alarm indicators: Install new each smoke detector and each sprinkler water flow switch and valve tamper switch that is not readily visible from normal viewing position.
- G. Audible Alarm Indicating Devices: Install not less than 6" below the ceiling. Install bells and horns on flush mounted back boxes with device operating mechanism concealed behind a grille.
- H. Visible Alarm Indicating Device: Install adjacent to each alarm bell or alarm horn and at least 6" below the ceiling.

- I. Device Location Indicating Lights: Locate in public space near the device they monitor.
- J. Fire alarm Panel: Recessed mounting with top of cabinet not more than 72" above finished floor. Coordinate location with casework in area of installation and report any conflicts to A/E prior to rough in.
- K. Remote Annunciator: Install at 60" unless otherwise noted.
- L. See Raceway and Boxes specification for conduit requirements.

1.4 CONNECTION REQUIREMENTS

- A. For fire protection systems related to doors in fire rated walls and partitions and to doors in smoke partitions, comply with requirements in door hardware specification. Connect hardware devices to fire alarm system. Verify that hardware and devices are NRTL listed for use with fire alarm system before making connection.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make and addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Alarm initiating connection to smoke control system (smoke management) at fire fighter smoke control panel.
 - 2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
 - 3. Smoke dampers in air ducts of designated air-conditioning duct systems.
 - 4. Alarm-initiating connection to elevator recall system and components.
 - 5. Alarm-initiating connection to activate emergency lighting control.
 - 6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
 - 7. Supervisory connections at valve supervisory switches.
 - 8. Supervisory connections at low-air pressure switch of each dry-pipe sprinkler system.
 - 9. Supervisory connections at elevator shunt trip breaker.
 - 10. Supervisory connections at fire pump power failure including a dead-phase or phase-reversal condition.
 - 11. Supervisory connections at fire-pump engine control panel

1.5 SUBMITTAL

- A. Contractor shall provide submittal with all calculations, wiring diagrams and indication of all code required system features. Submittals shall be provided to local Authorities for review and approval.
- B. All submittal documents shall bear the seal and signature of the contractor's design engineer, licensed to design fire alarm systems in the jurisdiction encompassing the project location.

1.6 MONITORING

- A. System shall be monitored at remote location in accordance with all code requirements and NFPA standards. All components required for building monitoring shall be provided in base bid. Contractor shall be responsible to ensure that panel is fully capable of communicating with owners monitoring vendor. Prior to rough in inspection, ensure that required cabling is in place or that conduit path is available to allow concealed wiring installation without removing building finishes. Prior to project closeout contractor shall provide owner with proposal for one year of monitoring services.

1.7 IDENTIFICATION

- A. Identify system components wiring, cabling and terminals. Comply with requirements of identification specified in Division 26.
- B. Install framed instructions in a location visible from fire alarm control unit.

1.8 GROUNDING

- A. Ground fire alarm panel and associated circuits. Comply with IEEE 1100. Install a ground wire from main service ground to fire alarm panel.

1.9 FIELD QUALITY CONTROL

- A. Field tests shall be witness by authorities having jurisdiction as required.
- B. Engage a factory authorized service agent representative to inspect, test and adjust components, assemblies and equipment installations including connections.
- C. Perform tests and inspections as recommended by equipment manufacturer as part of startup sequence and as required by NFPA 72 and local authority having jurisdiction.
- D. One year after date of substantial completion, test fire alarm system complying with visual and testing inspection requirements of NFPA 72.

PART 2 - PRODUCTS

2.1 OPERATIONAL DESCRIPTION

- A. Fire alarm initiation shall be by initiation devices as shown on plans.
- B. All initiation devices shall be addressable.
- C. Fire alarm signal shall initiate the following actions as applicable to the project:
 - 1. Continuously operate alarm notification appliances.
 - 2. Identify alarm at fire alarm control unit and remote annunciators.
 - 3. Transmit an alarm signal to the remote alarm receiving station.
 - 4. Unlock electric door locks in designated egress paths.
 - 5. Release fire and smoke doors held open by magnetic door holders.
 - 6. Activate voice alarm communication system.
 - 7. Switch heating, ventilating and air conditioning equipment controls to fire alarm mode.
 - 8. Activate smoke control system (smoke management) at fire fighter smoke control system panel.
 - 9. Activate stairwell and elevator shaft pressurization system.
 - 10. Close smoke dampers in air ducts in air conditioning duct systems.
 - 11. Recall elevators to primary or alternate recall floors.
 - 12. Activate emergency lighting control.
 - 13. Activate emergency shutoffs for gas and fuel supplies.
 - 14. Record events in the system memory.
 - 15. Record events by the system printer.
- D. Supervisory signal initiation shall be by one or more of the following devices and actions:
 - 1. Valve supervisory switch.
 - 2. Low air pressure switch of a dry pipe sprinkler system.
 - 3. Elevator shunt trip supervision.
- E. System trouble signal initiation shall be by one or more of the following devices and actions:
 - 1. Open circuits, shorts and grounds in designated circuits.
 - 2. Opening, tampering with or removing alarm initiating and supervisory signal-initiating devices.

3. Loss of primary power at fire alarm control unit.
 4. Ground or a single break in fire alarm control unit internal circuits.
 5. Abnormal AC voltage at fire alarm control unit.
 6. Break in standby battery circuitry.
 7. Failure of battery charging.
 8. Abnormal position of any switch at fire alarm control unit or annunciator.
 9. Fire pump power failure including a dead phase or phase reversal condition.
 10. Low air pressure switch operation on a dry pipe or pre-action sprinkler system.
- F. System trouble and supervisory signal actions: Initiate notification appliance and annunciate at fire alarm control unit and remote annunciators. Record the event in system memory.

2.2 DEVICE COLORS

- A. Pull Stations:
 1. Red with White Lettering
- B. Smoke Detectors:
 1. White
- C. Annunciation Devices:
 1. White with Red Lettering
- D. Fire alarm Panel and Remote Annunciator:
 1. Housing and/or cabinet shall white, black, tan or brown as selected by A/E.

2.3 FIRE ALARM PANEL

- A. Unit shall be field programmable, microprocessor based, modular, power limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL. System software and programs shall be held in flash electrically erasable programmable read-only memory, retaining information through failure of a primary and secondary power supplies. System shall be equipped with a real time clock for time annotation of events of the event recorder and printer.
- B. Unit shall be equipped with alphanumeric display and system controls with liquid crystal display and keypad.
- C. Install no more than 50 addressable devices on each signaling line circuit for notification, initiation and signaling line circuits.
- D. Provide all components required for transmission of alarm, supervisory and trouble signals to remote alarm station.
- E. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers and tone generators provided either as a module integral with the fire alarm panel.
 1. Allow the application of and evacuation signal to indicated number of zones and at the same time, allow voice paging to the other zones selectively or in any combination.
 2. Programmable tone and message sequence selection.
 3. Standard digitally recorded messages for "Evacuation" and "All Clear".
 4. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire alarm control unit.
- F. System shall be equipped with secondary power supply with batteries, automatic battery charger and automatic transfer switch.

- G. Existing Fire alarm panel as noted on drawings. All new fire alarm devices shall be compatible with existing fire alarm system.
- H. Contractor shall provide expansion panel as required for connection of new devices to existing system.

2.4 MANUAL FIRE ALARM BOXES

- A. Boxes shall comply with UL 38, show visible indication of operation and shall be mounted on recessed outlet box. If indicated as surface mounted provide manufacturer's surface back box.
- B. Boxes shall use double action mechanism requiring two actions to initiate and alarm and shall be reset with key or wrench operated switch.
- C. Where indicated on plans, boxes shall be equipped with factory fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate alarm. Lifting the cover actuates and integral battery powered audible horn intended to discourage false alarm operation. Where located in exterior location provide weatherproof protective shield with similar operation.

2.5 SMOKE DETECTORS

- A. Detectors shall comply with UL 268 and shall be equipped with integral addressable module to communicate detector status (normal, alarm or trouble) to fire alarm panel.
- B. Detector and associated electronic components shall be mounted in a twist lock module that connects to a fixed base.
- C. Detectors shall not require resetting or readjustment after actuation to restore normal operation.
- D. Detector shall be equipped with integral visual LED indicating light indicating detector has operated, and indicating power on status.
- E. Unless otherwise noted detectors shall be addressable type individually monitored at fire alarm control unit for calibration sensitivity and alarm condition and individually adjustable for sensitivity by fire alarm control unit.
- F. Duct smoke detectors shall be equipped with a NEMA 4X weatherproof housing enclosure listed for use with the supplied detector. Each sensor shall have multiple levels of detection sensitivity. Sampling tubes shall be of design and dimension as recommended by manufacturer for specific duct, size, air velocity and installation conditions where applied. Unit shall be equipped with fan shut down relay rated to interrupt fan motor control circuit.

2.6 HEAT DETECTORS

- A. Heat Detectors shall comply with UL 521 and shall be equipped with an integral addressable module to communicate detector status (normal, alarm or trouble) to fire alarm panel.
- B. Heat detectors shall be actuated either by a fixed temperature or a rate of rise indicating a fire in the detection zone. Temperature and rate of rise shall be as appropriate for application.
- C. Detector and associated electronic components shall be mounted in a twist lock module that connects to a fixed base.

2.7 CARBON MONOXIDE DETECTOR

- A. Detector shall be equipped with manually operated alarm reset and silence button. Pressing the button shall silence the alarm and reset the detector.
- B. Alarm shall sound within six minutes if CO level reaches levels at or above 70ppm.
- C. Where carbon monoxide detectors as shown on plans contractor shall have option to combine functionality with smoke detectors and omit manual reset button.

2.8 NOTIFICATION APPLIANCES

- A. Appliances shall be connected to a notification circuit and equipped for mounting as indicated with screw terminals for system connections.
- B. Audio/Visual combination appliances shall be factory integrated devices in a single mounting assembly.

- C. Audio chimes and horns shall provide sound pressure level as required for complete coverage of building based on layout shown on plans.
- D. Visual devices shall be equipped with field selectable light output letters. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place. Flashing shall be in a temporal pattern synchronized with other units.
- E. Voice/Tone appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL. Mounting shall be flush and unit shall be equipped with transformers with taps to match range of acoustical environment of speaker location.

2.9 MAGNETIC DOOR HOLDERS

- A. Units shall be equipped for wall or floor mounting as indicated on plans and shall be furnished complete with matching doorplate.
- B. Wall mounted units shall be flush unless otherwise noted.
- C. Material and finish shall match door hardware.

2.10 REMOTE ANNUNCIATOR

- A. Annunciator functions shall match those of fire alarm control unit for alarm supervisory and trouble indications. Manual switching functions shall match those of fire alarm panel, including acknowledging, silencing and testing.
- B. Mounting shall be flush type unless otherwise noted.
- C. Unit shall be equipped with alphanumeric display and LED indicating lights matching those of fire alarm panel. Provide controls to acknowledge, silence, reset and test functions for alarm, supervisory and trouble signals.

2.11 ADDRESSABLE INTERFACE DEVICE

- A. Provide microelectronic monitor module, NRTL listed for use in providing a system address for alarm initiating devices and for wired applications with normally open contacts.
- B. Unit shall be equipped with integral relay capable of providing a direct signal to elevator system to either initiate circuit breaker shunt trip for power shutdown or to initiate elevator recall at elevator controller.

2.12 DUAL PATH DIGITAL ALARM COMMUNICATOR

- A. Provide Internet and Digital Cellular Fire Alarm Communicator Panel with painted cabinet, key, lock, wall outlet box, Dialer Capture Module, iGSM Communications module, antenna and mounting adapter, power supply, LED display board, transformer and all required accessories for a complete system installation.
- B. Provide antennae cable as required to locate antennae in acceptable location for communication.
- C. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.
- D. Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report service restoration to the central station. If service is lost on both communication paths, transmitter shall initiate the local trouble signal.
- E. Local functions and display at the digital alarm communicator transmitter shall include the following:
 1. Verification that both communication paths are available.
 2. Programming Device.
 3. LED display.
 4. Manual test report function and manual transmission clear indication.

5. Communications failure with the central station or fire alarm unit.
- F. Digital data transmission shall include the following:
1. Address of the alarm-initiating device.
 2. Address or zone of the supervisory signal.
 3. Address or zone of the supervisory signal.
 4. Loss of AC supply or loss of power.
 5. Low battery.
 6. Abnormal test signal.
 7. Communication bus failure.
- G. Unit shall be equipped with integral rechargeable battery and automatic charger.
- H. Self-test shall be conducted every 24 hours (adjustable) with report transmitted to central station.

2.13 DEVICE GUARDS

- A. Where indicated on plans or where device is susceptible to damage, such as receiving areas, warehouse, gymnasiums, etc. provide welded wire mesh of size and shape required for the device requiring protection. Guard shall be factory fabricated and furnished by manufacturer of device. Finish shall match color of protected device.